Project AIR FORCE

1999 Annual Report

Director's Message

As the 20th century ended, the one-enemy, one-conflict focus of the Cold War era had given way to a period that many characterize as "boiling peace." Today, the U.S. military services confront an unstable global security environment and an undefined threat. Defense budgets are smaller, and so is force size. However, the demands on the military are large and growing.

For the Air Force—both in its combat role and as a frequent participant in peace-keeping and humanitarian operations—the high operating tempo is taking a toll. Stress on personnel and their families is causing a retention and recruitment problem. The aircraft fleet is aging, not just as a function of the calendar but because of accelerated usage.

Maintaining combat readiness, recruiting and retaining a capable force, and modernizing weapons and equipment all have costs. What options and levers does the Air Force have to achieve these goals within the limits of its budget? Project AIR FORCE (PAF) is intensely engaged in research to help the Air Force respond to this overarching question.

Although we remain watchful of developments in the former Soviet Union, our regional military studies currently focus on China and South Asia (particularly India and Pakistan). Our goal is to help the Air Force plan for potential engage-ments in these regions if necessary, but to prevent their occurrence if possible. Likewise, Southwest Asia remains important to U.S. and world security, and the need to develop new, less costly ways of accomplishing the objectives of Northern and Southern Watch is also a key concern.

We have worked with the Air Force to develop a new reporting system that will give commanders at all levels unprecedented visibility into the readiness of their forces. Our research on Agile Combat Support is leading toward new organiza-tional and operational concepts to underwrite the Expeditionary Aerospace Forces (EAF). Indeed, some of these concepts have already been tested in Operation Noble Anvil in Kosovo.

Mobility aircraft are a core component of the nation's military transportation system and EAF operational concepts. The strategic airlift fleet is now being modernized. However, with the retirement of the C–141s and the introduction of the C–17s, the end result is fewer aircraft. This will strongly affect the ability of the air mobility fleet to perform its missions. In addition, tankers comprise a large fraction of the aging aircraft population, and their availability is also an

integral part of mobility operations. Our research on mobility and aging aircraft examines ways that changes in the strategic airlift and tanker fleets affect both peacetime and combat operations. It also recommends ways to mitigate impending problems.

Manpower and personnel issues figure prominently in PAF's research agenda; and in 1999 a Manpower, Personnel, and Training Program was formally established. PAF researchers are currently helping the Air Force carry out its Total Force Assessment, which will determine manpower needs—what numbers in what specialties—for current and future operations. Also in 1999, in response to a request from the Chief of Staff of the Air Force, we conducted a quick-response manpower requirements study that focused on changes in the way the force is used and emerging needs to alter its future composition. As part of this research, we are now working with the Air Force to develop new tools to model personnel flow and "inventory" management.

Our work on competitive sourcing is producing important insights into the risks and potential rewards of the strategic-sourcing approach that the Air Force wishes to apply in its plan to free up resources for modernization and readiness. PAF's cost-estimation research—e.g., the effects of lean manufacturing and acquisition reform—contributes to the Air Force's understanding of the costs of new and existing systems. This research will provide the Air Force with an arsenal of information and tools for assessing costs of the F-22, Joint Strike Fighter, and other weapons systems of the future, including those designed for use in space.

Aerospace force development, which encompasses the creation of new systems as well as the improvement of existing ones, presents the Air Force with a complex set of trades. In the past, such trades were difficult, but they were always among like systems—among aircraft—for example. Current decisions are much more challenging because they involve investment trades among manned aircraft, unmanned air vehicles, and space systems that provide intelligence, surveillance and reconnaissance (ISR). Important variables not only center on performance issues but on manning the systems, timing their introduction into the force, and wisely investing scarce funds for maximum benefit. Building on recently completed research on airborne systems for ISR (including unmanned air vehicles), we are working closely with the Air Force on this complex problem.

Much of the research described above bears on, or contributes directly to, the Air Force's preparation for the Quadrennial Defense Review (QDR). PAF's 1998 study of C3ISR interoperability issues, as well as ensuing research on attacks against fleeting targets, likewise pertains to the QDR. We are now extending our work on fighter/bomber/weapon force-mix trades, and several projects on lessons

learned in Kosovo are under way. The Kosovo research, valuable in its own right, will also provide valuable insights for PAF's current and future research agendas.

Finally, at the request of the Air Force, we have written a "primer" on force application from space. Not an advocacy document, the primer will put forth what is possible, what is not, and what law and policy will permit. Its publication in 2000 is intended to promote understanding and encourage debate among a large and diverse audience.

Contents

Countering the New Terrorism

Terrorists have often targeted the United States. They attack American interests and citizens abroad because of the wealth of opportunities, the symbolic value, and the exposure from the world's most extensive news media. Because of its role in American power projection, the Air Force can be a target, as with the bombing of Khobar Towers, the USAF barracks in Dhahran, Saudi Arabia. The Air Force has also been called on to counter terrorism, as it did in striking targets in Afghanistan and Sudan after the August 1998 bombing of U.S. embassies in Kenya and Tanzania.

Highly publicized attacks such as the World Trade Center bombing, the use of chemical weapons in the Tokyo subway, and Hamas suicide attacks in Israel have led some to argue that terrorism is an increasing threat. Others point to "cyberterror," weapons of mass destruction, or other alarming scenarios. A multi-faceted Project AIR FORCE (PAF) study put such issues in strategic perspective, tracing the evolution of international terrorism against U.S. civil and military targets, identifying key trends, and proposing strategies for containment. The findings are presented in a RAND book entitled *Countering the New Terrorism*. Although this is not an issue for the Air Force alone, the book recommended a number of specific steps that could better prepare the Air Force to confront "the new terrorism."

An Increasingly Lethal Threat

The last decade has seen extraordinary change in the international security environment. Yet much discussion of terrorism remains tied to images from previous epochs; it assumes the same kinds of actors using new and more threatening weapons. The PAF team found that changing technologies and tactics accompany equally important changes in the motives and structure of terrorism itself.

These underlying changes are making terrorism more lethal. Although the number of incidents worldwide declined during the 1990s, the number of fatalities rose (see Figure 1). Several factors account for this new lethality. Some terrorists believe that ever more spectacular and lethal acts are necessary to capture public attention. Terrorists have also become more adept at killing, with deadlier weapons made more easily available through alliances with rogue states and private sponsors. (During the 1980s, for example, Czechoslovakia

reportedly sold over 40,000 tons of Semtex, a plastic explosive, to countries sponsoring international terrorism.) Assistance from such governments often enhances the capabilities of terrorist groups. With bomb-making and other information now widely available, the number of "amateur" terrorists has increased. These amateurs can be just as deadly as their professional counter-parts and, without a central command authority, both harder to anticipate and less concerned about indiscriminate casualties.

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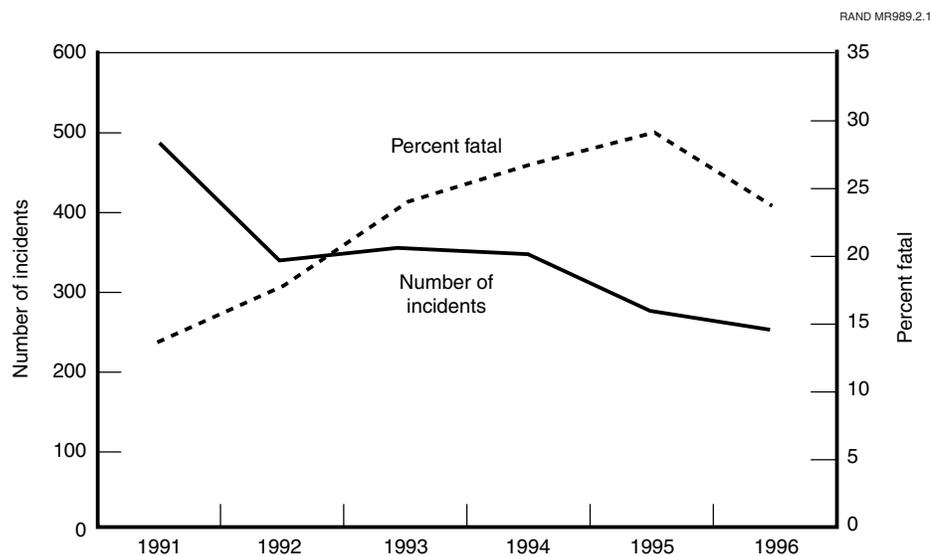
Figure 1—Number of Worldwide Terrorist Incidents, 1991–1996

A final trend is perhaps the most striking: the rise of religiously motivated ter-rorism has brought increased lethality. In the 1960s and 1970s, when modern international terrorism arose, it was motivated almost exclusively by ethnic, nationalist-separatist, or ideological causes. This began to change in the 1980s, and since then a significant share of current terrorist groups has been motivated at least partly by religion (see Figure 2). Such groups are an important force behind terrorism's rising lethality, presumably justified in the terrorists' minds by the transcendent cause. In 1996, for example, the year of the Khobar Towers attack, religiously motivated terrorism accounted for 10 of the 13 extremely violent and high-profile acts that took place worldwide.
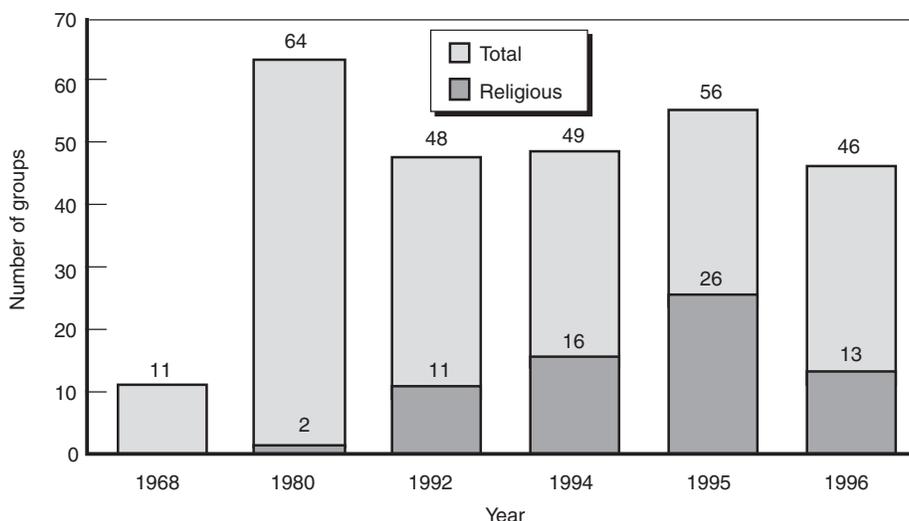
SOURCE: The RAND–St. Andrews Chronology of International Terrorism.

Figure 2—Religious Versus Other Terrorist Groups

Counterterrorism today requires diverse responses to an increasingly diverse challenge. Mainstream ethnic, separatist, or ideological groups will deviate little from established patterns. They will largely rely on the gun and the bomb, as they have for a century. The sophistication of their weapons will be in their simplicity: clever adaptation of technology and materials that are easy to obtain and difficult to trace. State-sponsored terrorism has been the most conservative in terms of tactics; almost without exception these acts have been carried out with conventional weapons.

But new entities with systemic, religious, or apocalyptic motivations and greater access to weapons of mass destruction may present a new and deadlier threat. High-tech weapons and nuclear materials from the former Soviet Union are increasingly available, and chemical or biological warfare agents are easily manufactured. Amateurs in particular, who may be exploited or manipulated by professional terrorists or covert sponsors, may be willing to use these weapons.

The Threat from Networks

In addition to becoming more lethal, the terrorist threat is changing in another dimension as well—one driven by computer and communication networks. The most striking development here is not attacks on America's information infra-

structure. It is the way that terrorists are organizing themselves into new, less hierarchical networks and being sponsored by secret, private backers. This change, enabled by the information revolution, makes detecting, preventing, and responding to terrorist activity more difficult than ever before. Analysis of terrorist organizations in the Middle East also suggests that the more active and lethal of these make extensive use of information techniques. Future terrorism may often feature information *disruption* rather than physical *destruction*.

PAF found that many terrorist entities are moving from hierarchical toward information-age network designs. Terrorists will continue using advanced information technology to support these organizational structures. More effort will go into building arrays of transnationally internetted groups than stand-alone organizations. And this is likely to make terrorism harder to fight. Hierarchies in general have a difficult time fighting networks. There are examples across the conflict spectrum, including the failings of governments to defeat transnational criminal cartels engaged in drug smuggling and narco-terrorism, as in Colombia. The persistence of terrorist movements, as in Algeria, in the face of unremitting state opposition, also shows the robustness of the network form—including its ability to spread to bases in Europe. Arrests in the United States just before New Year's Eve 1999 suggest the ability of such networks to operate across regions.

The study notes that this change is part of a wider move away from formally organized, state-sponsored groups to privately financed, loose networks of individuals and subgroups that may have strategic guidance but enjoy tactical independence. Conventional counterterrorism techniques may not work well against such groups. Retaliation directed at state sponsors, for example, may be effective against traditional terrorist groups but will be likely to fail against an organization with multiple, dispersed leaders and private sources of funding.

Implications for the Air Force

How can the United States respond to more lethal, more diverse, and increasingly privatized patterns of terrorism? What does the Air Force need to do to protect its forces and support national leaders? The study points to a strategy—and a set of national capabilities—tailored to dealing with these challenging problems. The United States needs to formulate a clear, realistic, and realizable national strategy that can evolve with the changing terrorist threat. The PAF team identified four core elements to that strategy: reducing systemic causes, deterring terrorists and their sponsors, reducing the risk of "superterrorism" such as attacks involving weapons of mass destruction, and retaliating where deterrence fails.

This strategy leads to key implications for the use of air- and space-based assets:

- Air power's pervasiveness and speed are advantages in the face of transnational and transregional terror. In an era when terrorism may take place across the globe and sponsors may cross national and regional lines, the global sight and reach of Air Force assets will be valuable to national decisionmakers.

- Air and space power will not always be the instruments of choice in the U.S. counterterrorism arsenal. They can, however, play an important role in intelligence and covert action.

- Air and space power will rarely be used independently; instead, they will have a synergistic effect with other counterterrorism instruments such as covert action, diplomacy, economic instruments, and joint military operations. And the same instruments may be used in parallel against terrorist supporters, terrorist infrastructure and networks, and terrorists themselves.

- Air power in the service of counterterrorism will include, but also go beyond, surveillance and punishment of state sponsors. Deterrence and response will probably evolve in the direction of a more "personalized" approach emphasizing the monitoring and attack of key nodes in terrorist networks and the forcible apprehension of individual terrorist suspects. Demands on air power may be driven as much by the requirement to intercept and extract suspects as by the need to attack training camps or strike supporting regimes.

- Air and space power will help make terrorism—an increasingly amorphous phenomenon—more transparent. The ability to identify and target terrorist-related activity and help expose terrorism and its sponsors for policy action and international censure will be key contributions of Air Force assets. As terrorism becomes more diffuse and its sponsorship increasingly hazy, finding the "smoking gun" will become more difficult but essential to building a consensus for action. Space-based sensors, surveillance by unmanned air vehicles, and signals intelligence will facilitate the application of air power and other counterterrorist capabilities.

- Counterterrorism will increasingly focus on urban areas and thus face strong operational constraints. For political reasons, terrorists find key targets in cities. The use of air power for counterterrorism therefore faces the more general problem of operating in urban environments, a situation where the difficult Israeli experience in Beirut and south Lebanon is instructive. The value of air power here may depend on its capacity for discriminate targeting and less-than-lethal technologies.

With its increasing lethality, possible access to weapons of mass destruction, and the shift to flexible and robust network organization, terrorism is a more formidable problem than ever before. Air and space power will be critical elements in defending U.S. interests—including USAF forces—against this evolving threat.

MR-989-AF, *Countering the New Terrorism*, I. Lesser, B. Hoffman, J. Arquilla, D. Ronfeldt, M. Zanini.

NATO and Caspian Security:
A Mission Too Far?

During the Cold War, NATO's security concerns focused almost exclusively on the central European front. Even in the immediate aftermath of the Soviet Union's disintegration in 1991 and the emergence of eight new states in the former Soviet south (see Figure 3), Central Asia barely intruded on the geopolitical consciousness of most Western officials. Since the mid-1990s, there has been a dramatic rise in Western interest in the area around the Caspian Sea. This change has been spurred largely by the exploitation of Caspian oil and gas resources by the West and the growing perception that instability in the region could have broad reverberations. Indeed, the pendulum has swung so far in this new direction that some observers now describe the Caspian basin as an area of "vital" American and Western interest.

RAND MR1074

Figure 3—The Caucasus and Central Asia

Are Western interests in the Caspian area truly vital? What should the West, and NATO in particular, be doing in the region to promote its interests? PAF researchers undertook to answer these questions as part of a study on the implications of the changing strategic environment in and around Europe for the United States and NATO.

Among their major conclusions:

- While the West has interests in the Caspian area, they are not "vital."
- These interests and the threats to them are not commensurate with any aspirations for NATO to play a major security role in the region.
- Western interests will be best served by political and economic measures to promote stability, market economies, and democracy and reduce the region's dependence on Russia.
- NATO's role should be restricted to advisory assistance, training, and guidance in helping the military establishments of the Caspian states to restructure along Western lines.

Concerns, Counters, and Implications

The researchers reached these conclusions by identifying several Western security concerns regarding the Caspian area and finding that, in each case, the concern was either not of great importance or not resolvable through NATO action. The concerns and the analysis of each may be summarized as follows.

Russian hegemony: *Because most of the states of Central Asia and the south Caucasus are fragile and unstable, there will be an intense competition among external powers not necessarily friendly to Western interests (Russia in particular) to fill the power vacuum.*

Although Russia will remain the dominant power in the region for some time, neither it nor any other regional or outside power will have the capability to establish regional hegemony, given the multiplicity of actors on the Caspian scene and their inherent limitations. Many of the Caspian states will maintain some degree of dependency on Russia. However, Russia will lack the strength to reintegrate the Commonwealth of Independent States, prevent Western inroads in the region, or dictate the policies of the Caspian states.

Threats to energy supplies: *Conflict and instability in the area could jeopardize the flow of Caspian oil and natural gas to the West.*

The Caspian region is unlikely to become a major source of oil or gas for at least ten years. Even if the region achieves its maximum potential, which remains uncertain, its contribution to global energy supplies will be modest for several reasons: Caspian reserves are small compared to the global oil reserve base; the costs of extraction and production are considerably higher than they are elsewhere; and oil prices have stayed fairly low in recent years. As a result, the West is unlikely to become dependent enough on Caspian energy supplies to warrant NATO military intervention in the event of threats to them.

Risks to independence of the Caspian states: *Because the borders of the nations were drawn (as Soviet republics) with little regard to ethnic coherence, and because most of the national governments have little basis of popular support, the future of the states is uncertain. Collapse of governments, pressure from Russia and other neighboring countries, and conflict among the Caspian states could lead to the disintegration or loss of sovereignty of some of them.*

Although there is general Western support for the independence of states in the region, there is little likelihood of a NATO consensus that preserving the independence and territorial integrity of the Caspian states is critical to Western security. Most NATO countries continue to regard Central Asia and the south Caucasus as tangential to the Alliance's core security interests. In light of the deep divisions within NATO over military operations in the Balkans, it is illusory to believe that the Alliance could reach consensus on similar undertakings in the Caspian region. Hence, it is highly unlikely that NATO will extend security guarantees to any of the Caspian states.

Weapons of mass destruction: *Some of these states might now move to acquire such weapons which, given the weakness of central authority, might fall into the hands of substate groups. These states or groups might include some unfriendly to the West.*

At least for the next decade, the Caspian states (and substate actors) will generally lack the means and the motivation to acquire weapons of mass destruction. Moreover, even if states in the region acquired such weapons in response to unanticipated security threats, it is unlikely that they would pose a threat to NATO's security. For these reasons, NATO should probably not extend its counterproliferation mission to the Caspian region, particularly with respect to developing the operational capabilities to deal with specific threats.

Spillover of conflict beyond the Caspian region: *Conflicts involving the new states could spread outside them.*

Most of the region's conflicts are likely to remain localized, and those with the potential to spread (e.g., civil war in Tajikistan) have little strategic import for NATO. The most likely scenario for a spillover affecting NATO is the possibility of Turkey's supporting Azerbaijan in a territorial dispute with Iran. This seems unlikely in the foreseeable future, but the situation bears watching over the long term.

Spread of political Islam: *Most of the new states are Muslim. Now that they are free of the Soviet Union's strictures against Muslim practice, radical Islamists, possibly encouraged by Iran, may exploit the grievances of the economically and politically oppressed to foment revolution.*

Such a prospect is unlikely, given differences between the practice of Islam in Iran and in the Caspian states. Further, the internal dynamics of Caspian societies, rather than Western actions, will determine the future of militant Islam there. The use of NATO military force would be an inappropriate and ineffective response to combat the spread of radical Islam.

What Should the West Do?

Several key principles emerge as guideposts for developing a road map for NATO in the Caspian region:

- U.S., Western, and NATO resources are limited. Western objectives for the region must therefore be fairly modest.

- The most serious threats to the security and stability of the Caspian states are internal. Western policy should therefore focus on resolving the political, economic, and social challenges that could breed internal conflict and instability.

- NATO's most relevant military instruments in the region will be advisory assistance, training, and guidance in helping the military establishments of the Caspian states to restructure along Western lines. The United States and NATO should consider offering higher levels of aid to countries that demonstrate a real commitment to democratic reform.

- Russia's legitimate interest in security and stability along its borders should be accommodated. But Russia should recognize that the establishment of stable, prosperous, and independent states along its periphery is in its

interests. Consequently, NATO initiatives in the region, if sensitively imple-mented, need not work at cross-purposes with a strategy of engaging Russia on matters of concern to the West.

- The Alliance should avoid creating expectations among the Caspian states that NATO's interests are so important that it will extend security guarantees vis-à-vis Russia. NATO is probably not prepared to deliver on such promises.

In light of these considerations, as well as the Alliance's more pressing priorities on its immediate eastern and southern periphery, deepening NATO engagement in the Caspian region should not command a high priority in terms of resources, planning, or forces. In view of the West's limited interests and leverage in the region and the dangers of NATO overextension, the Alliance should focus its mil-itary assistance on promoting restructuring and training, while resisting new commitments and security responsibilities in the region.

MR-1074-AF, *NATO and Caspian Security: A Mission Too Far?* R. Sokolsky, T. Charlick-Paley.

China's Arm Sales: Motivations and Implications

Since the 1980s, China has sold large quantities of conventional arms to rogue states such as Iran. It has also transferred to several nations, including potential U.S. adversaries, technologies and equipment useful for the production of ballistic missiles and nuclear, biological, and chemical (NBC) weapons. What motivates this trade, and what factors keep it from growing even larger? What are the implications for the United States and for the U.S. Air Force in particular? As part of a project on Chinese defense modernization, PAF researchers answered these questions as follows:

- China develops arms trade relationships primarily for strategic advantage and only secondarily for commercial reasons.

- In the past decade, China has found it politically advantageous to come further into compliance with various international arms conventions. U.S. pressure also can effectively constrain China's actions.

- Despite the improvement in China's behavior, the U.S. Air Force should anticipate facing Chinese missile technology and perhaps even nuclear technology in the event of conflict in Southwest or South Asia.

Problematic Trading Relationships

China's most problematic trading relationships from the point of view of the United States have been with six Asian countries. The most important relationships have been with Pakistan and Iran. China has sold both countries large numbers of conventional weapons. It has supplied Iran with equipment and materials to produce chemical and biological weapons and Pakistan with enriched uranium and components of short-range ballistic missiles. China has provided technical assistance to both countries' nuclear and ballistic-missile programs.

In the 1990s, China was a major supplier of conventional arms to Myanmar (Burma). Other problematic arms customers in the 1980s included Iraq, North Korea, and Thailand. On the other hand, China observed the UN arms embargo against Iraq in the 1990s, and strategic reasons for aiding North Korea and Thailand have subsided.

Motivations

On the demand side, countries seek Chinese weapons because they are available, cheap, and easy to use and maintain. China is one of the few countries willing to sell arms to "pariah" states. However, demand has fallen significantly since the 1980s for several reasons:

- The war between Iran and Iraq ended, reducing both countries' need for weapons.
- Operation Desert Storm demonstrated the advantages of technological superiority, which Chinese weapons do not possess.
- With the collapse of the Soviet Union, more advanced Russian designs have become available at low prices.

On the supply side, China's arms sales can be explained by a combination of commercial and strategic motivations. China's commercial motives include desires to

- maintain its defense industries in the face of diminished domestic procurement,
- earn foreign exchange for the country as a whole and for the defense industries in particular, and
- stimulate technological progress by competing in foreign markets.

It has been claimed that such commercial considerations are the primary motivation for China's arms transfers. But PAF researchers say that is inaccurate. Revenues from arms sales are of diminishing importance to Beijing, having fallen from 7 percent of export earnings in the 1980s to 1 percent in 1996. Indeed, many of China's transfers have been subsidized, and Beijing has refrained from transfers to possible foes, suggesting that arms-trading relationships have been driven by strategic factors such as

- strengthening foes of China's rivals (e.g., Pakistan against India, Iran and Pakistan against the Soviet Union, and Thailand against Vietnam),
- countering Soviet influence in North Korea and (through Myanmar) Indian influence around the Bay of Bengal, and
- sustaining friendly relations with oil producers (e.g., Iran, Iraq), which could be important for China's oil-importing economy.

Source of Restraint

Until the 1990s, China's leadership had shown little concern for the dangers of proliferation of NBC weapons and ballistic missiles. In recent years, however, China's attitudes appear to have gradually evolved toward an understanding of these dangers and of the costs involved in remaining outside the international nonproliferation community. In 1992, China signed the Nuclear Nonproliferation Treaty and agreed to observe the Missile Technology Control Regime (though China did not sign it), and in 1993 it joined the Chemical Weapons Convention.

During this transition period, there may have been as many backward steps as forward. For example,

- China provided nuclear assistance to Iran and Algeria, although this assistance was consistent with the Nonproliferation Treaty. In 1997, China agreed to stop assisting Iran.
- In 1995, China transferred ring magnets to Pakistan, in probable violation of the Nonproliferation Treaty. Three years later, China agreed to stop assisting Pakistan's nuclear program.
- China violated the spirit of the Missile Technology Control Regime in 1994 when it transferred ballistic-missile parts to Pakistan.

The United States has a modest ability to influence China's arms transfers. Beijing wishes to be seen as a responsible member of the international community, and the United States has exploited this desire in successful attempts to prevent certain transfers—particularly to Iran and Iraq. The United States has also been able to exert influence through threats to withhold certain technologies from export to China. Some of this influence has, however, been diluted through what China sees as U.S. violations of the spirit of agreements it has made, particularly with regard to transferring arms to Taiwan. The ability of the United States to influence China is also limited by lack of support on the part of its European allies.

It has been claimed that China's ability to adhere to arms transfer protocols has been constrained by the central government's lack of control over arms-selling entities. PAF researchers argue that this is fallacious. All important arms sales must have the approval of China's top leadership. They concede, however, that the export control system for equipment of use to both civilian and military sectors is weak and that such equipment might be transferred without the knowledge of China's leadership.

Implications for the United States

Arms control protocols and U.S. pressure notwithstanding, some Chinese arms transactions injurious to U.S. interests will inevitably occur. Of particular importance are transfers of nuclear- and chemical-weapons technologies and equipment. Such transfers greatly aided Pakistan's nuclear-weapons program and may well contribute to further improvements in that country's capabilities. China's transfers will probably make a minor contribution to Iran's efforts to develop nuclear and chemical weapons. Furthermore, both Pakistan and Iran could pass these technologies on to other countries. The likelihood that the U.S. Air Force could become involved in a conflict with an adversary possessing nuclear or chemical weapons has therefore increased.

The missile technology that China has transferred to Pakistan and Iran is another serious concern. This technology represents a qualitative improvement over that in the Scud missiles common in Third World inventories. Missiles built with Chinese technology are longer-range, more accurate, mobile, and, because they are solid-fueled, can be ready to fire much more quickly. If this technology spreads to countries that are adversaries of the United States, it would present serious difficulties for U.S. military planners. Even if China persists in its recent restraint in transferring such missiles, its other transfers of missile-related technology are of concern. Cruder Iranian missiles may have benefited from Chinese guidance technology. Thus, although China's outright missile sales have been restrained, the U.S. Air Force must nonetheless prepare for the possibility that potential regional adversaries will be equipped with Chinese missile technology.

MR-1119-AF, *China's Arm Sales: Motivations and Implications*, D. Byman, R. Cliff.

Can the Air Force Rely on Civilian Procurement Approaches?

American air power depends heavily on the technology of U.S. weapon systems. But declining defense budgets and growing procurement costs make it difficult to retain a technology edge. This dilemma, combined with advances in commercial technology, has led some to argue that the Air Force should prefer civilian components, technologies, and procurement practices. An approach called Civil-Military Integration, or CMI, does exactly that: it integrates the civilian and military industrial bases. Advocates believe that, by adopting CMI, the Air Force can reduce costs, improve performance, shorten development times, and maintain key parts of the industrial base. Critics argue that CMI will probably not yield such benefits but may result in degraded performance, price-gouging, or fraud.

PAF conducted case studies of three areas: munitions, transport aircraft, and a class of components crucial to military avionics. The findings are helping the Air Force determine what benefits it may realize from CMI and how it can reduce the risks.

How Much Air Force Technology Can Be Dual-Use?

The U.S. market for defense-related goods is not like most commercial markets. In it, a single buyer defines the product in great detail and controls sales opportunities for weapons suppliers. Weapon systems are also more complex and innovative than most commercial products. To achieve performance requirements that may be central to air superiority, developers push the limits of technology, incorporating sometimes unproven elements.

This has led the United States to develop a separate defense industrial base, especially in aerospace. But advocates for CMI argue that recent, rapid growth in civilian technology has created extensive "dual-use" overlap between commercial and military markets. Sharing people, machines, and facilities between defense and commercial applications could then reduce both the cost of systems and the share of R&D costs that the Department of Defense must bear. Advocates also argue that, in areas such as electronics, commercial technology is ahead of military; thus, *not* adopting CMI might threaten the Air Force's technology edge. But skeptics worry that using commercial technology could cause failure in military applications that require extremely high or consistent performance.

To assess the potential for dual use, PAF conducted a detailed case study of microwave and millimeter-wave technologies used in radar and other military avionics. These items that have had no close commercial analog exemplify a great challenge for CMI. The study revealed that the use of commercial-grade parts will probably increase dramatically even without a CMI strategy. The market for these technologies is already driven by such commercial products as wireless communications, television broadcasting hardware, and automotive sensors, where production may reach millions of units. Military demand is so much smaller that in some cases only dual-use components will be available. Using this civilian industrial base is thus an important national priority.

In addition to helping the Air Force continue to exploit leading-edge technologies, use of the civilian industrial base can substantially cut costs. Reducing the use of military-specification (Mil-Spec) parts is a major source of savings. Mil-Spec parts are more expensive than similar civilian products, and generally slower to procure. Figure 4 illustrates the difference for three parts examined in the case study.
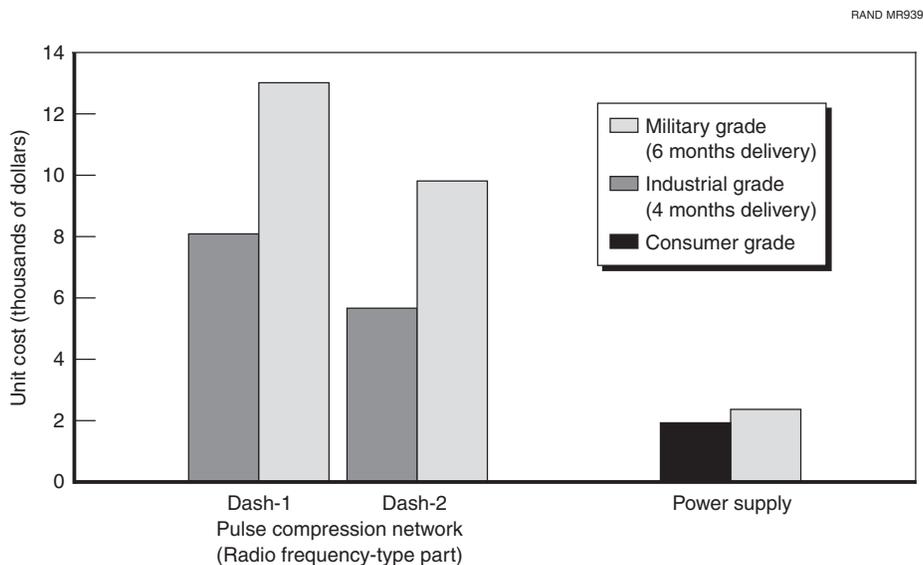
Figure 4—Schedule and Cost for Mil-Spec and Commercial Grade Parts (Pulse Compression Network)

The additional costs come from two primary sources. First, Mil-Spec parts are often produced in much smaller lots, resulting in higher unit prices. Second, even when Mil-Spec parts are manufactured on the same line as commercial equivalents,

they are rigorously screened to ensure reliability, durability, and consistently high-level performance. Figure 5 displays the end result for one case: a digital integrated circuit (IC) now being used in a prototype radar module. For this program, engineers chose to reduce both costs and development time by purchasing consumer-grade ICs rather than Mil-Spec equivalents at eight times the price. (As the figure shows, the cost of the components—"basic lot cost"—was not dramatically different. The cost of screening the parts, however, was much higher for the Mil-Spec ICs. The cheaper ICs were screened, though less rigorously, then inserted into prototype radar modules. The modules themselves are now being tested for durability in harsh environments.) Similar savings were found in developing modules for fighter and helicopter communication, navigation, and identification systems. After maximum insertion of commercial parts, the modules are estimated to cost only about 60 percent of the original baseline cost projection. Cost would probably be even lower if the modules had been designed from the start to use non-Mil-Spec parts. Only 10 percent of the module's components remain Mil-Spec, but they account for 50 percent of its cost.

RAND MR939
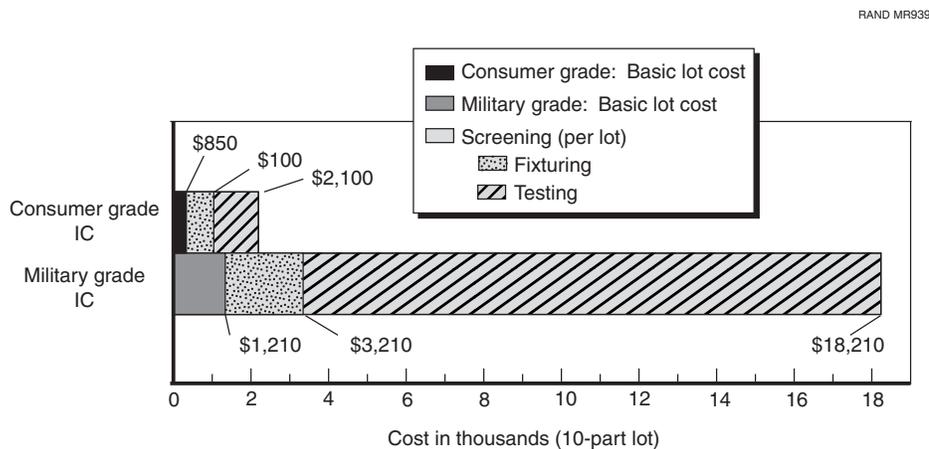
Figure 5—Large Cost Premiums Are Paid for Mil-Spec Parts Screening

More broadly, systematic use of commercial parts, technologies, and processes is likely to reduce the cost of typical avionics modules by 20 to 50 percent and also to shorten R&D schedules. But PAF found two important caveats:

• Civilian contractors may need authority to make changes throughout the system's life. This helps achieve the right component mix and avoid dependence on obsolete (and paradoxically expensive) parts in a world of very short

product life-cycles. It can also motivate contractors to continuously insert the more effective, lower-cost technologies that inevitably emerge.

• Concerns remain about the long-term reliability and durability of systems that include non-Mil-Spec components. Early evidence is mostly encouraging, but such hybrid systems require continued testing for long-term resistance to the extremes presented by military environments.

The Value of Commercial Procurement Practices

Advocates argue that CMI benefits flow not only from technology but also from procurement practices. As it developed a separate defense industrial base, the U.S. government assumed a great deal of risk, directly funding much R&D, entering into cost-based contracts, and awarding what were often effective monopolies to suppliers. To prevent abuse, it also constructed an exceedingly complicated web of procurement laws, regulations, and practices. Loosening these restrictions might cut costs in two ways. First, complying with the regulations creates large costs that are ultimately borne by the government. Second, many argue that modern commercial practices, while they do not correspond to current DoD regulations, actually provide stronger mechanisms to keep costs down and performance up. Skeptics respond that mission requirements and political constraints make commercial business practice unsuitable.

To assess the potential of commercial acquisition practices for Air Force weapon systems, PAF examined airliner production, where procurement once resembled the traditional military model but has now undergone radical transformation. Airline deregulation combined with increased foreign entry has encouraged intense competition between airlines and rival teams of aircraft producers. The buyer-supplier relationships that have resulted are more complex than those envisioned by current DoD policy on commercial procurement. One key procurement approach is "must cost" pricing, where the airframe integrator chooses a price and profit target for the finished aircraft, consults with prospective suppliers, then allocates rigorous price targets for each firm. "Must cost" has been used both by Boeing and, before their merger with Boeing, by McDonnell-Douglas. It has successfully reduced industry costs. Careful examination suggests that a parallel acquisition strategy could benefit the Air Force. As in avionics, this would require closer working relationships with contractors. In particular, aircraft R&D would become more integrated with maintenance, repair, and overhaul activities. And strategies would be needed to manage three issues:

Performance. "Must cost" has shifted airline and manufacturer focus from performance to cost. This has not resulted in poor performance, but it may have discouraged dramatic technological improvements. If the Air Force adopts an approach that closely emulates the civilian world in emphasizing cost over other considerations, careful program management will be required to maintain technical innovation.

Industrial base. Civilian experience indicates that the Air Force should be able to reduce its R&D support for new aircraft development without causing qualified contractors to leave the market. But the Air Force must be willing to give contractors more responsibility and flexibility in program management and probably also to accept a narrower supplier base. Greater profit incentives and enhanced access to foreign markets may also be necessary to spur contractors to take on greater risk and responsibility in military programs. To enforce price and quality discipline, DoD should maintain competition as long as possible in each program. In sectors where maintaining competition may be difficult, contractual incentives—including provisions that reimpose traditional, intensive oversight on contractors who fail to meet government targets—will be especially important.

Competition. To prevent price-gouging, DoD should continue to foster cooperation between the services in weapon system acquisition (encouraging more manufacturers to compete for the larger military contracts that would result), support the use of existing commercial specifications (enabling greater competition), and carefully consider the role of foreign firms (providing, in the commercial world, vital resources and competition).

Lessons from CMI Pilot Programs

The government has conducted several CMI pilot programs that offer valuable evidence because they operate on a fairly large scale and incorporate both acquisition approaches and technologies from the commercial sector. Although individual programs had been evaluated, across-the-board lessons had not yet been drawn. PAF carefully examined three such programs used for acquiring munitions—Joint Direct Attack Munition, Wind-Corrected Munitions Dispenser, and Joint Air-to-Surface Standoff Missile—as well as three other innovative acquisition reform efforts—DarkStar, Global Hawk, and the Commercial Operations & Support Savings Initiative. The results suggest that, in practice, CMI can achieve great benefits. For example, in all three munitions programs, likely acquisition prices appear to be considerably less than half of what they would have been under traditional procurement. And while R&D is not complete, performance

seems to be meeting or exceeding original requirements. PAF found that these benefits derive not only from commercial technology or facilities, but also from commercial-like program structure and management. Buyer and seller establish and achieve price and performance targets in a cooperative rather than an adversarial environment.

Despite its clear benefits, CMI also poses risks to the nation's technology edge. To avoid accidentally sacrificing capabilities that may prove critical, the Air Force must thoroughly understand the performance, schedule, and cost priorities for each new weapon system. In a global environment of great uncertainty, this is a daunting task, especially with systems expected to remain in active service inventories for decades. The Air Force must also be able to communicate these priorities to the system developers who would be largely responsible for making the tradeoffs among them. Given these challenges, the specifics of CMI evolution will remain important to Air Force leaders. Three issues—ensuring open-system architecture, developing a strategy for continuously inserting new technologies, and providing incentives for contractors to continue improving capabilities after production begins—merit further examination.
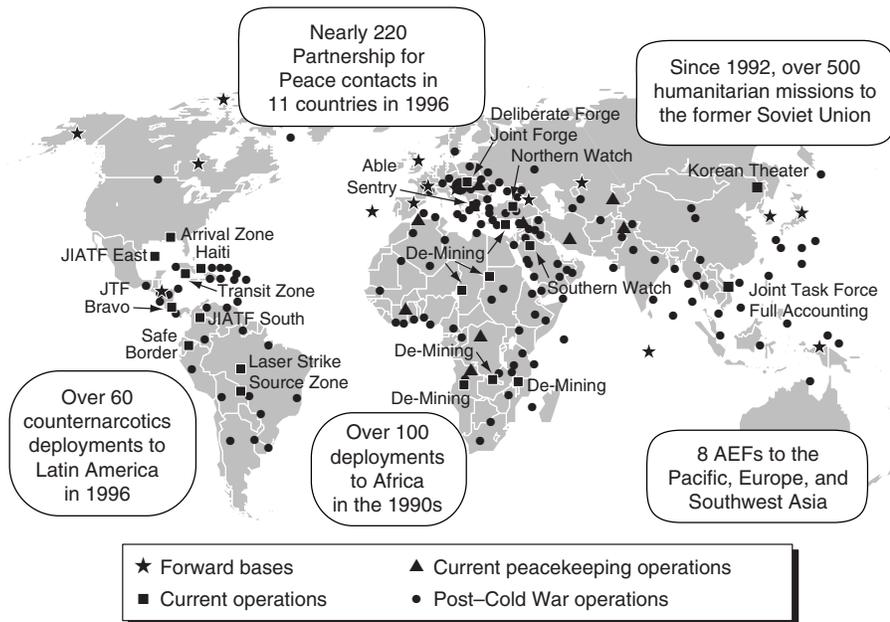
MR-1147-AF, *Cheaper, Faster, Better? Commercial Approaches to Weapons Acquisition*, M. Lorell, J. Lowell, M. Kennedy, H. Levaux.

Achieving Global Presence for Expeditionary Aerospace Forces

Today's security environment presents the Air Force with radically different challenges than in the past. For most of its history, the adversary was well known and theaters of operation were defended with permanently stationed forces. Today, missions range from "pop-up" contingencies where the Air Force has rarely operated to continuing commitments far from any main operating base (MOB).

The result has been frequent deployments to austere locations (see Figure 6). Supporting these deployments with traditional organization and basing structure has created shortfalls in retention and readiness. The Air Force is responding by transforming itself into an Expeditionary Aerospace Force (EAF)—one that can quickly project sizable forces overseas to unpredictable locations and then sustain them.

RAND MR1113-1.3

Nearly 220 Partnership for Peace contacts in 11 countries in 1996

Since 1992, over 500 humanitarian missions to the former Soviet Union

Deliberate Forge
Joint Forge
Northern Watch

Able Sentry

Korean Theater

Arrival Zone
Haiti

JIATF East

JTF Bravo

Transit Zone

JIATF South

Safe Border

Laser Strike Source Zone

De-Mining

Southern Watch

Joint Task Force Full Accounting

De-Mining

De-Mining

De-Mining

De-Mining

Over 60 counternarcotics deployments to Latin America in 1996

Over 100 deployments to Africa in the 1990s

8 AEFs to the Pacific, Europe, and Southwest Asia

★ Forward bases   ▲ Current peacekeeping operations
■ Current operations   • Post–Cold War operations

SOURCE: Michael E. Ryan, General, USAF, "Expeditionary Aerospace Force: A Better Use of Aerospace Power for the 21st Century," briefing, Washington, D. C.: HQ USAF, 1998.

Figure 6—Global Air Force Operations in the 1990s

The transition has necessarily begun with organizational structure. But an expeditionary force also needs overseas operating locations and that poses a problem; the number of overseas bases has dropped dramatically, and those that remain are not well located to support operations in unstable regions around the world today. Building new MOBs in many areas of regional instability is neither affordable nor realistic. To attain global presence, a new approach is needed. As part of a major initiative supporting the EAF transition, PAF developed a strategy to provide this global presence, modeled its operational performance, and identified key issues that the Air Force should consider.

A New Approach: Flexbasing

The suggested strategy, "flexbasing," replaces efforts to achieve an elusive assured access to a great many forward operating sites around the world. Instead, it creates a robust *capability* to go swiftly and easily into whatever base, airport, or remote airfield becomes available. Achieving this capability is complex, depending as it does on advanced logistics and mobility, a robust mix of long- and short-range combat systems, innovative use of space, and a new approach to planning. But doing so would enable the Air Force both to address base access issues and to enhance operational effectiveness of deployed forces.

To assess the strategy's operational value, PAF modeled a representative EAF mission: conducting punitive or coercive strikes in a remote region as quickly as possible. For this situation, the key difference between flexbasing and current practice is that flexbasing provides a network of forward support locations (FSLs)—storage sites situated to support rapid deployment to a large number of possible operating locations. The analysis calculated how many air-to-ground Joint Direct Attack Munition (JDAM) strikes could be delivered over the first two weeks of a conflict in three scenarios:

- Case A: deployment to a well-stocked forward base under the threat of theater ballistic missiles and chemical/biological agents
- Case B: deployment to a bare (unequipped) base with a similar high-intensity threat
- Case C: deployment to a moderately equipped base with a lower threat.

By providing the FSL, flexbasing enabled far more JDAMs to be delivered in each case and contributed substantially to the early application of force (see Figure 7). The impact was largest in theaters where the Air Force could not depend on a

built-up forward operating location. In that scenario, the Air Force was able to deliver 96 JDAMs in the first five days without flexbasing and 561 with flexbasing—a token series of strikes on one hand, and the shock and intensity of a true air campaign on the other.[1] Even for the other scenarios, the intensity of Air Force strikes was substantially greater. The FSLs integral to flexbasing make a substantial contribution to the quick response and intensity of expeditionary air campaigns.
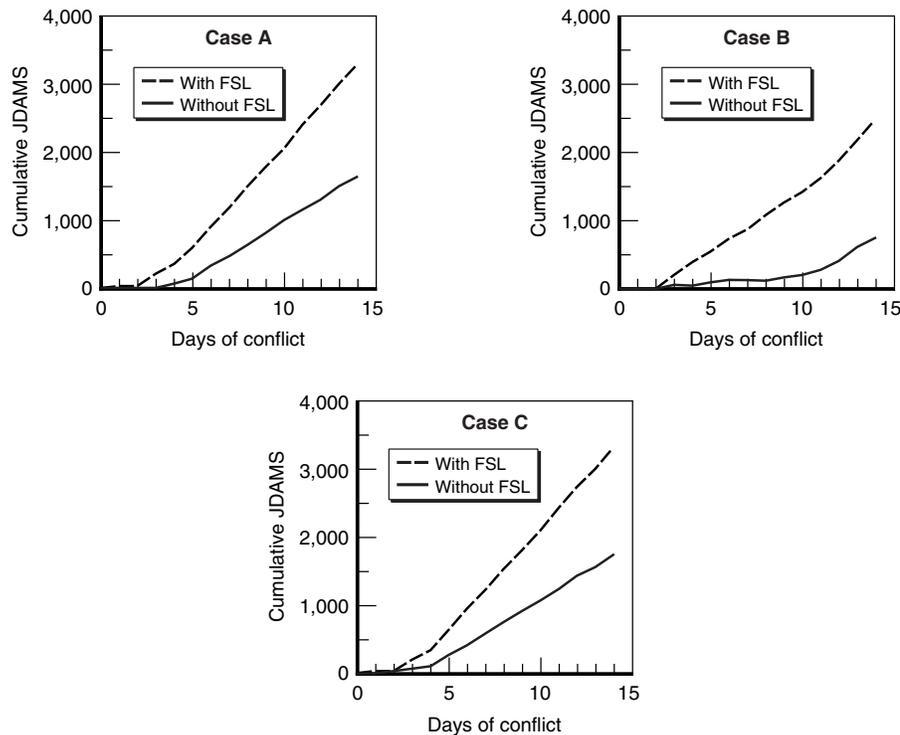
RAND MR1113-5.4

Figure 7—Precision-Guided Munitions Delivered

Key Elements of Flexbasing

Flexbasing builds on core Air Force capabilities in operations, logistics, and space. Although complex cost and operational tradeoffs must still be analyzed—detailed studies are already underway—PAF has defined six key elements of the strategy:

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[1] A recent PAF study emphasized that the intensity of an attack could make a real difference in the value of air power for coercion, not only for the immediate case but in future conflicts as well. See p. 33, "Air Power as a Coercive Instrument."

- *A global system of sites.* These would include core support locations, normally EAF home bases; forward operating locations, which might be allied bases, civilian airports, or remote airfields; and the FSLs just discussed. Support locations would be chosen to enable rapid deployment to a large number of possible forward operating locations in each region. In addition to storage, FSLs could provide regional maintenance facilities and en route infrastructure.

- *A robust mix of long- and short-range combat capabilities.* Expeditionary operations need a flexible balance; the Air Force must be able to project power whether or not close-in bases are immediately available. During a crisis, long-range operations can often help gain access to closer locations by demonstrating U.S. resolve.

- *Space as a regional support location.* Low-earth orbit is only 200 miles from any theater of operations, exploiting a relative strength of the United States with almost assured access. The Air Force should aggressively pursue the feasibility of placing enabling assets in earth orbit. In particular, AWACS (airborne warning and control system) and JSTARS (joint surveillance and target attack radar system) functions could conceivably be performed from space. The feasibility of space-based suppression of enemy air defense and anti-theater ballistic-missile missions should also be investigated.

- *A joint global presence strategy.* A global support infrastructure such as the one envisioned in flexbasing would enable all services to regionally locate support equipment and supplies.

- *A global logistics/mobility support system designed to support the expeditionary strategy.* This would provide the combat support flexibility that the EAF will need to deploy anywhere within a region and then rapidly commence and sustain operations.

- *Full-spectrum protection against key threats to deployed expeditionary forces.* Protection would make it less likely that enemy threats could prevent expeditionary forces from deploying to an operating location.

The last two elements are described more fully below. The combination of all six elements would give the EAF potential access to many locations without depending on access to any particular base. Figure 8 shows a notional example of the concept.
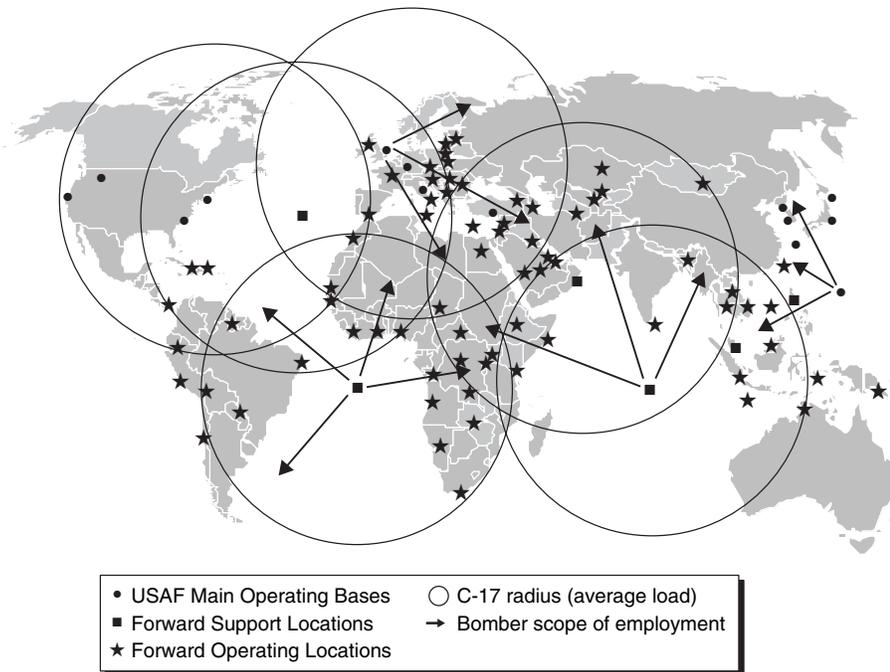
RAND MR1113-S.2

• USAF Main Operating Bases   ◯ C-17 radius (average load)
■ Forward Support Locations   → Bomber scope of employment
★ Forward Operating Locations

Figure 8—Notional Flexbasing Concept

Global Logistics/Mobility Support

PAF's initial flexbasing research examined two of the strategy's elements in detail. The first is the global logistics/mobility support system. Early deployments of EAF force packages demonstrated that today's support equipment and processes cannot provide the very high levels of deployability the Air Force requires—such as deploying and employing within 48 hours—without prepositioning substantial infrastructure at expected operating locations. To ensure access, a number of such prepositioned sets would be needed, and support costs would be high. The study found that positioning this infrastructure at FSLs, then moving it to forward operating locations with theater airlift, represented a good compromise between cost and responsiveness. Striking this compromise systemwide requires an air mobility network that must be able to support both peacetime and crisis movement of equipment and personnel among various support and operating locations. In addition, it would also enable the periodic deployment and redeployment of forward-based air expeditionary force (AEF) packages. And it would support the upkeep and surveillance of infrastructure placed throughout the system.

Flexbasing also requires a logistics command and control system to facilitate decisionmaking and the flow of requirements information. This enables fast reaction to changing circumstances. The entire structure would need to be supported by a dynamic strategic planning process, informed by an analytic capability that can address such issues as what to preposition and where, which functions should be performed at FSLs, and how many of each type of forward operating location are needed. These decisions must be made centrally for the entire system so that theaters can support each other and global transportation networks can be established.

Stronger Force Protection

The study's second detailed focus was force protection—a vital element of flexbasing. Credible enemy threats could prevent the Air Force from using some locations or prepositioned resources. The study identified four areas that need attention:

- **Better sensors and firepower.** Attacks on forward deployment locations could be our adversaries' best option for countering U.S. air power. Security forces need more capable systems. One example is a tactical unmanned air vehicle (UAV) with infrared sensor to counter the serious threat from mortars or rockets.

- **Anti-theater ballistic-missile and cruise-missile capability.** Within the decade, expeditionary forces will face more accurate theater ballistic missiles. Global Positioning Systems and stealth features will probably increase the cruise missile threat as well. Without countermeasures, this may force the United States to rely solely on long-range weapons. Until the Air Force can field an effective, *deployable and sustainable*, defensive system, such as envisioned in the Airborne Laser program, this risk can be managed only with a mix of deterrence, prepositioning, and longer deployment times.

- **Collective protection against chemical/biological weapons.** Although great progress has been made in this area, ultimately the EAF will face adversaries with sophisticated military chemical/biological capabilities. The Air Force needs to procure a deployable collective protection capability that allows bases to continue operation while decontamination takes place. Without it, the only option after major attacks would be evacuation.

- **Threats to information flows.** EAF force protection and enhancement depend on command and control, intelligence, and planning resources far

from forward locations. Denying these capabilities through jamming or information warfare—an unclear but growing threat—would substantially reduce EAF effectiveness. The Air Force needs to evaluate the threat and design appropriate measures to mitigate it.

National security now requires a rapidly deployable aerospace force, not just a rotational one. Flexbasing is a promising option to support this new level of deployment, enabling the Air Force to move swiftly into, and operate effectively out of, whatever locations become available during crises. This will reduce dependence on particular overseas bases and provide potential access through-out each theater of operations—a major step in the process of creating a truly expeditionary aerospace force.

MR-1113-AF, *Flexbasing: Achieving Global Presence for Expeditionary Aerospace Forces*, P. S. Killingsworth, L. A. Galway, E. Kamiya, B. Nichiporuk, T. L. Ramey, R. S. Tripp, J. Wendt.

Supporting Expeditionary Aerospace Forces

Expeditionary Aerospace Forces (EAF) can provide sustainable, quick-strike capabilities for global power projection. This new expeditionary operational concept in turn requires an agile combat support (ACS) system that can quickly provide supplies, munitions, and transportation.

To analyze support options for different types of missions, PAF has created a series of ACS planning models that identify employment requirements and provide time-phased estimates of support resource requirements for commodities such as F-15 avionics or LANTIRN intermediate maintenance needs. Once support requirements are computed, the models are used to evaluate options for meeting them—e.g., prepositioning support resources or deploying from consolidated locations. Their output is an evaluation of the effects of alternative support options on the key performance metrics of spin-up time, airlift footprint, investment and recurring costs, risks, and flexibility (see Figure 9).
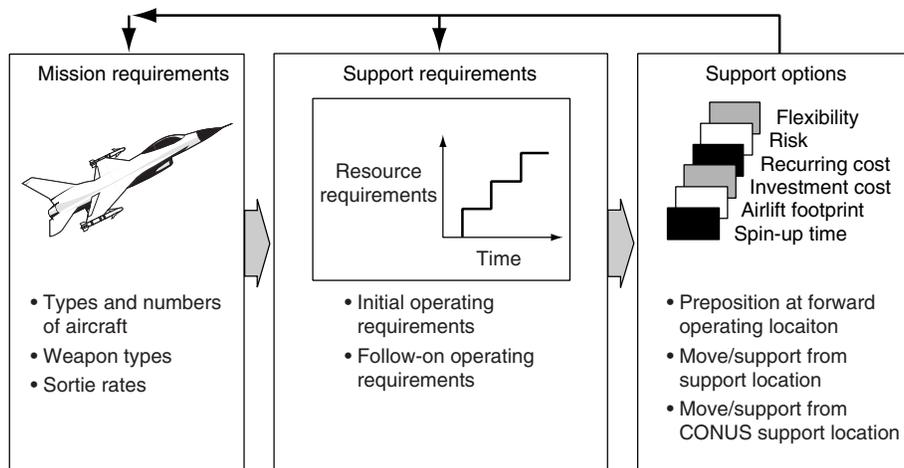
Figure 9—Elements of the Strategic Agile Combat Support Planning Framework

Preliminary use of this framework for specific commodities has yielded important insights about the support of expeditionary operations. The most important

is that the Air Force goal of deploying to an unprepared base and sustaining a nominal expeditionary force at high optempo cannot be met with current support processes. Today, a 48-hour timeline can be met only with judicious prepositioning and, even then, often only under ideal conditions.[2] Technology and process changes may reduce the need to deploy heavy maintenance equipment. For now, however, these results mean that setting up a strategic infrastructure to perform expeditionary operations involves a series of complicated tradeoffs.

A Vision for an Evolving Agile Combat Support System

The models have been used as the foundation of a broader analytical framework developed by PAF to give the Air Force a continuing ability to review and improve its support-system design. Some of the results have been used in recent war games. Several of the specific analyses present a vision for the future system and how two commodities, F-15 avionics support and LANTIRN repair, can best be provided in this system.

This research has begun to make clear the broad characteristics of an ACS system for expeditionary operations—e.g., it would be global and have several elements based at forward positions, or at least outside CONUS.

In the concept developed by PAF, the ACS system would have five components, some of which were implemented during Operation Noble Anvil in Kosovo.

- Forward operating locations in areas critical to U.S. interests
- Forward support locations whose configurations and functions would depend on geographic locations and the costs and benefits of using current facilities
- CONUS support locations
- A transportation network linking the locations indicated above
- A logistics command-and-control system.

New technologies, political developments, and budget changes will require that the ACS system be continually reassessed to ensure that the EAF can execute missions required of the Air Force in any theater.

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[2] See "Achieving Global Presence for Expeditionary Aerospace Forces," p. 22, for a fuller discussion of pre-positioning at forward support locations.

F-15 Avionics Maintenance Concepts

The Air Force currently decentralizes F-15 avionics maintenance by deploying test equipment from home bases to forward operating locations. The PAF analysis considered the advantages and disadvantages for support options ranging from the current system to a more consolidated option using a few forward support locations.

The current decentralized system has the advantages of low relative cost, greater certainty in resource requirements, and an existing infrastructure. However, its disadvantages in personnel turbulence, airlift constraints, and single-string risk have caused many deploying units to modify their procedures informally.

A variation of the current decentralized option that eliminates deployment of avionics equipment and personnel would reduce turbulence and eliminate the airlift requirements of the current structure. Moving to this system would be relatively easy, although it would require an increase in spare-part inventories. The risk for this structure would be in CONUS resupply.

Consolidated structures reduce the personnel turbulence and deployment footprint concerns associated with the current structure, while being cost competitive. Consolidated repair depends upon consistently available transportation, but its transportation requirements are limited to shorter intratheater lift and present less management complexity.

The 48th Component Repair Squadron at Royal Air Force Lakenheath implemented a hybrid strategy to support F-15 operations in Operation Noble Anvil, supporting initial operations with existing assets and developing augmentation plans with CONUS organizations. This plan, which is representative of the decisionmaking needed to make the EAF work, cut airlift footprint and deployed personnel requirements by more than 50 percent each.

LANTIRN Maintenance Concepts

The Air Force also uses a decentralized structure to maintain LANTIRN pods. As with F-15 avionics, other options exist which consolidate repair.

Decentralized and centralized LANTIRN support structures each carry unique risks, particularly in time constraints, for supporting operations. For decentralized structures, the key variable is deployment time. In a two-major-theater-war scenario, if deployment takes longer than seven days, pod availability for

engaged aircraft starts to degrade. Centralized structures may face unique risks in vulnerability to attack, but the key variable for their performance is transportation time. If one-way transportation time between CONUS support locations and forward support locations exceeds five days, pod availability for engaged aircraft starts to degrade.

As in the case of F-15 avionics, centralization offers some distinct advantages over the current system, particularly in cutting deployment and airlift requirements. The most efficient structure that PAF analyses identified would use two forward support locations and a CONUS support location for LANTIRN repair. For now, the study team recommends that the Air Force invest in the Advanced Deployment Kit upgrade for LANTIRN support equipment and conduct a proof-of-concept experiment of the consolidated options for regional repairs. This will allow the Air Force to work out further issues of cross-organizational cooperation and communication that must be addressed in any change to the LANTIRN support system.

MR-1056-AF, S*upporting Expeditionary Aerospace Forces: An Integrated Strategic Agile Combat Support Planning Framework*, R. S. Tripp, L. A. Galway, P. S. Killingsworth, E. Peltz, T. L. Ramey, J. G. Drew.

Air Power as a Coercive Instrument

In recent years, the U.S. Air Force has been called upon to help the nation coerce foes in the Persian Gulf, the Horn of Africa, and Europe. Although these efforts have sometimes been successful, the record has been mixed. In some cases, adversaries have openly defied the United States or complied incompletely with U.S. demands. To help understand coercive diplomacy, PAF examined what is necessary to carry out coercion, what can be learned from past attempts, how coercion is likely to be used in the future, and the implications of these findings for the use of air power.

Conditions of Successful Coercive Diplomacy

Coercion is the threatened use of force, including the limited use of actual force, to induce an adversary to change its behavior. The historical record suggests that the presence of certain conditions makes coercion more likely to succeed. Those conditions are the ability to dominate the escalation process, to counter the adversary's military strategy, and to magnify a third-party threat to the adversary.

Achieving Escalation Dominance. The ability to escalate a threat against the adversary—that is, to threaten a greater and greater price of defiance—allows a coercer to manipulate levels of costs that the adversary associates with a particular behavior. If the coercer also has the ability to increase those costs while denying the adversary the opportunity to neutralize their effects or to counter-escalate, then that nation achieves "escalation dominance." Examples are the U.S. attack on Bosnian Serb forces in 1995 and the U.S. threat of nuclear use during the Cuban Missile Crisis, the Korean War, and even Desert Storm.

Blocking the Adversary's Military Strategy. When its strategy for victory is thwarted, an adversary is more likely to come to the negotiating table. Such a "denial" strategy prevents the adversary from obtaining the benefits of aggression and makes it more likely to concede. Serb leaders, for example, made concessions in 1995 because they recognized that they could not make further gains in the face of NATO air strikes and might even be vulnerable to losses from Croat and Bosnian Muslim forces. In 1975 Iraq also recognized after over a year of fighting that it could not defeat Kurdish insurgents as long as they had Iran's backing. Thus, Baghdad agreed to Iran's demands about the contested border.

Denial strategies are impossible, however, when an adversary's plans cannot be thwarted by military force or when the strategy it employs, such as guerrilla warfare, is difficult to counter even with overwhelming might.

Magnifying Third-Party Threats.   Coercive threats are more likely to succeed when they magnify other threats—external and internal—to the adversary. NATO's air strikes on Bosnian Serb forces in 1995 not only hurt Bosnian Serbs directly but posed the risk that Bosnian Muslim and Croat forces would make further advances at the Serbs' expense. Israel's cross-border operations against Jordan in the 1950s and 1960s fomented instability in Jordan and forced the Jordanian government to crack down on Palestinian cross-border activity.

The primary danger of this strategy is that internal instability can operate unpredictably on a regime, perhaps even hardening rather than weakening resistance to the coercer's demands. If widespread domestic unrest appears likely, some regimes will increase police presence, order mass arrests, or even slaughter potential opposition members to preserve power. In Iran during the Iran-Iraq war, the clerical regime regularly arrested, tortured, and killed suspected opposition members.

Common Causes of Failure

The factors that most often disrupt coercive strategies are inadequate intelligence, doubts about the coercer's credibility, and the inability of political leaders to make concessions because of their tenuous hold on power.

Inadequate Intelligence.   The primary intelligence challenge is to discern the adversary's interests and priorities. This requires not only the collection of accurate data but also an understanding of the adversary regime's objectives, including its military goals. A common failure in intelligence is poor assessment of an adversary's determination and resilience. In the eight-year war between Iran and Iraq, for example, each side believed that the other was on the verge of collapse and that attacks on cities would cause the rival government to collapse. In this case and many others, experience shows that adversaries are often far more motivated than the coercing power. Coercers also tend to overestimate the effect that destroying specific targets will have on the adversary's behavior.

Weakened Credibility.   Doubts about a coercer's credibility can also undermine a coercive strategy. Successful coercion depends on the threat of future losses. When an adversary doubts that the coercer can escalate—or even sustain— operations, the perceived costs of defiance fall. A coercer's credibility is sustained

by skillful diplomacy in the immediate crisis and by its reputation for past actions. If the coercer's willingness to carry out threats is perceived as questionable, then even weak adversaries may feel confident defying the coercer.

Internal Instability. Finally, some adversaries simply cannot concede. Some regimes fear their own downfall if they back down, while others are too weak to impose the demanded change even if they choose to yield in the face of threats.

Constraints on U.S. Coercive Strategies in the Future

The lessons of past successes and failures of coercion must be understood within the context of U.S. foreign policy today and in the near future. Domestic politics inevitably shape coercive strategies, and the United States increasingly acts as part of a multinational coalition. Moreover, the United States is increasingly likely to face nonstate adversaries, which poses distinct challenges to coercion.

Public Opinion. The study shows that the level and strength of domestic support for military operations are highly contextual and depend greatly on the public's assessment of the benefits and costs in any given situation. Most military campaigns in the foreseeable future will probably be undertaken with mixed public support. In such an environment, political leaders will impose constraints on military operations to hedge against the possibility that military actions will turn into political liabilities. These constraints may reduce the effectiveness of U.S. forces.

Political Restrictions on Military Operations. U.S. policymakers tend to view air strikes as a low-cost, low-commitment tool of coercion, but they regularly impose restrictions on U.S. military operations to gain public support. Restricting the size of forces, the type of missions, or the length of an operation may impede coercive diplomacy by preventing the United States from escalating its operations. Adversaries can also exploit domestic concerns, such as fears of U.S. and enemy civilian casualties, to counter coercive threats.

Limitations Imposed by Coalition Partners. Other limitations on coercive strategies come from coalition partners. With few exceptions, all coercive military operations carried out by U.S. forces since the end of the Second World War have been prosecuted from within international coalitions. Coalition partners bring assets to the table that can prove useful for coercive operations—for example, including additional bases, local access, and diplomatic support. But coalition members sometimes have different goals and policies that reduce the options for concerted action.

Even when coalition members share a common ultimate goal with respect to the adversary, their interests are unlikely to be perfectly aligned. In the Bosnian conflict, for example, U.S. and European operational perspectives diverged. Whereas the United States favored a more aggressive coercive air strategy, Britain and France feared that air strikes would provoke retaliatory responses by the Serbs against vulnerable coalition ground personnel. Similar problems plagued attempts to coerce Saddam Hussein in 1993.

Involvement of Nonstate Actors. The United States is increasingly involved in crises that involve nonstate actors, such as communal militias, which pose their own challenges. They often lack identifiable targets, and their very structure impedes coercion because it has only limited control over its component parts. Although these problems can be circumvented to some degree by coercing the states sponsoring the groups in question, such a strategy multiplies the challenges listed above.

Implications for the USAF

If used correctly, air power can play a major role in successful coercive diplomacy. As the Gulf War revealed, air power is capable of destroying a vast array of targets with speed and precision. It has the flexibility and versatility to provide escalatory options, disrupt adversary military operations, or leave an adversary vulnerable to a magnified third-party threat. By providing intelligence and observing compliance, it can ensure that military force and diplomacy are effective.

Yet many of the constraints on the coercive use of force are not technical but political and diplomatic. The American public and coalition partners frequently view air power as offering the potential of accomplishing policy objectives while minimizing risks and costs. This view poses a critical challenge for air power because it will be called on when U.S. public or allied commitment is weak—a situation that will make coercion far harder. If the threat of escalation in such circumstances cannot be used credibly and the rules of engagement are also restrictive, then adversaries may question U.S. credibility, and air power's effectiveness will be perceived to suffer as a result.

For air power to retain its ability to coerce, it must be used only in situations where it is likely to achieve the desired effect. As Eliot Cohen argues, "American air power has a mystique that it is in the American interest to retain. When presidents use it, they should either hurl it with devastating lethality against a few targets…or extensively enough to cause sharp and lasting pain to a military and a society."[3] When

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[3] "The Mystique of Air Power," *Foreign Affairs*, Vol. 73, No. 1, January/February 1994, p. 124.

air power is used to attempt missions it cannot plausibly fulfill, this perception is diminished and adversaries will be more willing to challenge the United States.

The challenge for Air Force planners today is to develop military options for carrying out coercive strategies in the context of international diplomacy and domestic political pressures. That means developing capabilities that will make air power an effective coercive instrument for achieving U.S. objectives in spite of stringent constraints imposed by both coalition partners and American public opinion.

MR-1061-AF, *Air Power as a Coercive Instrument*, D. L. Byman, M. C. Waxman, E. V. Larson.

The Threat to USAF Aircraft on the Ground

> "The large ground organization of a modern air force is its Achilles' heel."
> Basil Henry Liddell Hart, *Thoughts on War*, 1944

The unprecedented success of the U.S. Air Force (USAF) during the 1991 Gulf War was achieved at the cost of just 14 aircraft lost to ground-based air defenses. Potential adversaries are likely to invest considerable resources on strategies— such as the use of special operations forces, terrorists, information attacks, or weapons of mass destruction—that will ensure that the USAF does not inflict so much damage at so low a cost in a future conflict.

PAF examined how potential adversaries could use readily available commercial and military technology to modify conventionally armed cruise and ballistic missiles to attack USAF aircraft on the ground at theater operating bases. It also considered what steps the USAF could take to minimize the threat of such attacks.

Emerging Threat Technology

Until recently, only a few nations had the technological sophistication necessary to develop ballistic and cruise missiles that were accurate and robust enough to be used effectively against military targets. Now, however, global positioning system (GPS) guidance devices provide a fairly cheap and effective way of improving the guidance system of the ballistic and cruise missiles used in most of the world. If missiles equipped with GPS guidance were armed with submunitions rather than unitary warheads, they could pose a serious threat to U.S. aircraft on the ground.

The study assumed that an adversary would use small, slow cruise missiles—i.e., unmanned aircraft designed to fly a one-way attack mission—to slip under the current USAF radar umbrella. These missiles are significantly different from the high-performance fighter-size weapons U.S. defenses were designed to detect during the Cold War. Because they are small aircraft that cruise at about 70 knots, they would be difficult for current air defense systems to detect. In fact, existing U.S. air defense systems are designed specifically to ignore aircraft traveling at this speed so that attacking aircraft can be distinguished from ground-vehicle clutter. Some systems can detect and track slower targets, but only in narrow sec-

tors and for short periods of time before the number of potential targets exceeds the system's data-processing and display capabilities.

Surface radars are less affected by ground clutter than are airborne radars, but they suffer from limited line of sight. Patriot and AEGIS could acquire and track a slow-moving cruise missile, but only above the radar horizon, which is less than 20 miles for a cruise missile flying at 100 to 130 feet.

Operational Impact

In the study's scenario, Iran uses an Iraqi succession crisis that has become a civil war as an opportunity to invade southern Iraq. The United States responds in a variety of ways, including deploying USAF combat aircraft to several bases on the Arabian peninsula: Dhahran, Doha, Riyadh Military, and Al Kharj.

These bases have a total of 14 potential parking areas with a total area over 44 million square feet—the equivalent of almost 1000 football fields. However, the number of GPS-guided cruise missiles armed with submunition warheads and ballistic missiles required to attack this area is remarkably small. Assuming a 20-foot lethal radius for the 1-lb submunitions and standard USAF aircraft-parking procedures, it would take only 30 M-9 and 30 M-18 ballistic missiles and 38 small cruise missiles to achieve a 0.9 probability of kill. The total cost of this force would be about $101 million.

Attacking the tent cities at all four bases and a Patriot or theater high-altitude air defense (THAAD) radar at each requires an additional 40 ballistic missiles and 8 cruise missiles, raising the total cost to about $163 million—about the cost of four Russian Su-27 export-version fighters. Such a force could destroy a large number of aircraft, living quarters, most personal equipment, and some work centers, and would have a devastating effect on USAF sortie generation.

Possible USAF Responses in the Short Term

To reduce the vulnerability of deployed forces to such a threat, the USAF could take a variety of actions over the next few years, including improving passive defenses, improving active defenses, and dispersing its operations. But some of these measures have serious drawbacks.

• To improve *passive defenses*, the USAF could construct hardened aircraft shelters and living facilities at likely deployment bases; acquire deployable

shelters; and construct more parking ramp space to spread out aircraft on the ground. These measures could be effective against GPS-guided missile attacks. However, hardened shelters and additional parking ramps are expensive and time-consuming construction projects, and they require the USAF to anticipate where it will fight the next war. Building deployable hardened shelters would allow for more flexible operations but would put a huge new burden on airlift.

*   Short-term *active defenses* against the small, slow cruise-missile threat could include relatively low-tech, simple measures such as putting machine-gun teams with night-vision goggles in towers surrounding USAF operating bases or deploying radar-guided guns. Target-area GPS jamming—both noise jamming and "smart" jamming—could also be an effective counter. Because a GPS signal is weak at the earth's surface, a low-power transmitter could probably jam GPS signals over a large area.

*   Another short-term alternative is to *disperse operations* to a large number of highway landing strips to complicate an adversary's targeting problem. But this option has several risks: it would increase U.S. exposure to terrorist or special operations attacks; it would not be effective against an adversary with access to good human intelligence or satellite capability; and it would require more personnel to achieve the same number of sorties, assuming other factors, such as range to target and availability of munitions, are equal.

Potential Long-Term Solution: Stand-Off Operations

Over the long term, another response to airbase vulnerability is to shift away from an operational concept that requires large numbers of fighters and their support aircraft and personnel to deploy to a combat theater. Instead, the USAF could conduct its air campaigns with a fleet of long-range aircraft operating from permanent bases. This strategy would require aircraft with very different characteristics from anything the USAF currently owns or plans to acquire.

Current combat aircraft probably could not sustain intense combat operations (defined as one sortie per day per aircraft) over a distance of more than about 2000 nmi. It takes about eight hours for an aircraft cruising at 500 knots to fly 2000 nmi—an extremely long mission for fighter crews. Figure 10 shows the areas within reach of such a force operating from four secure bases—three on U.S. territory (Anderson Air Force Base on Guam; Elmendorf Air Force Base outside Anchorage, Alaska; and Homestead Air Force Base near Miami, Florida) and one near London (Royal Air Force Lakenheath).
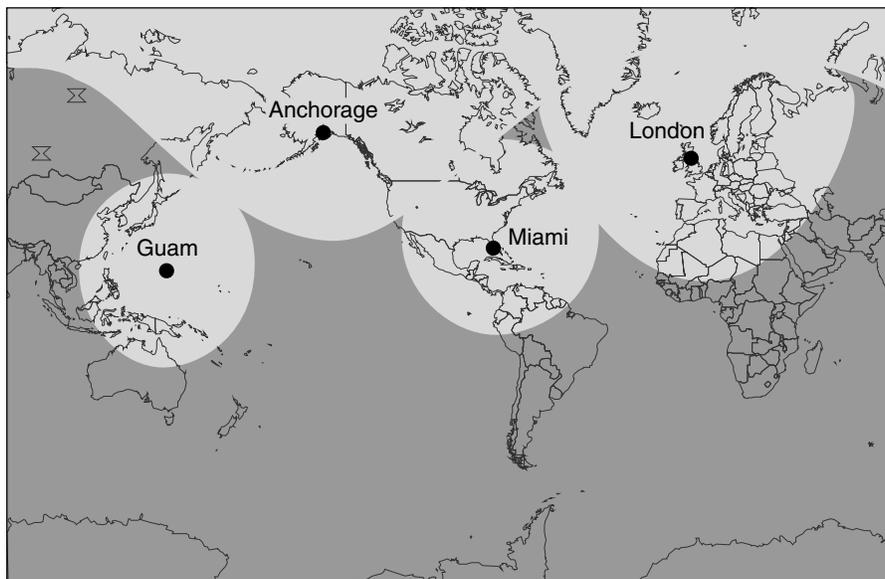
**Figure 10—Area That Current 500-Knot Fighter Forces Could Reach
from Four Secure Bases**

The study recommends that the USAF consider an operational concept for longer ranges centered on fast, long-range bombers. As shown in Figure 11, an aircraft with a 1000-knot cruise speed could cover virtually the entire inhabited earth's surface, except for the southern tips of Africa and South America, by operating from secure hardened bases at the same four sites.

An inventory of 80 to 105 Mach 2 bombers with the following specifications could deliver enough precision-guided munitions (about 560 tons per day) to replicate the USAF Desert Storm effort:

- A weight of 290,000 to 350,000 lbs
- An unrefueled range of 3250 nmi
- A payload of 15,000 to 20,000 lbs.

= Areas reached   = Areas not reached
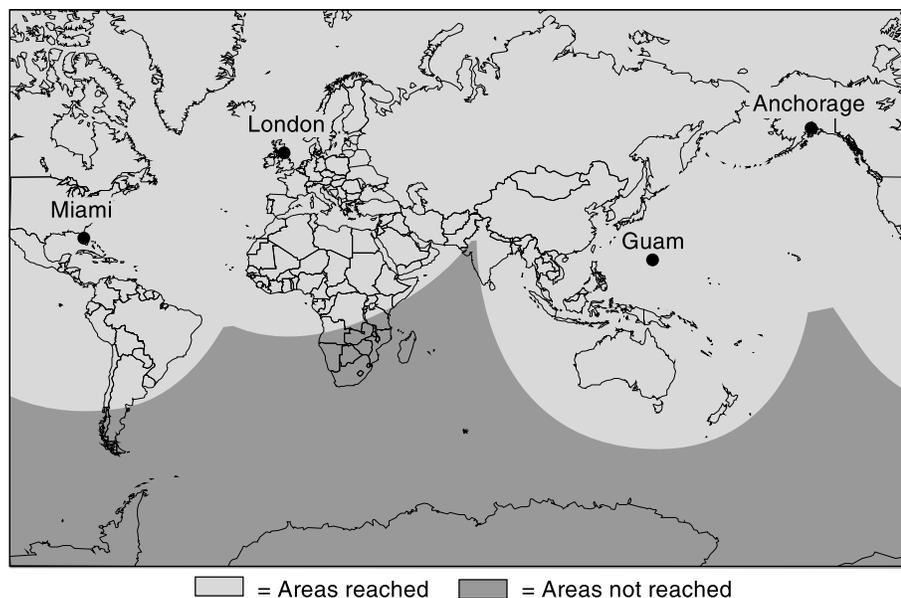
Figure 11—Reach of a 1000-knot Aircraft from Four Secure Bases

Such a concept would address the need to protect USAF assets from the ever-expanding range of enemy threat systems and ease the kinds of access burdens that have troubled U.S. power-projection operations in the past. More detailed research should be conducted that compares this concept with other options—such as 747 "arsenal planes"—in terms of technical feasibility, operational effectiveness, and cost.

The study does not offer an exhaustive discussion of how adversaries might attack theater airbases or how the USAF might defend against those attacks. Rather it argues for the need to begin the long process of planning required to counter just one such strategy: a rather simple and affordable approach to attacking USAF aircraft on the ground.

MR-1028-AF, *Airbase Vulnerability to Conventional Cruise-Missile and Ballistic-Missile Attacks: Technology, Scenarios, and U.S. Air Force Responses*, J. Stillion, D. Orletsky.

The Active/Reserve Mix: Mission Matters

As the nation's military adapts to the demands of a 21st century global environment, decisionmakers must consider the balance between active and reserve forces. That balance, which has important implications for the cost, effectiveness, sustainability, and national support of the Air Force, can change dramatically. From fiscal year 1988 to fiscal year 1998, the reserve component (Air Force Reserve and Air National Guard) grew from 25 percent to 33 percent of total Air Force personnel. Such changes are often influenced by many separate force structure decisions, made in isolation by a broad range of stakeholders who tend to advocate different active/reserve mixes.

To help achieve a more integrated approach, USAF leadership asked PAF to analyze two key questions: What active/reserve mix will maximize the Air Force's contribution to national defense? Do the many strategic changes the Air Force is facing favor a deliberate change to that balance?

PAF researchers created an analytic framework that can integrate accepted principles and relevant data into a practical decision tool. The work did not prescribe a specific active/reserve mix. However, testing with best-estimate data demonstrated the framework's ability to reveal tradeoffs. It also revealed that the ideal active/reserve mix can vary widely; the right mix depends on whether the Air Force needs to emphasize preparedness for major theater war or for the kind of small-scale contingencies that have dominated in recent years.

Driving Factors

The general principles that shape active/reserve decisions have been hammered out in policy deliberations but until now never placed into a unifying framework that makes their implications clear. And a few widely accepted principles turn out not to fit Air Force experience. Working with stakeholders and decisionmakers, PAF synthesized the implicit principles into six explicit and quantifiable factors:

- **Social considerations.** Reservists are more integrated into the larger society and more geographically representative than members of the active force. Thus they help increase public awareness and trust of military institutions.

- **Political considerations.** Reserve call-up is subject to stronger political constraints and thus links military involvement more closely to public support. Moreover, because reserve forces increase the number of veterans, understanding of military issues among voters and policymakers likewise increases.

- **Readiness.** In other military services, reserves may be less ready than active forces because training opportunities are limited. However, Air Force reservists have more training opportunities than other reserve forces do, as well as lower turnover and more weapon system experience than their active counterparts.

- **Availability.** Reserve forces rely heavily on part-time participants who have full-time occupations. There are strict statutory limits on how and for how long they may be called up involuntarily, as well as practical limits on how long and how often they can be used voluntarily. They are less available, particularly for needs other than major theater warfare.

- **Personnel flow.** Reserve forces depend on a flow of trained and acculturated personnel from active-duty forces. This ultimately limits the maximum size of the reserves.

- **Cost.** Many assume that reserve forces are always less costly. Total costs per unit or aircraft *are* much lower. But cost for equivalent outputs—for each day an aircraft with crew and support is available, for instance—can vary dramatically.

Each of these factors can be clearly related to a particular force-mix decision. In combination, they can clarify what balances of active and reserve forces can meet defined needs and what tradeoffs are available. Figure 12 shows how the factors combine to form a decision space—i.e., a conceptual range of possible active/reserve mixes. Each factor is mathematically represented as a line forming one possible boundary of the decision space.
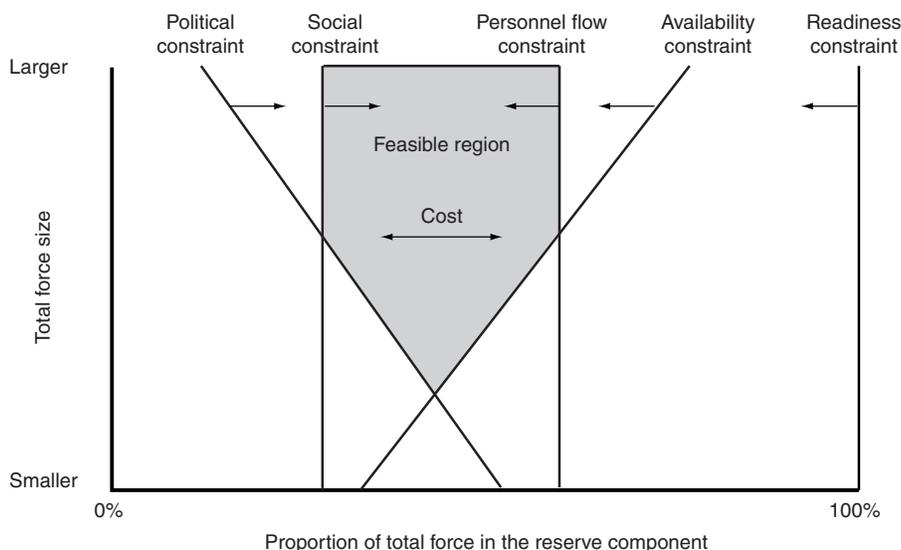
**Figure 12—A Framework for Considering Multiple Force-Mix
Principles Simultaneously**

Applying the Framework to Fighter and Airlift Units

Defining a conceptual range with actual numbers requires fairly detailed data, and it cannot be done for the force as a whole. Assessments must be made for each mission or mission design series individually. To test the framework, PAF applied it first to fighter force structure. At this stage, the researchers did not invest in deriving analytically rigorous inputs. Instead, they used available data and reasonable estimates. Thus, the study's results should not drive any particular force-mix decision, but they do highlight three broad findings that many will find surprising.

In the Air Force, active and reserve components are equally ready. Modern air reserve assets receive much praise for their combat effectiveness because they performed with little difference from active units in Operations Desert Shield and Desert Storm, in peacetime contingency deployments, in operational readiness inspections, and in combat crew competitions. This performance is driven, at least in part, by the reserves' higher average career flying experience and greater time with their units. As anticipated shortages of active component pilots emerge, such differences will increase.

Reserve forces are less available for contingencies. For major theater war sce-
narios, active and reserve forces are essentially equally available; reserve units
can be written into operations plans as active units are. But sustained deploy-
ments, such as those related to peacekeeping in Bosnia or enforcement of no-fly
zones in Iraq, create different demands. In such cases, the reserves participate in
a nonmobilized status. Statutory constraints then make them considerably less
available than otherwise equivalent active forces.

***Cost considerations cut in opposite directions for major theater war versus
peacetime contingencies.*** Although force structure costs less in the reserves, for
military planning the cost of equivalent outputs is more relevant and more com-
plex. For major theater war, when reserve availability is equivalent to active, the
reserve component is *less* expensive per unit of output. But for contingencies
and other situations where reserve availability is limited, these forces can cost
substantially *more* for equal military impact.

Figure 13 depicts the quantitative result: the PAF decision framework applied to
fighter force structure in the Air National Guard. Based on the estimated data
used in this research, the reserves might occupy between 20 and 42 percent of the
total fighter force while satisfying all tradeoff factors. Within this range, cost-
conscious decisionmakers would gravitate toward a 42 percent mix if they were
primarily concerned about major theater war or toward a 20 percent mix if they
were more concerned about current contingency deployments.

Even if the analysis were based on precise, rather than estimated, data inputs,
these particular results would apply only to fighter units. Output and other con-
siderations vary by mission. For fighter units, it might be the number of deployed
aircraft-days per unit of time, while for airlift units, it might be flying hours devot-
ed to nontraining missions. These differences affect the ultimate force mix. Based
on the approximations used in this study, a decisionmaker preparing for contin-
gencies would place only 20 percent of the fighter force in the reserve component
but would split airlift resources equally between active and reserve associate units.

How Can the Air Force Improve the Active/Reserve Balance?

For the Air Force, the direction in which cost drives the force mix depends on the
need being met. At any given budget level, providing the greatest military capac-
ity for peacetime operations and small-scale contingencies requires a different
force mix than that which would best prepare the Air Force for major theater
war. To make this tradeoff requires balancing the risks and benefits in each set
of scenarios, a task of military strategy compounded by the uncertainty
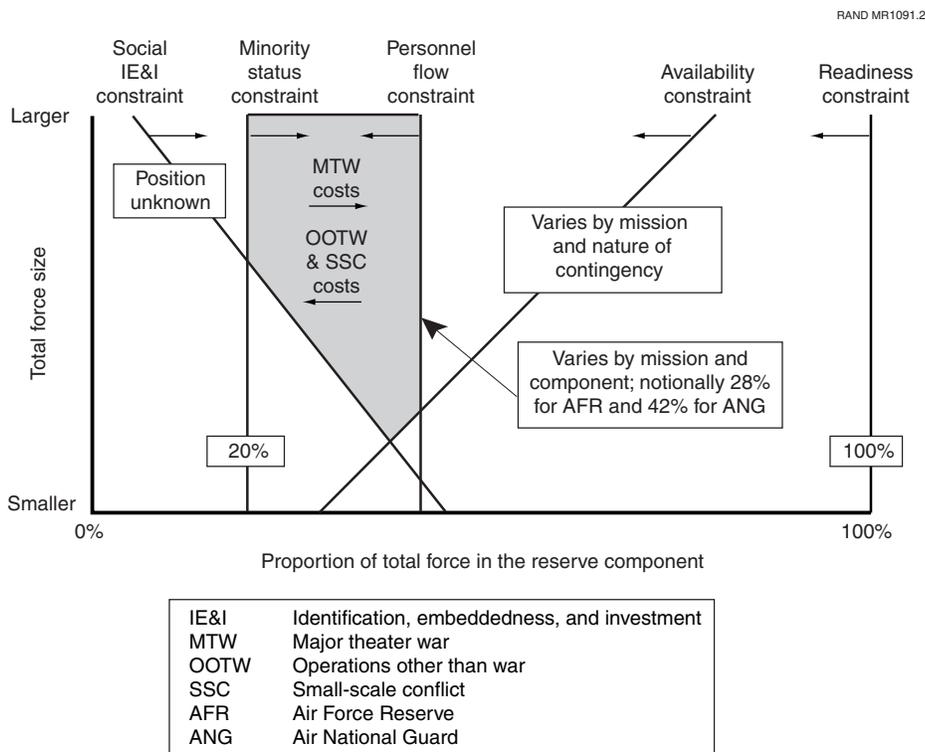
Figure 13—Notional Values for Force-Mix Constraints:
An Air National Guard Case

about how much capacity would be required in either case. PAF believes that additional analysis could make the tradeoff somewhat easier by producing a comprehensive set of frameworks for each mission or mission design series and populating those frameworks with detailed, high-quality data. They could then be used, along with estimates of expected operational demand, to quantify likely risks and stresses. PAF also believes that, although Air Force and other decision-makers must weigh the tradeoffs between preparing for contingencies and preparing for major theater war, peacetime contingency demands should be given greater weight in force-mix decisions, especially for aviation communities that experience high-deployment-related stress.

MR-1091-AF, *Principles for Determining the Air Force Active/Reserve Mix*, A. A. Robbert, C. R. Cook, W. A. Williams.

The Loss of Experienced Pilots: A Crisis for the Operational Units?

The Air Force is confronting a pilot shortage that is unprecedented in its peace-time history. As shown in Figure 14, the FY 1999 shortfall exceeded 1200 pilots; and by FY 2002 it is projected to grow to about 2000 pilots, almost 15 percent of the total requirement. (The next most serious peacetime pilot shortage, which occurred in 1979, was only 5.6 percent of the requirement.) Since FY 1997, the loss rate for pilots reaching the end of their initial active-duty service commitment—approximately the tenth year of service—has averaged close to 70 percent, higher than it has ever been except in periods of demobilization or drawdown.

RAND DRR2192
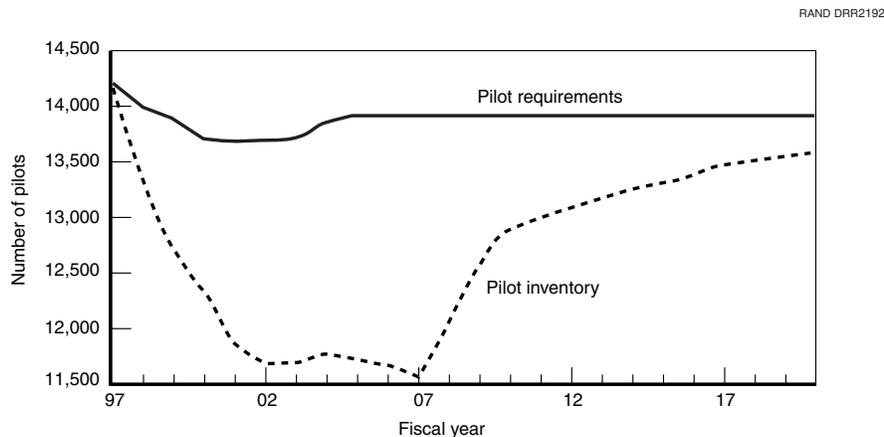
NOTE: Assumes 1100 new pilots per year.

Figure 14—Pilot Inventory Is Dropping Sharply and Remains Below Requirements

Also unprecedented is the loss rate for pilots who have reached their 15th year of service but are not yet eligible for retirement. They are now exiting at a rate of almost 25 percent. The previous high for this group was 7 percent during the drawdown when pilots were offered monetary incentives to separate from the service. Prior to that time, these loss rates were between 1 and 2 percent. The combined effect since FY 1997 is that three pilots have left active duty for every two new pilots that the Air Force has trained. And half of the shortfall is among fighter pilots, thus making the situation even more grave because of its implications for readiness and combat capability.

PAF conducted research to help the Air Force understand the nature of the retention problem and to suggest ways to mitigate it. As part of that effort, researchers used an operational training unit model they had developed to quantify training needs. They also investigated the relationship of commercial airline growth to military pilot retention, and they examined ways in which the extensive experience of air crews in the Air National Guard and Air Force Reserve might be tapped to help alleviate the retention problem.

Why Are Pilots Leaving the Air Force?

The Air Force has polled exiting pilots to learn the reasons for their departure. Responses appear to cluster in two key areas. First are the negative effects of frequent deployments, frequent moves, long separations from families, and other quality-of-life issues.

Second is the allure of commercial airline careers. Air travel has become a staple of modern American life, and the resulting upsurge in revenue passenger miles and equipment is likely to continue unabated for the foreseeable future. Because of the extent and quality of their training and experience, military pilots are highly sought after by the major carriers and thus have a distinct edge in the hiring process. This advantage is further compounded by the fact that the supply of available military pilots falls far short of meeting the projected demand of commercial carriers, so there is a ready market at all times.

Recently, many of the major airlines have essentially eliminated maximum-age limits for new pilots and lower pay scales for older candidates. Recognizing the mutual benefits of this policy change, the Air Force is exploring initiatives that will encourage pilots to defer their pursuit of airline careers until they are eligible for retirement. One such program, PHOENIX AVIATOR, helps active-duty pilots enhance their appeal to the major airlines by ensuring that they retire with specific Federal Aviation Administration credentials and recent flying experience. The airlines have enthusiastically embraced this program, and many of them have agreed to guarantee employment interviews for participating pilots.
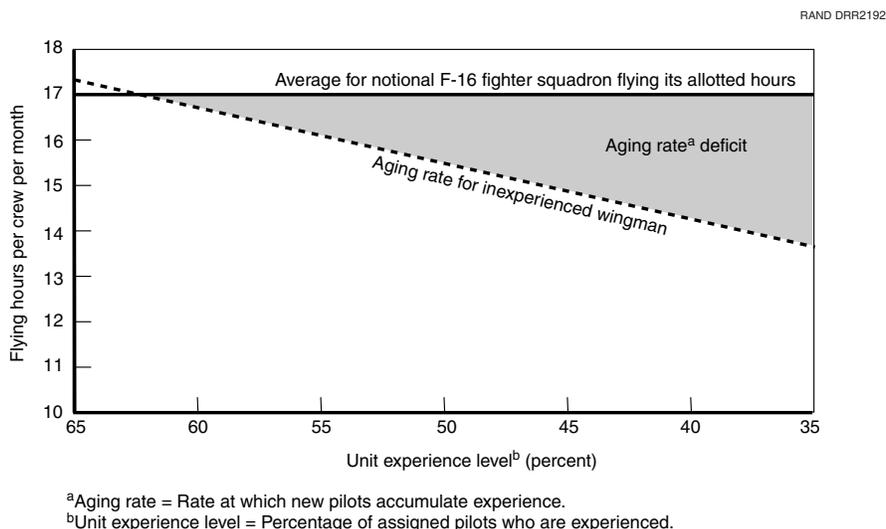
How Does a Shortage of Experienced Pilots Affect the Operational Units?

It might seem that an obvious solution to the retention problem is to recruit and train more new pilots. However, the answer isn't so simple. To function effectively,

the Air Force's operational units must have the proper experience mix. Inexperienced pilots are those who are learning their mission and whose perform-ance must be constantly monitored. They fly in operational units as wingmen (in fighter units) or as copilots (in bomber or transport units) under the direct supervi-sion of a flight leader or an aircraft commander. Experienced pilots are basically those who have completed one three-year operational tour in their mission aircraft.

If there are insufficient numbers of experienced pilots to fill the cockpits in oper-ational units, then unit readiness and operational capability suffer because of the reduction in available crews. Moreover, when the experience level drops within a unit, the reduced number of flight leaders and instructor-pilots must each fly significantly more sorties to provide essential supervision to the increased num-ber of inexperienced pilots who are flying primarily as wingmen. If sortie pro-duction and aircraft utilization rates remain fixed—which is likely because of budgetary constraints and maintenance issues—wingmen fly less and therefore develop more slowly than the Air Force desires.

PAF analyzed the effect of unit experience levels on the rate at which pilots "age"—i.e., accumulate experience. Researchers found that, at levels below about 60 percent, flight leaders and instructor-pilots individually must fly more than the inexperienced wingmen do. Figure 15 illustrates the "aging rate deficit" that results from this imbalance. A squadron with an aging rate deficit cannot turn inexperienced pilots into experienced ones at the programmed rate, even when it is flying its specified total number of hours per crew per month.

RAND DRR2192

aAging rate = Rate at which new pilots accumulate experience.
bUnit experience level = Percentage of assigned pilots who are experienced.

Figure 15—The "Aging Rate" Drops Rapidly as the Experience Mix Falls

If the aging rate deficit is ignored and the assumption is made that inexperienced pilots are developing as expected, the squadron's experience level over time appears to level off (see Figure 16). However, when the aging rate deficit is taken into account, it becomes clear that the unit's overall experience level is on a path down a slippery slope.

RAND DRR2192

NOTE: Assumes 370 new pilots per year in fighter units.
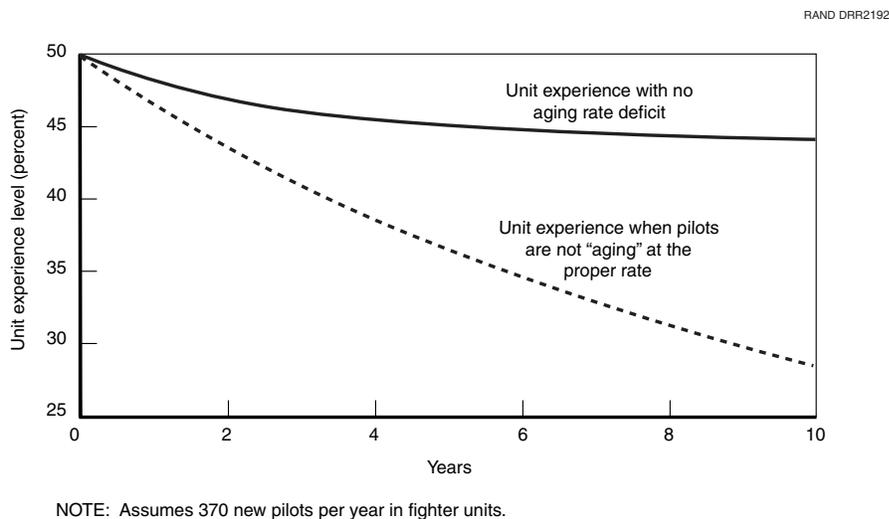
Figure 16—The Aging Rate Deficit Creates a Dangerous Problem

What Can the Air Force Do to Maintain an Acceptable Mix of Experienced and Inexperienced Pilots?

There are a limited number of options for controlling experience levels in operational units. One of those options is to fly enough additional hours to eliminate the aging rate deficit. However, as previously suggested, there are practical constraints that make it difficult not only for the Air Force to program additional flying hours into its budget but also for the units to fly more hours even if they could be funded.

Another approach is to train fewer new pilots, but this would hardly seem to be the preferred long-term solution to a pilot shortage problem. Therefore, PAF sought alternatives that would yield similar advantages without reducing fighter-pilot production levels. Because new pilots must be absorbed into operational units, and because such units in the Air National Guard and Air Force Reserve have much higher experience levels than active units do, PAF examined several Total Force approaches.

Assuming a production requirement of 370 new fighter pilots per year, researchers found that, if 40 inexperienced active-duty pilots were trained in Guard or Reserve units, the effects of the aging rate deficit could be virtually eliminated (see Figure 17).[4]

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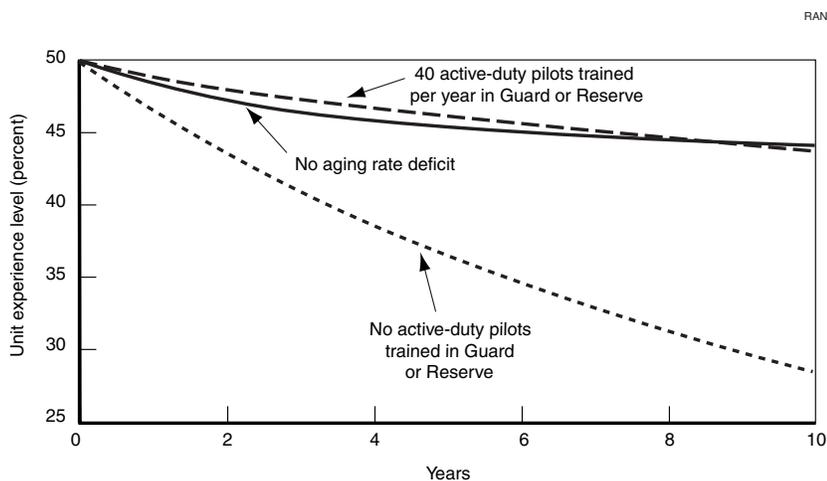
Figure 17—Training 40 Pilots per Year in the Guard or Reserve Essentially Eliminates the Effect of the Aging Rate Deficit

The study team also suggested that the Air Force consider programs that would place experienced Guard and Reserve "associate pilots" in active-duty units. Both of these alternatives show promise, but they must be implemented carefully and evaluated thoroughly to deal with cultural issues and prevent unintended consequences. This care and diligence must be exercised quickly while there is still a relatively large pool of pilots leaving active duty.

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[4] It should be noted that the Air Force attempted a similar approach in the past—the Project Season initiative—and encountered difficulties. However, PAF researchers believe that the important lessons learned from that attempt can be used to guide an effective future implementation of this option.

DRR-2192-AF, *The Loss of Experienced Air Force Pilots*, W. W. Taylor, C. R. Roll, S. C. Moore.

The Changing Role of Information in Warfare

Threats to U.S. information systems have become an issue of national importance. As break-ins to the Department of Defense and other sensitive computer systems have made headlines, a recent presidential commission documented the widespread vulnerability of various critical information infrastructures, ranging from the financial system to the air traffic control system. In response to these developments and to the report of the commission, President Clinton has announced the goal of building "the capability to protect critical infrastructures from intentional acts by 2003." The Joint Chiefs of Staff have recognized the vulnerability of the military to information attacks and have emphasized the need for "full dimensional protection." As a first step toward achieving these objectives, PAF conducted a strategic appraisal of the changing role of information in warfare. The findings of the appraisal are discussed below in three broad categories.

Evolution of Warfare

Much has been written and said about the "information revolution" and an information-driven "revolution in military affairs." If recent progress in the development and commercialization of information technologies is truly revolutionary, we might expect far-reaching consequences for societies and the competition and conflict among them.

First, the major challenge for the U.S. armed forces will be serving a changed society that has new and different expectations, assignments, and support for those forces. Much of the attention so far to advanced information technology and the military has been directed to the application of new tools to fighting traditional kinds of wars. This attention may well be misplaced. The information revolution, in shifting power from nation-states to nonstate groups and individuals, may fundamentally alter the nature and means of conflict. The challenge the information revolution poses for the American military is thus not so much in applying the new technology as anticipating the new military enterprises that might arise. What those new enterprises might be is difficult to predict, but they are not likely to include, for example, deterrence, since nonstate actors have little to lose.

Second, to whatever extent that nation-states retain power and the potential for interstate conflict, it will not be long before geostrategic face-offs between open- and closed-system global powers disappear. For example, we are not likely to see a new Cold War, with China taking the place of the Soviet Union. The reason is that national military and economic power accrues to those at the forefront of the information revolution, and the information revolution has been driven by free markets and freedom of expression. Nations not choosing the path of free markets and open societies will not be able to keep up with those that do; they will always be playing catch-up. They will fall outside the circle of global powers and remain there. There may be dissension within that circle and dangers from without, but there will be powerful incentives for community and partnership among the global powers and for other nations to join the circle.

Third, the dangers from without will evolve—and in the cyberspace era, "without" will not always refer to national borders. Terrorist groups and related non-state challengers to the United Sates and its allies are already changing their objectives from coercing specific actions to wreaking damage and widespread disruption on a more warlike footing. They may thus be more interested in the use of weapons of mass destruction and in targeting military assets. They are also switching from hierarchical structures to networks. These network structures are facilitated by the use of advanced information and communication technologies. The redundancy and diversity within networks makes them robust and resilient, and networks are adept at exploiting strategies—such as "swarming" and blurring offense and defense—that are difficult for hierarchically structured adversaries to cope with. The lesson for the United States is that it takes networks to fight and win against networks.

Not all experts agree, however, that there is really a revolution going on. Some claim that, although revolutions are hard to identify while in progress, none of the social or military reinventions that characterize true revolutions is yet apparent. There are not the kind of productivity improvements necessary for dramatic improvements in economic power. There is insufficient evidence to suggest that current political and military structures cannot adapt to the new information technologies. And sweeping force structure changes are unlikely to occur without a compelling geostrategic imperative, which has not yet emerged. This is not an academic debate or a quarrel over semantics. As suggested above, a revolution demands revolutionary changes if the United States is to remain secure. But if sweeping changes in U.S. armed forces are made for insufficient cause, such changes will put at risk the forces' ability to dominate opponents.

U. S. Opportunities and Vulnerabilities

Whether a true information "revolution" is under way and, if so, how to react are important questions to resolve in planning U.S. defense and military strategy over the long term. In the shorter term, there is no doubt that advances in information technologies present both opportunities and vulnerabilities for U.S. society and military forces.

With respect to prospective theater conflicts, the armed forces of the United States have entered an era in which they can expect to have a substantial margin of superiority over their enemies in terms of their ability to "see" and understand what is happening on the battlefield. At the engagement level, the ability to put more information and processing ability into "smart" munitions will make fires increasingly effective and allow delivery platforms to do more per unit of time. At the tactical level, forces with current, accurate information should have heightened situational awareness and thus face fewer losses. At the operational level, information will make it possible to have a greater proportion of the force engaged against valuable enemy targets, thus permitting greater concentration of forces in both offensive and defensive operations. For the present and near future, the United States thus appears to have a distinct advantage in almost all areas of the struggle for information dominance.

Given overwhelming U.S. dominance on the conventional battlefield, U.S. military strategists and planners anticipate that future antagonists will not challenge the United States in open battle but through various asymmetric strategies—both physical and cyber related. Physical strategies include attainment of niche capabilities such as gaining access to satellite imagery and communications and building up inventories of nuclear, chemical, or biological weapons and the means to deliver them. They also include strategies targeting key U.S. vulnerabilities—for example, short-warning attacks, anti-access operations, and deep-strike operations. Offensive information warfare has a role to play in countering these strategies. Several operational concepts are possible. For example, the United States could undertake information-based deterrence by attempting to turn international opinion against the aggressor, altering his perception of the correlation of forces, or fostering instability in his homeland. U.S. strategic reach could be preserved by attacking the enemy's integrated air defense systems: sensors could be degraded or false or deceptive information planted in communication links or data-processing components. Other offensive information attacks could be mounted to thwart enemy strike planning, assessment, and execution or intelligence, surveillance, and reconnaissance capabilities.

The other set of asymmetric strategies comprises cyberspace attacks against U.S. civil systems (communications, physical distribution, energy, etc.) and military systems. In the case of Air Force systems, computers involved in combat operations are isolated from insecure networks and are therefore not very vulnerable. That is not the case, however, for computers involved in logistics functions. Communication systems are also vulnerable. Nonetheless, simulations show that delays in deployment and operations caused by cyberattacks are unlikely to reverse the enormous U.S. advantage in future major conflicts. Lesser operations, however, could be more sensitive to such attacks. Various inexpensive improvements to military-computer security and the public telephone network should mitigate some obvious vulnerabilities. More comprehensive security enhancements would be more expensive and, in some cases, require further research and development.

Issues and Lessons for Decisionmakers

Considering the great uncertainty regarding the outcomes or even the very existence of a true information revolution, what should the United States do in response to those opportunities and vulnerabilities that are well established? The PAF strategic appraisal answered this question in four ways: What the government should do to protect information systems in the civil sector, what it should do by way of its national-security function, what structural steps the military might take, and how the Air Force should define its role.

The first thing to realize is that no government or private entity is likely to be able to completely protect its systems from information attacks; that is, it will not be possible to eliminate all vulnerabilities. In regard to the civil sector, then, it may be optimal for system owners to bear the costs of protection, given the government's inability to make any guarantees. The government, it might be argued, should limit itself to protecting its own systems, enforcing laws against hacking and spectrum abuse, promoting interoperability and security standards, investing in research and development related to information security, and establishing an incident clearinghouse. The government might also generate attack warnings, though that would be helpful only if such warnings were credible; and it might foster international norms and cooperation, though this could work against maintenance of U.S. information dominance. Other actions might include identification of a minimum essential information infrastructure and reduction of legal liability for security auditors and network owners.

To the extent that military assets are targeted by information warriors and that civil-sector assets are viewed as vital to national security, the government has a responsibility to act in their defense. The first step is, again, to protect such systems from attack by eliminating as many vulnerabilities as possible. But the limitations of a purely protective strategy will also require that adversaries be deterred from using information weapons and prevented from developing the capability to produce or use such weapons. Deterrence implies the ability to identify attacks and determine the parties responsible and the will to retaliate. Prevention implies the ability to identify potential attackers, define and recognize whatever warning signals may indicate an upcoming attack, and use offensive information warfare techniques to disable attack assets.

What does the changing role of information in warfare imply for military organization? The corporate world has already begun reorganizing in response to advances in information technology. While there are important differences between the private sector and military enterprises, a few lessons seem applicable to the DoD. First, to take full advantage of information technology, the military will need to institutionalize an environment of constant learning, one that includes the freedom to fail without serious consequences. Second, skills and authority should be redistributed toward the bottom of the hierarchy, and more autonomy should be given to lower levels of the military. Third, the debilitating and seemingly intractable problem of streamlining the procurement system must be solved to allow the military to benefit from cutting-edge commercial technology.

And what of the Air Force's role? The Air Force came into existence to extend the nation's defenses to a new medium of human activity—the air. When it became possible to exploit a further medium—space—the Air Force took the primary defense role there, too. Cyberspace is the latest medium of human endeavor. Should the Air Force, perhaps the most technologically oriented of the nation's services, take the lead role in information warfare also? The PAF strategic appraisal answered this question "yes" and "no." The best places for the Air Force to build up and defend unique core competencies appear to lie in unit-level operations against enemy information systems and in the care and maintenance of the top-level "system of systems." By contrast, the case for centralizing tactical-system defense and understanding adversary decision processes under Air Force control will be harder to make.

MR-1016-AF, *Strategic Appraisal: The Changing Role of Information in Warfare*, edited by Z. M. Khalilzad and J. P. White.

Publications

MR-581-AF, *Lean Logistics: High-Velocity Logistics Infrastructure and the C-5 Galaxy*, T. L. Ramey.

This report considers the effects on operation of the C-5 Galaxy of radically reducing the time required to move and repair components of that airlift aircraft. It is part of a body of research defining and evaluating the concept of Lean Logistics for the U.S. Air Force. The analysis uses Air Force data to drive simulations of C-5 logistics operations and considers peacetime flying programs. This study finds that a high-velocity infrastructure would provide C-5 performance that is the same as or better than that provided by the current infrastructure across a wide range of conditions and circumstances. A high-velocity infrastructure would require only one-sixth the amount of inventory at one-third the cost of the current infrastructure.

MR-895-AF, *The Changing Role of the U.S. Military in Space*, D. R. Gonzales.

Growth in the technical capabilities of commercial and foreign space systems, potential exploitation of space by adversaries, increasing use of commercial space capabilities by U.S. forces, and continuing budget constraints are all changing the role of the U.S. military in space. The growth of commercial space markets, and the rapid privatization and increasing foreign ownership of commercial space assets, suggest that the Department of Defense must develop a long-term strategy to ensure adequate and secure access to commercial communications satellites and other commercial space resources. Space control will assume increasing importance in military operations, and space itself may become a theater of military operations. The United States should develop a long-term strategy to enable the U.S. military to deny space capabilities to potential adversaries. Such a strategy should rely on system or operational concepts that minimize collateral damage to commercial, civil, and third-party space assets and that do not violate existing arms control agreements or treaties. Space surveillance—the ability to precisely identify, track, and predict the position of objects in space—is an essential aspect of space control. Space control and changing space surveillance needs have implications for the Air Force as an institution.

MR-939-AF, *The Cutting Edge: A Half Century of U.S. Fighter Aircraft R&D*, M. A. Lorell, H. P. Levaux.

The proposition that innovation is critical in the cost-effective design and development of successful military aircraft is still subject to some debate. RAND research indicates that innovation is promoted by intense competition among three or more industry competitors. Given the critical policy importance of this issue in the current environment of drastic consolidation of the aerospace defense industry, the authors here examine the history of the major prime contractors in developing jet fighters since World War II. They make use of an extensive RAND database that includes nearly all jet fighters, fighter-attack aircraft, and bombers developed and flown by U.S. industry since 1945, as well as all related prototypes, modifications, upgrades, etc. The report concludes that (1) experience matters, because of the tendency to specialize and thus to develop system-specific expertise; (2) yet the most dramatic innovations and breakthroughs came from secondary or marginal players trying to compete with the industry leaders; and (3) dedicated military R&D conducted or directly funded by the U.S. government has been critical in the development of new higher-performance fighters and bombers.

MR-956-AF, *Changes Ahead: Future Directions for the U.S. Overseas Military Presence*, R. L. Kugler.

U.S. military forces stationed abroad play vital roles. As regional political and military dynamics shift, so too will the United States need to adjust its overseas military posture to accommodate new objectives and missions in new places. In general, that posture will need to become more flexible and more expeditionary, covering a wider array of challenges and broader geographic areas. Such changes can be unsettling to accomplish and may even worry allies and friends. Yet the United States cannot adequately reassure foreign countries with an outdated force posture. Planning for these changes should not be based on marginal adjustments to arbitrary manpower levels but should assess strategic objectives, missions, and requirements before considering the implications for manpower, units, activities, and money. This planning also should establish coherent goals and orderly means of reaching them, rather than muddle along in incremental ways that lack direction or can be blown off course by the shifting political winds. This study offers eight options that can be used to help guide thinking and planning for the coming era of change.

MR-958-AF, *To Find, and Not to Yield: How Advances in Information and Firepower Can Transform Theater Warfare*, D. A. Ochmanek, E. R. Harshberger, D. E. Thaler, G. A. Kent.

Absent significant changes in U.S. defense investment priorities, American forces could soon find themselves unable to cope with some emerging challenges in large-scale power projection operations. Specifically, U.S. forces will need better capabilities to secure a foothold in distant theaters, to defeat weapons of mass destruction and their delivery vehicles, to gain control of operations in the air, and to locate and destroy invading ground forces. New surveillance sensors, information processing capabilities, communication systems, and guided munitions are enabling operational concepts that can allow U.S. forces to meet emerging challenges and, indeed, to adopt new approaches to warfare. The authors assess quantitatively the capabilities of U.S. forces in the context of a generic scenario depicting a large-scale war in the next decade. From this, they identify priorities for modernizing U.S. forces. They argue that modernization dollars should be focused on forces and enabling capabilities that allow for decisive operations early in a conflict. If necessary, funds for such enhancements can come from modest reductions in forces that are slower to deploy.

MR-983-AF, *Investment Guidelines for Information Operations: Focus on Intelligence, Surveillance, and Reconnaissance* (U), M. Hura, G. McLeod, R. Mesic, D. Gonzales, M. Eisman, P. Feldman, G. P. Frost, J. Jacobs, C. Lampard, D. McCusker, B. Schweitzer, L. Teitelbaum, T. Bonds, E. Larson, C. Shipbaugh, N. Trongale, J. Godges. Classified.

MR-989-AF, *Countering the New Terrorism*, I. Lesser, B. Hoffman, J. Arquilla, D. Ronfeldt, M. Zanini.

The contours of terrorism are changing, and the new terrorism has more diverse sources, motivations, and tactics than the old. It is more lethal, global in reach, and characterized by network forms of organization. Terrorist sponsorship is becoming hazier and "privatized." The August 1998 terrorist bombings of U.S. embassies in Kenya and Tanzania fit in many ways the new mold. The chapters in this book trace the evolution of international terrorism against civilian and U.S. military targets, look ahead to where terrorism is going, and assess how it might be contained. Terrorism and counterterrorism are placed in strategic perspective, including how terrorism might be applied as an asymmetric strategy by less-capable adversaries. The report builds on a existing body of RAND research on terrorism and political violence, and makes extensive use of the RAND–St. Andrews Chronology of International Terrorism.

MR-1006-AF, *Defining a Common Planning Framework for the Air Force*, L. Lewis, B. Pirnie, W. Williams, J. Schrader.

Within the Air Force, resourcing requirements and recommended allocations are developed within the Major Commands (MAJCOMs), and the corporate Air Force has few mechanisms that allow it to look across all Air Force requirements and set institutional priorities. RAND was asked to develop a common planning framework that could extend across the Air Force, allow better coordination of requirements and options, incorporate the Air Force "vision," and link to the external environment. The strategies-to-tasks methodology would provide the framework's foundation. Eventually, it was determined that the proposed planning areas were confusing and that all planning and programming should be based on Air Force core competencies. Other means have been implemented to strengthen existing processes to ensure that cross-cutting issues are raised and that horizontal integration across MAJCOMs takes place. Although the Air Force chose not to implement the proposed common planning framework, the effort is documented to contribute to the field of defense planning and programming.

MR-1016-AF, *Strategic Appraisal: The Changing Role of Information in Warfare*, edited by Z. M. Khalilzad and J. P. White.

Advances in information technology have led us to rely on easy communication and readily available information—both in our personal lives and in the life of our nation. For the most part, we have rightly welcomed these changes. But information that is readily available is available to friend and foe alike; a system that relies on communication can become useless if its ability to communicate is interfered with or destroyed. Because this reliance is so general, attacks on the information infrastructure can have widespread effects, both for the military and for society. And such attacks can come from a variety of sources, some difficult or impossible to identify. This, the third volume in the Strategic Appraisal series, draws on the expertise of researchers from across RAND to explore the opportunities and vulnerabilities inherent in the increasing reliance on information technology, looking both at its usefulness to the warrior and the need to protect its usefulness for everyone. The Strategic Appraisal series is intended to review, for a broad audience, issues bearing on national security and defense planning.

MR-1028-AF, *Airbase Vulnerability to Conventional Cruise-Missile and Ballistic-Missile Attacks: Technology, Scenarios, and U.S. Air Force Responses*, J. Stillion, D. Orletsky.

As part of a two-year effort to develop an expansive construct of air and space power in the early twenty-first century that capitalizes on forthcoming air and space technologies and concepts of operation and is effective against adversaries with diverse economies, cultures, political institutions, and military capabilities, the research team investigated the possibility that future adversaries might be able to mount effective missile attacks on U.S. Air Force (USAF) main operating bases in critical regions. This report does not assess the relative vulnerabilities of various force elements and facilities; instead, it aids the USAF in addressing a potential vulnerability of its in-theater bases: highly accurate attacks against USAF aircraft on parking ramps at such bases made possible by the proliferation of Global Positioning System (GPS) guidance and submunition warhead technologies. If such attacks are feasible, the current USAF operational concept of high-tempo, parallel strikes from in-theater bases could be put in jeopardy. This report concludes that these guidance and munition technologies could, in fact, put USAF bases at serious risk. The report describes the threat technologies and concept of operation in detail, then explores both short-term responses—such as putting machine-gun teams equipped with night-vision goggles in towers around the bases—and long-term responses—such as operating anywhere in the world from a few secure, hardened, fixed bases with guaranteed access—to these threats.

MR-1045-AF, *Chinese Policy Toward Russia and the Central Asian Republics*, M. Burles.

This report examines the foundation of China's policies toward Russia and the five republics of Central Asia, identifies the combination of issues and environmental conditions likely to shape the policies' evolution, and assesses their potential impact on regional or global U. S. interests. After discussing why China has improved its relations with Russia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, the report describes the goals of Chinese policies toward these countries, highlighting the wide range of issues and interests involved. The report next examines the prospects for Sino-Russian and Sino-Central Asian relations, and how the development of these relations might affect U. S. interests. China's relationships with the Central Asia Republics pose fewer potential problems for U. S. interests than does its relationship with Russia. There is little threat of China dominating the region in a manner that would restrict U. S. access to energy resources. Other aspects of China's relationship with the Central Asian states might become problematic; for example, land-

based transportation links through Central Asia to the Middle East may facilitate greater economic, political, and military cooperation between Beijing and regional regimes that are hostile to the United States.

MR-1056-AF, *Supporting Expeditionary Aerospace Forces: An Integrated Strategic Agile Combat Support Planning Framework*, R. S. Tripp, L. A. Galway, P. S. Killingsworth, E. Peltz, T. L. Ramey, J. G. Drew.

A key challenge facing the future Air Force is how to nearly continuously deploy relatively small-scale forces for peacekeeping and humanitarian relief missions while maintaining the capability to win major theater wars. In response to this challenge, the Air Force has developed the concept of an Expeditionary Aerospace Force (EAF) to deal with the range of expected missions. The report argues that this new concept requires a complete reexamination of the combat support system, especially the planning framework for combat support. This framework must integrate logistics, mobility, and operational planning across echelons, commands, and phases of warfare. The report discusses how integrated Agile Combat Support (ACS) planning aimed at mid-term or strategic decisions can enhance the effectiveness and efficiency of EAF operations. The authors provide an example of use of the ACS planning framework to evaluate support alternatives for a strike AEF deployment to Southwest Asia, addressing aviation support, reparable avionics components, and munitions.

MR-1061-AF, *Air Power as a Coercive Instrument*, D. L. Byman, M. C. Waxman, E. V. Larson.

Coercion—the use of threatened force to induce an adversary to change its behavior—is a critical function of the U.S. military. U.S. forces have recently fought in the Balkans, the Persian Gulf, and the Horn of Africa to compel recalcitrant regimes and warlords to stop repression, abandon weapons programs, permit humanitarian relief, and otherwise modify their actions. Yet despite its overwhelming military might, the United States often fails to coerce successfully. This report examines the phenomenon of coercion and how air power can contribute to its success. Three factors increase the likelihood of successful coercion: (1) the coercer's ability to raise the costs it imposes while denying the adversary the chance to respond (escalation dominance); (2) an ability to block an adversary's military strategy for victory; and (3) an ability to magnify third-party threats, such as internal instability or the danger posed by another enemy. Domestic political concerns (such as casualty sensitivity) and coalition dynamics often constrain coercive operations and impair the achievement of these conditions. Air power can deliver potent and credible threats that foster the

above factors while neutralizing adversary countercoercive moves. When the favorable factors are absent, however, air power—or any other military instrument—will probably fail to coerce. Policymakers' use of coercive air power under inauspicious conditions diminishes the chances of using it elsewhere when the prospects of success would be greater.

MR-1074-AF, *NATO and Caspian Security: A Mission Too Far?* R. Sokolsky, T. Charlick-Paley.

This report attempts to put the Caspian Basin and Central Asia into a comprehensive strategic perspective at a time when NATO is increasingly concerned with challenges on its periphery. The authors examine NATO's interests, capabilities, and constraints as well as the salient trends and factors shaping the regional security environment. In spite of the region's potential energy riches and the jockeying for influence among major powers and oil interests, the authors suggest that NATO should see the region as a potential quagmire rather than as a vacuum waiting to be filled. The report discusses Western objectives and interests in the Caspian, internal and intraregional threats to Western interests, the competition for influence among outside powers, transnational threats, Caspian oil and energy security, and implications for NATO and Western policy and planning. The authors conclude that the West has limited interests and leverage in the Caspian Basin, and the Alliance should focus on promoting the restructuring and professionalization of indigenous armed forces, while resisting new commitments and security responsibilities in the region.

MR-1082-AF, *The United States and a Rising China: Strategic and Military Implications*, Z. M. Khalilzad, A. N. Shulsky, D. L. Byman, R. Cliff, D. T. Orletsky, D. A. Shlapak, A. J. Tellis.

China has been embarked on a process of reform and modernization that has led to unprecedented economic development. The goal is to make China a developed country, which would, among other things, raise the standard of living and prepare the base for a strong military. The Chinese leadership considers good relations with the United States to be strongly advisable, if not absolutely necessary, but sovereignty concerns (especially with regard to Taiwan) could cause tensions in the Sino-U.S. relationship. China could emerge, by 2015, as a formidable power, one that might offer an alternative to the current U.S. role as the region's preferred security partner and its ultimate security manager. At present, the best U.S. response appears to be a combination of engagement and containment, a "congagement" policy that would continue to try to bring China into the current

international system while both preparing for a possible Chinese challenge to it and seeking to convince the Chinese leadership that a challenge would be difficult and extremely risky to pursue.

MR-1091-AF, *Principles for Determining the Air Force Active/Reserve Mix*, A. A. Robbert, C. R. Cook, W. A. Williams.

Although the mix of active and reserve forces constituting the total Air Force has shifted during the last decade's force drawdown, reductions have not been proportional and may not have taken into consideration effects on other components. This report sets forth a set of principles to help force planners and programmers recognize the implications for the cost, effectiveness, sustainability, and popular and political support of military forces. A framework is provided for integrating the range of considerations that decisionmakers face and for gaining perspective on the arguments voiced by interest groups who hope to influence the force mix. The authors find that cost considerations can cut in opposite directions depending on whether the force is being optimized for major theater war preparedness or for peacetime contingency operations.

MR-1113-AF, *Flexbasing: Achieving Global Presence for Expeditionary Aerospace Forces*, P. S. Killingsworth, L. A. Galway, E. Kamiya, B. Nichiporuk, T. L. Ramey, R S. Tripp, J. Wendt.

The Expeditionary Aerospace Force (EAF) will need a strategy to deploy and employ forces in the face of uncertain overseas operating locations. The authors propose that this uncertainty can be managed by actively pursuing an overseas presence strategy based on maintaining high levels of logistical and operational flexibility. They call this strategy "flexbasing." To leverage the advantages of aerospace power, the authors suggest establishment of a global logistics support systems and provision of full-spectrum force protection for deployed forces. The Air Force should (1) establish a global system of core and forward support locations and forward operating locations; (2) maintain a robust mix of long- and short-range combat capabilities; (3) develop space as a forward support location; (4) advocate a global presence strategy as a joint initiative; (5) establish a global logistics/mobility support system for the EAF; and (6) provide full-spectrum force protection to deployed expeditionary forces. The combination of these initiatives will enable the forces to deploy to widely varying locations.

MR-1119-AF, *China's Arms Sales: Motivations and Implications*, D. L. Byman, R. Cliff.

China's arms sales have become the focus of considerable attention and pose a moderate threat to U. S. interests. Although Chinese sales have fallen in recent years, and Beijing has become more responsible in the transfer of nuclear, biological, and chemical (NBC) technologies, much progress will be needed to curtail China's behavior. Principal recipients of Chinese arms have been Iran, Iraq, Myanmar, North Korea, Pakistan, and Thailand. These countries and others seek Chinese weapons because they are available, cheap, and easy to use and maintain. In addition to missiles, the Chinese are willing to transfer NBC technology. The United States and other countries do have a modest ability to influence Chinese behavior, and China has increasingly wished to be viewed as a responsible world nation. The analysis supports three major findings about China's arms sale behavior: (1) China's arms transfers are not motivated primarily to generate export earnings but by foreign policy considerations; (2) China's government has more control over transfers than some have reported: its weapons export control system is quite centralized; and (3) China's adherence to international nonproliferation norms is in fact increasing. Nevertheless, Washington must hedge against the likelihood of sales and develop offsets in concert with allies.

DB-255-AF, *Alternatives for Achieving Aircraft Survivability: Phase 2, Air-to-Air Attrition* (U), J. Hagen, J. Huff. Classified.

DB-263-AF, *Force Protection for Air Expeditionary Forces: Threats, Responses, and Issues* (U), P. Killingsworth. Classified.

DB-267-AF, *Information for the Warfighter: Integrating C2 and ISR* (U), M. Hura, G. McLeod, R. Mesic, J. Jacobs, G. P. Frost, B. Dingess, J. Rothenberg, D. Norton, I. Lachow, W. L. Perry, A. M. Bullock. Classified.

IP-187-AF, *Congage China*, Z. M. Khalilzad.

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