Project AIR FORCE

Annual Report

Fiscal Year 1993

AR-3900-AF

RAND

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Fiscal Year 1993

Foreword

Two years ago in this space, I suggested that Project AIR FORCE faced a challenge as great as any in its history. With the momentous changes in the national security environment, the Air Force has asked us to address the most basic questions about its future: What kind of Air Force do we need? How do we acquire it? How do we support and sustain it? These questions have shaped our research agenda during the past two years and will motivate our research in the years to come. The results of our efforts have influenced the new Administration's defense strategy and force posture as presented in the Bottom-Up Review.

Our research in 1993 has explored new trends that have important implications for the Air Force of the future: new challenges for national security policy, new technologies and methodologies, changes in the military aircraft industry, and the shifting spectrum of Air Force missions. Among the new challenges to national security policy is how the United States should respond to the growing proliferation of weapons of mass destruction. We examined how the Coalition dealt with the threatened use of such weapons in the Gulf War, and we explored how U.S. strategy for regional deterrence will have to be changed to deal effectively with regional aggressors. Another new challenge addressed in our research is rethinking the NATO alliance and reorganizing its security structure to deal with the increasing instability outside its borders.

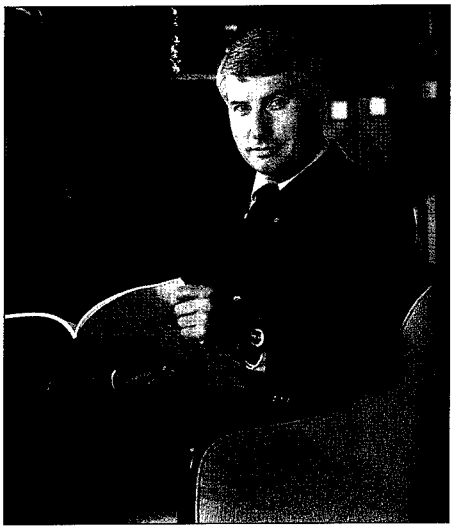
Other research assessed new technologies and methodologies. Detection of small theater ballistic missiles, a major problem in the Gulf War, was the focus of an assessment of several tactical warning satellites. We also continued the development of the new RAND Theater-Level Campaign model, which capitalizes on new software and hardware developments to capture many of the new factors of theater warfare. Other research offered guidance to the Air Force on near-term procurement issues by developing a new methodology to compare the payload and range characteristics of fighter aircraft. Methodologies of this type are now being used to assess the requirements trade-offs for the future Joint Advanced Strike Technology (JAST) program.

The consequences of a shrinking aircraft industry have been an ongoing topic of research in PAF for several years. Research described here examines the danger of losing competition in key technical areas, such as stealth, Navy aircraft expertise, and avionics integration, if industry consolidation is allowed to proceed without some level of government involvement.

While the size of the strike forces will probably decrease during the next decade, the opposite will be true for transport aircraft. The long-term trend is toward an increasing need for rapid projection of security and civil infrastructures of all kinds, both for combat operations and for humanitarian

relief. PAF examined the implications of this trend, including whether the Air Force should purchase large civil transports to augment its current airlift fleet. We also examined the possibility of a greater role for the reserves to help the shrinking active-duty forces of the Air Mobility Command cope with the increase in short-notice peacetime demand for airlift.

The highlights in this volume offer a representative sample of these research activities. Since its founding 47 years ago, Project AIR FORCE has directed its resources toward high-priority, long-term needs of the Air Force, particularly in that ill-defined area where military policy, planning, and technology merge and interact. It is my hope that the research represented in this volume carries out our original mandate and helps the Air Force anticipate and adapt to the needs, problems, and opportunities of the future.



George L. Donohue
Vice President and Director
Project AIR FORCE

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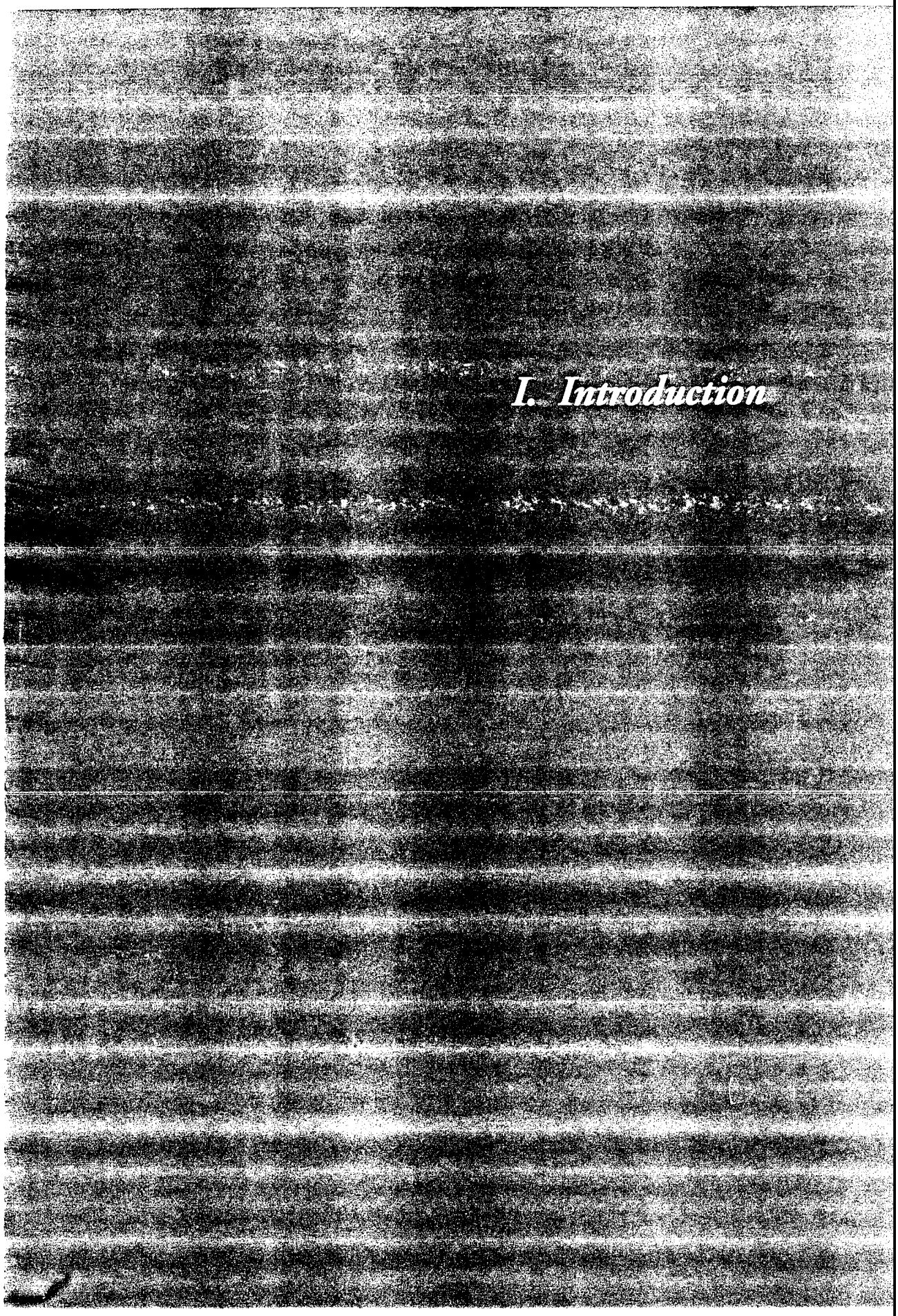


I. Introduction

Introduction

Project AIR FORCE (PAF) is a federally funded research and development center (FFRDC) operated by RAND on behalf of the U.S. Air Force. Its mission has not changed materially since it was founded 47 years ago: to conduct objective and independent research and analysis on enduring issues of policy, management, technology, and resource allocation that will be of concern to the senior leaders of the Air Force. This annual report describes some of the research results and other relevant aspects of PAF research activities conducted in FY 1993. To help put that research in context, however, we first provide an overview of PAF's role within RAND and its governing research agenda and funding.

The RAND Setting

In addition to being an FFRDC, PAF is a division of RAND, an independent, nonprofit organization devoted to research in the interest of the public welfare and the security of the United States. PAF began as Project RAND in 1946 and has operated continuously since then to help meet Air Force needs for independent research and analysis.

Air Force oversight of the PAF activity is provided by the Air Force Advisory Group (AFAG), which is chaired by the Vice Chief of Staff and includes senior representatives from across the Air Staff. The Director of Plans serves as the executive agent for the AFAG and is responsible for the day-to-day oversight of PAF relations with the Air Force. The AFAG, in turn, helps establish research priorities and serves as a critical link between RAND and the Air Force. The basic framework of objectives and operating principles for PAF is contained in a sponsoring agreement between RAND and the Air Force. PAF research is funded by a single, multiyear contract between the Air Force and RAND that is structured to provide the stability, continuity, and flexibility needed for successful research on enduring and complex policy issues.

Within RAND, a corporate vice president provides the leadership for and serves as the director of PAF. The PAF division is organized into three programs, each representing a different perspective on Air Force operations and the issues affecting it, as their titles suggest:

- Strategy, Doctrine, and Force Structure
- Force Modernization and Employment
- Resource Management and System Acquisition.

The programs, in turn, are organized into seven multidisciplinary project teams that conduct the actual research. The teams are drawn from RAND's staff of about 600 professionals trained in a broad range of disciplines (see Figure 1). About 90 percent of RAND's staff members work at RAND's headquarters in Santa Monica, California; the remainder are based at RAND's Washington office. The RAND staff is supplemented by part-time associates who contribute about 90 person-years of work annually.

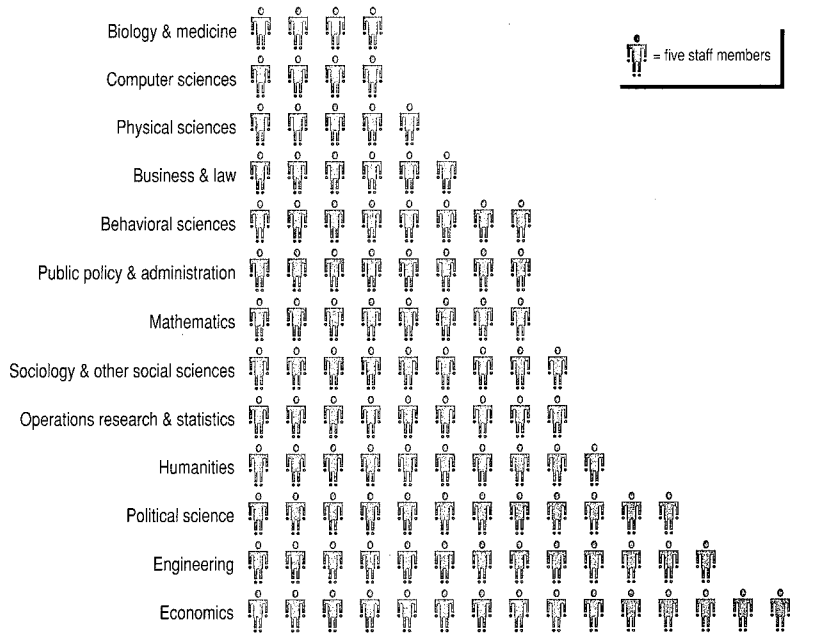


FIGURE 1

Disciplines Represented by RAND Research Staff

PAF is one of three national security FFRDCs at RAND. The Army Research Division houses the Arroyo Center, an FFRDC responsive to the needs of the Department of the Army. Similarly, RAND's National Security Research Division contains the National Defense Research Institute, an FFRDC sponsored by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies. Although each FFRDC has its own research agenda and a separate and privileged relationship with its sponsor, they all share a common RAND heritage and benefit equally from the diversity and experience of the research staff. Moreover, opportunities sometimes arise for collaboration on the development of analytic methods and the examination of policy issues that cut across the interests of all the sponsors.

About one-third of RAND's research is directed at national and international policy issues outside the national security realm. In keeping with its mission to promote the public welfare, RAND has built a substantial body of research over the years on health, education, civil and criminal justice, labor and population studies, and international economics. The Critical Technologies Institute, a new FFRDC established last year, will help government decisionmakers develop informed, coherent science and technology policies that benefit both the economy and society at large. In addition, the RAND Graduate School

offers an accredited program leading to a doctoral degree in policy analysis.

Research Agenda

PAF is uniquely qualified to analyze problems that are too broad or too complex to become the focus of a competitive procurement, such as problems that do not stand alone but are so linked to others that a highly specific analysis may be misleading, issues that cannot be formulated sharply in advance, or unprecedented problems that require the development of new research.

The planning process used to select research areas combines a mutual assessment of Air Force needs by the Air Force and RAND with the practical considerations of RAND staff capabilities and the availability of the analytical tools, data, and other materials needed to conduct the research. Suggestions for PAF research may come from anywhere within the Air Force and RAND. Although the planning process continues throughout the year during both formal meetings and informal discussions with Air Force leaders, the agenda is finalized as an annual research plan in September every year and the plan is reviewed and approved by the AFAG.

PAF's new organizational structure, implemented last year, consolidates PAF research into seven major projects: strategy and doctrine, force structure, force modernization, force employment, C^3I/space, logistics, and acquisition. This new structure was created to allow depth of analysis over longer periods in selected key areas and to provide more flexibility to respond to direct requests for research in those areas. About 20 percent of the research effort in FY 1993 was devoted to direct assistance—requests for quick-turnaround responses to questions as well as longer-term analysis performed within established projects in response to specific demands. The principal direct assistance efforts in FY 1993 focused on roles and missions, defense management reforms and the application of business practices, budget issues, force modernization, preservation of the industrial base, and methodology development.

Research Funding

All told, in FY 1993 PAF provided a research level of effort of just under 116 members of the technical staff, an accounting measure essentially equivalent to a professional person-year. Costs incurred for this research were approximately $23.6 million. This level of effort reflects a decrease from the average level of effort at which PAF operated during the 1980s (see Figure 2). The Air Force is attempting to stabilize long-term funding at the 125 member of the technical staff (MTS) level, consistent with the minimum needs for PAF and within the overall DoD limits for funding of FFRDCs.

PAF is primarily funded through a single program element in the Air Force budget and is operated under a single contract (FY 1993 was the third year under a new five-year contract). This funding and contractual arrangement is central to the concept of an FFRDC such as PAF—the reactions of Air Force sponsoring officers

to the findings of specific studies are kept separate from funding decisions, thereby enhancing PAF's independence and objectivity.

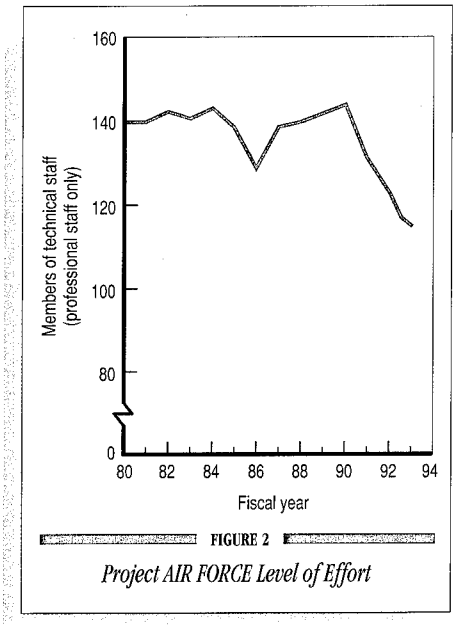


FIGURE 2

Project AIR FORCE Level of Effort

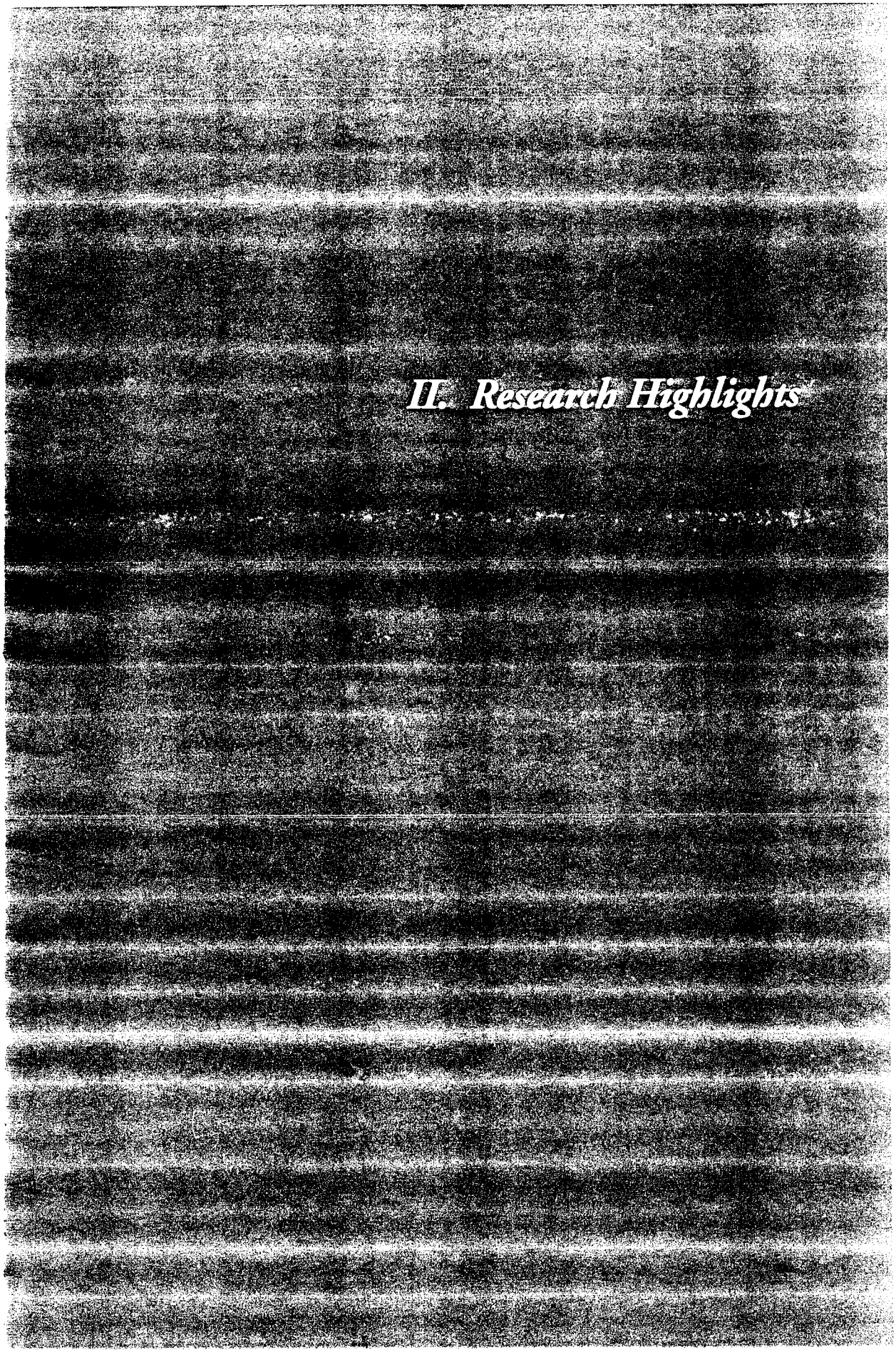
Organization of This Report

Section II, Research Highlights, constitutes the largest portion of this report. It contains 14 brief, substantive, and unclassified summaries of PAF research efforts completed during FY 1993.[1] These research projects were chosen to provide a broad representation of the research agenda as a whole.

Section III provides selected abstracts of the year's publications and an annotated list of the most prominent briefings presented to Air Force and other defense-community audiences during the same period. The final section presents information about the AFAG membership, the PAF management team, the RAND organization, and the membership of the RAND Board of Trustees.

For more information about the research summarized here or other aspects of Project AIR FORCE, please contact George L. Donohue, Vice President and Director, Project AIR FORCE, RAND, 1700 Main Street, P.O. Box 2138, Santa Monica, California 90407-2138.

[1]Some Project AIR FORCE research is performed in classified venues. The research highlights presented here are in unclassified form to make this report more readily accessible.



II. Research Highlights

Weapons of Mass Destruction and the Persian Gulf War

The proliferation of nuclear, biological, and chemical weapons and ballistic-missile delivery systems in the Third World threatens U.S. national security interests and adds to the cost and difficulty of defending these interests around the world. The possession of such weapons may also encourage potential aggressors to act more assertively.

In the Persian Gulf War, the United States and a coalition of other countries fought a Third World state that possessed weapons of mass destruction. Though still several years away from nuclear capability, Iraq had amassed a significant chemical warfare capability by the time it invaded Kuwait. It probably also had a significant inventory of biological warfare agents. It had the capability to deliver chemical agents by artillery shells and spray tanks mounted on aircraft. It could probably also have delivered chemical and biological agents by aerial bombs, artillery rockets, and missiles, including some Scuds.

This research examined how the Coalition dealt with the threatened use of such weapons. The results offer important lessons for dealing with future confrontations.

Coalition Reaction to the Iraqi Threat

The Coalition had a three-part strategy to counter the threat of Iraqi attack with chemical and biological weapons:

- Preventive attacks to neutralize Iraqi capabilities to develop, produce, and deliver nuclear, biological, and chemical weapons
- Defensive measures to protect Coalition personnel and facilities from all modes of chemical/biological attack
- Public and private warnings to deter Iraqi use of chemical/biological agents.

The preventive attacks were not completely successful. Even after gaining air supremacy and conducting six weeks of intensive bombing, the Coalition could not deny Saddam Hussein the option of attacking Coalition targets with chemical and biological agents, had he chosen to do so. Nor was the Coalition air campaign able to decisively cripple Iraq's capabilities to reconstitute its nuclear, biological, or chemical programs when and if United Nations inspections cease.

The warnings were apparently effective, however, despite conflicting statements by Washington officials about U.S. intentions. Certainly Iraq did not use chemical or biological weapons, and senior Iraqi prisoners captured in the ground campaign reported that their units had not been issued chemical weapons. Saddam Hussein may have feared that the United States, Britain, France, or Israel would retaliate with nuclear or chemical weapons or that the

Coalition would broaden its aims to include the occupation of Iraq, his own removal from power, and the prosecution of Iraqi leaders for war crimes. He may have considered the potential political and military advantages to be gained by using chemical and biological weapons not worth the possible cost, or he may have withheld this chemical/biological capability for use as a last resort to prevent the Coalition's complete takeover of Iraq. His failure to employ such weapons seems consistent with his overall policy of limiting the risks of confrontation with the Coalition over Kuwait.

Responding to an Iraqi Attack Could Have Proved Difficult

The Coalition probably could not have responded effectively to an Iraqi chemical/biological attack without sacrificing important humanitarian and political interests. The three major options for response—conventional punitive attacks against military or nonmilitary targets, retaliation with chemical or nuclear weapons, and seizure of Baghdad—had serious drawbacks. Since the Coalition was already bombing all targets of military consequence, more intensive air strikes against these targets would have had little punitive value. Expansion of the set of economic and political targets would have run counter to the Coalition's aim to minimize Iraqi civilian casualties, to avoid creating long-term hardships for the Iraqi people, and to maintain Iraq as a buffer against Iran.

Also, the Coalition could not have retaliated with chemical or nuclear weapons without heavy cost. This type of retaliation not only would have resulted in the loss of the moral high ground but would have undermined long-term objectives to prevent the use and stem the proliferation of such weapons. The use of nuclear weapons would have required the United States to contravene its pledge not to use such weapons against a nonnuclear state that is party to the Non-Proliferation Treaty, which Iraq signed in 1968. Also, use of either nuclear or chemical weapons would have seriously harmed U.S. relations with other nations in the region.

Finally, the Coalition could not easily have expanded its war aims to include the occupation of Iraq. Doing so would presumably have needed approval by the U.N. Security Council and would have required overcoming the reluctance of Coalition military and civilian leaders who feared becoming bogged down in Iraq. Such action might well have alienated the Arabs and thus fractured the Coalition.

What If Iraq Had a Nuclear Capability?

Coalition leaders did not perceive Iraq as presenting a well-defined and credible strategic chemical/biological threat. They were confident that their forces could survive Iraqi chemical/biological attacks and continue operations. Consequently, Iraq's possession of chemical and biological weapons did not circumscribe the Coalition's policy,

strategy, or military operations during the Gulf conflict.

Had Saddam Hussein possessed a small number of nuclear warheads for his mobile Scud missiles, however, the Coalition might have responded more cautiously. While the United States would probably still have deployed forces to defend Saudi Arabia, an Iraqi nuclear capability might have delayed, perhaps even postponed indefinitely, a U.S. and Saudi agreement to initiate hostilities. Had it decided to risk offensive military operations despite such a notional Iraqi nuclear capability, the Coalition might have ended the war earlier and conducted more circumspect air and ground campaigns.

This speculative excursion from Desert Storm suggests that in any future U.S. confrontation with a nuclear-armed Third World adversary, the United States will have to assure its allies—including those providing the bases for U.S. operations—that U.S. forces can deter and/or defeat enemy nuclear attacks. American decisionmakers will back assertive war aims and bold military strategies probably only if they have high confidence that U.S. forces can cope decisively with such attacks. For this reason, the United States needs robust defenses against all likely delivery modes, including leakproof defenses against ballistic and cruise missile attacks. Without such confidence, U.S. decisionmakers are likely to circumscribe U.S. war aims and impose significant constraints on U.S. military strategies and operations.

The need for effective defenses could become acute, in part because the experience of the Gulf War may spur proliferation in the Third World. Would-be aggressors may conclude that they must acquire a nuclear capability if they are to deter intervention by the United States or limit the scope of U.S. military action in future conflicts or crises. States may also be motivated to acquire mobile ballistic and cruise missiles to carry weapons of mass destruction because of the ability of such missiles to escape detection and penetrate defenses, as demonstrated during the Gulf conflict.

Future Deterrence and Response

In the future, competing political interests and constraints may preclude the United States from conducting preventive attacks against the nuclear, biological, or chemical programs of even rogue governments before the outbreak of general hostilities—unless such attacks are clearly needed to preempt an immediate threat to vital U.S. interests and/or are sanctioned by the United Nations or some other authoritative international organization. Even if such preventive attacks can be justified, the Gulf War demonstrated how difficult it is to neutralize the weapons of mass destruction and associated delivery systems of a well-prepared enemy who is adept at deception and dispersal. If preventive attacks are to be more effective in the future, the United States will need up-to-date, precise intelligence,

including near-real-time human intelligence; a dedicated central staff in an operational military organization to target nuclear, biological, or chemical facilities and weapons; and the capability to penetrate an adversary's defenses at the outset of a conflict with sufficient force to destroy all its time-urgent targets simultaneously. Even with such capabilities, preventive strikes will probably not be 100 percent effective. The United States will continue to need robust defenses and credible retaliatory options to ward off nuclear, biological, or chemical attacks.

It is important that U.S. leaders consider possible retaliatory options before committing their forces to battle. In future confrontations with states possessing weapons of mass destruction, the United States should:

- Expect that punitive attacks with conventional weapons may not deter the use of nuclear, biological, or chemical weapons
- Adhere to a consistent declaratory policy that will magnify enemy concerns about potential U.S. retaliation
- Retain the political and military freedom of action to pursue retaliatory war aims, including the capture and trial of enemy leaders
- Maintain the credibility of a possible U.S. nuclear response in the event that grievous damage is inflicted on U.S. troops or civilians.

This research was conducted by Stephen T. Hosmer as part of the Strategy and Doctrine Project of the Strategy, Doctrine, and Force Employment Program.

Measuring Effects of Payload and Radius Differences of Fighter Aircraft

Until the F-22 air superiority fighter begins to enter the force after the turn of the century, the Air Force has two principal options if it wants to enhance its force with new models of Air Force fighter aircraft: It can buy either more F-15s or more F-16s. Procurement of the F-15E for the Air Force is winding down with production of a limited number of aircraft to replace those lost in Operation Desert Shield and Desert Storm, while procurement of the F-16C for the Air Force is scheduled to end in 1994. Continuing production of both airplanes for foreign customers will keep open the option of further procurement for the Air Force for several years. If the Air Force chooses to exercise that option, which is by no means certain, constrained budgets will limit the production rate and the quantity of either aircraft purchased and, in fact, may limit Air Force procurement to only one of the two airplane types.

PAF's *New Calculus* study of airpower's changing role in joint theater campaigns[1] suggested that the addition of more F-15Es to the interdiction force structure could provide a cost-effective near-term enhancement to the Air Force's air-to-ground attack capabilities. To better weigh the merits of this recommendation, the Air Force asked RAND for a more detailed comparison of the relative cost-effectiveness of F-15E and F-16C Block 50 model aircraft (the most current variant of the F-16C) when carrying air-to-ground weapons.[2]

As is the case with many requests for special assistance by the Air Force, this question was more focused and less sweeping in scope than many PAF studies, including the *New Calculus* study. The desire for a quick response shaped not only the scope but also the methodological approach of the resulting PAF response. Researchers developed and applied an analytical framework that deliberately avoided exhaustive modeling of tactical missions; instead the focus was on major parameters that differentiated the F-15E and F-16C, using those parameters to make relative comparisons for several aircraft configurations, mission types, weapon loads, and regional theaters. These comparisons provide a rich set of insights about the relative capabilities of the two aircraft that can support decisions about the future procurement of either aircraft.

A Changing Cost Picture

In the past, although many in the Air Force have acknowledged that the F-15E holds a qualitative capability advantage

[1]Christopher Bowie, Fred Frostic, Kevin Lewis, John Lund, David Ochmanek, Philip Propper, *The New Calculus: Analyzing Airpower's Changing Role in Joint Theater Campaigns,* RAND, MR-149-AF, 1993.

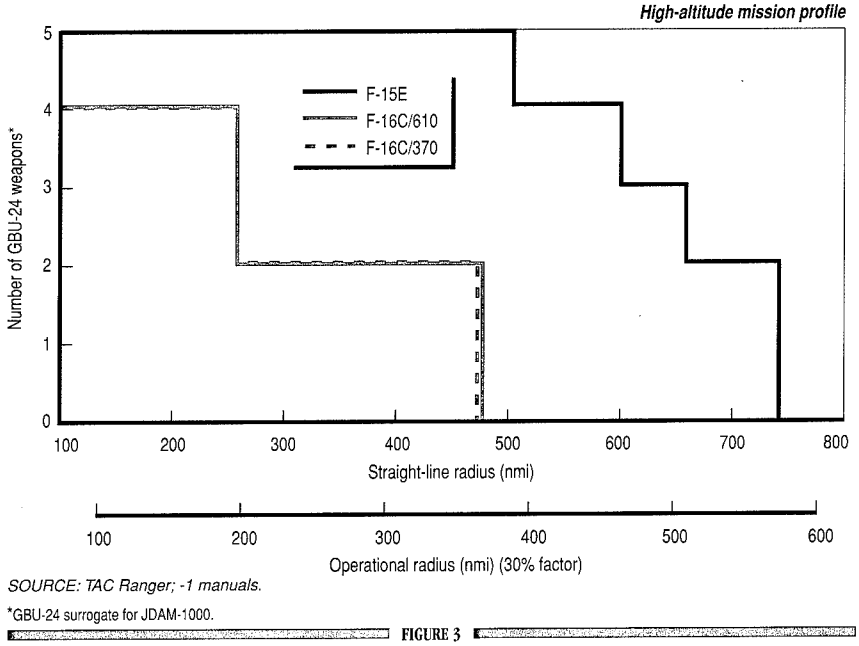
[2]William Stanley, Gary Liberson, *Measuring Effects of Payload and Radius Differences of Fighter Aircraft,* RAND, DB-102-AF, 1993.

over the F-16C, they have also noted the substantial cost premium attached to this extra capability. Historically, the F-16 has cost considerably less than the F-15 because it is smaller and less complex to produce and because its much larger base of production and higher production rates have kept costs relatively low. As production rates have fallen in recent years, the costs of both aircraft have increased—but not at the same rate. The cost ratio between the F-15E and the F-16C appears to be narrowing, thus providing new impetus for reassessing their relative cost-effectiveness.

F-15Es are now estimated to cost about 50 percent more to buy and operate than Block 50 F-16Cs when both are equipped with LANTIRN navigation and targeting pods (the configuration evaluated in this study). This cost relationship means that the Air Force can buy and operate three squadrons of F-16Cs for every two squadrons of F-15Es. In examining whether the capability advantages of the F-15E were commensurate with its greater costs, we measured the value of the F-16C's quantity advantage against the quality advantage of the F-15E.

The Qualitative Difference

Figure 3 illustrates the large radius and payload advantage that the F-15E has over the F-16C when carrying laser-guided bombs on a high-altitude mission profile. The advantage is even greater when carrying other weapon types.



SOURCE: TAC Ranger; -1 manuals.

*GBU-24 surrogate for JDAM-1000.

FIGURE 3

Payload/Radius Comparison

Although some in the Air Force have suggested that using larger 610-gallon external wing tanks could compensate for F-16C shortfalls in combat radius, the larger tanks offer only a marginal increase in radius over the more typical 370-gallon tanks because they cannot be filled to capacity without exceeding the F-16C's takeoff gross weight limit of 42,300 pounds set by braking considerations. Refueling in flight beyond maximum takeoff gross weight but within structural weight limits permits the F-16 to better exploit the capacity of the 610-gallon tanks but not to the extent that it overtakes the F-15E in cost-effectiveness.

We compared the F-15E with several configurations of F-16C Block 50 aircraft for nominal and close basing postures in the Southwest Asia theater, as well as for operations in a smaller theater like Korea. We also evaluated the impact of in-flight refueling in the Southwest Asia theater. The aircraft carried laser-guided bombs, cluster bombs, or conceptual representations of future inertially aided Joint Direct Attack Munitions (JDAM).

We compared the number and ton-miles of weapons delivered, the distribution of weapon deliveries by radius, the number of targets within range, and the number of bridges cut and tanks killed for 30 days of air-to-ground sorties. These were combined with estimates of procurement and operating costs to evaluate cost-effectiveness.

Greater Cost-Effectiveness of the F-15E

Figure 4 illustrates a typical result for the Southwest Asia theater without the use of in-flight refueling. Despite having fewer aircraft, an equal-cost force of 48 F-15Es delivers more bombs to greater depths, servicing a much greater fraction of the target set than a larger force of 72 F-16Cs. The greater depth of F-15E attacks could put at risk high-value strategic targets such as nuclear, biological, and chemical (NBC) weapon facilities clustered around a national capital such as Baghdad.

For most of the air-to-ground cases examined, the effectiveness advantage offered by the F-15E relative to the F-16C was more than commensurate with its higher procurement and operating costs. The larger, heavier F-15E was most cost-effective in larger theaters such as Southwest Asia where its payload and radius capability were exploited to best advantage. The smaller, lighter F-16C exhibited its best performance in more compact theaters, such as Korea, which shaped its original design. In-flight refueling improves the effectiveness of both aircraft but does not alter their relative cost-effectiveness ranking. It allows the F-16C to service more targets at greater depths and the F-15E to service more targets at greater depths with heavier payloads.

Several actions, although not uniformly desirable from an operational or technical standpoint, can in some circum-

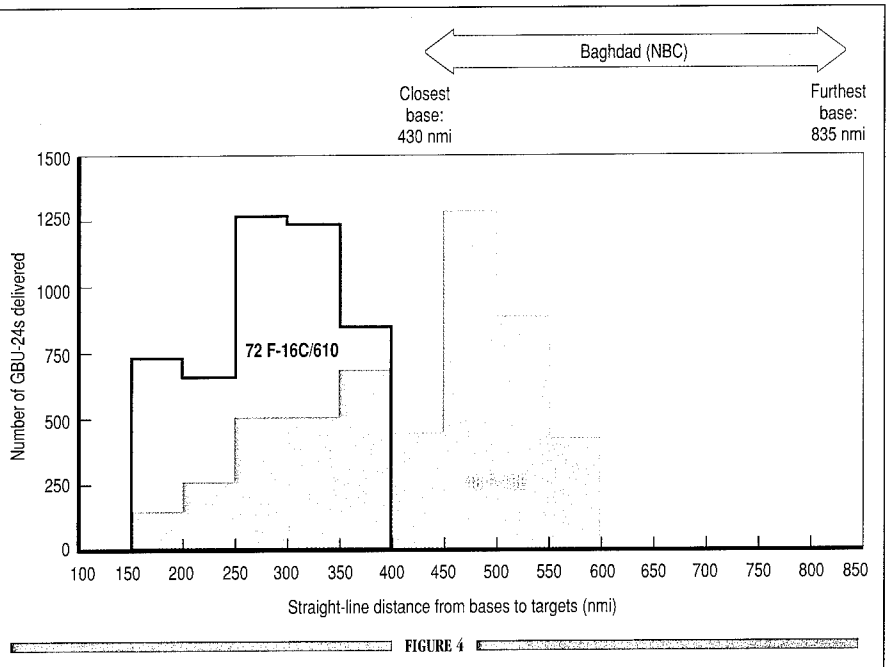


FIGURE 4

Distribution of Bomb Deliveries for an Equal Investment in Aircraft (Southwest Asia Theater)

stances enhance the target coverage and payload carriage of the F-16C in larger theaters. These include basing closer to enemy territory, in-flight refueling relatively close to the border, in-flight refueling beyond the maximum takeoff gross weight but within structural weight limits, using 610-gallon wing tanks, and substituting a centerline external fuel tank for an electronic countermeasures external pod. Although these actions can narrow differences between the F-15E and F-16C, in most circumstances the F-15E is still clearly more cost-effective.

Looking to the Future

Our research also highlights the importance of three factors in assessing trade-offs between the F-15E and F-16C in the Air Force of the future.

- Inertially aided weapons such as the JDAM are emerging as a key weapon type for the future. Because aircraft carrying these weapons will no longer need to linger in a target area to laser designate and attack individual targets, those aircraft with larger payload capabilities, such as the F-15E, will be in a better position to carry heavy loads in more situations.
- The compact size of the Korean theater is the exception rather than the rule. Most potential future regional theaters of conflict are larger. Aircraft having long combat radius capabilities are well-suited for these larger regional theaters.
- As the Air Force contracts, it should be alert to opportunities for maintaining—and where possible even

enhancing—overall force effectiveness. The superior cost-effectiveness of the F-15E offers the Air Force an opportunity for doing more with less.

This research was led by William Stanley as part of the Aero Systems Modernization Project in the Force Modernization and Employment Program.

Reluctant Partner: FS-X and the U.S. Quest for Technology from Japan

In the summer of 1985, senior U.S. government officials began a quiet effort to reverse Japan's decision to launch independent development of its first world-class fighter aircraft since the Second World War, called the Fighter Support Experimental (FS-X).[1] They urged Japan to join the United States in the cooperative development of a modified version of an existing U.S. fighter. Their primary motive was to preserve and enhance the existing security relationship between the two countries by ensuring U.S. government and industry participation in the most important Japanese procurement program of the 1990s.

Over time, the bilateral discussions regarding the FS-X became increasingly enmeshed in broader economic frictions concerning the trade balance, technology transfer, and U.S. industrial competitiveness. In early 1989, an outburst of criticism in Congress elevated the FS-X issue into a major public policy debate over the transfer of advanced aerospace technology to Japan and other allies during cooperative military procurement programs. Within weeks, the controversy mushroomed into one of the most serious and bitter public disputes between the United States and Japan since the end of World War II.

[1]In the early 1970s, Japan developed the F-1 support fighter by modifying the existing T-2 advanced trainer aircraft. Unlike the F-1, the FS-X was intended from its inception to be an advanced first-line fighter.

Since the ultimate outcome of the FS-X program will have major implications for the future of arms procurement collaboration, U.S. government policy toward the aerospace industry, technology transfer policy, and U.S.-Japan security relations, this research set out to provide a systematic analysis of the policy implications of the program for the U.S. Air Force and the Department of Defense.

Flawed Compromise

The Pentagon strongly advocated Japanese procurement of a licensed-produced or slightly modified U.S. fighter for five principal reasons:

- To ensure procurement of a militarily effective and reasonably priced fighter by the Japanese Air Self Defense Force (ASDF)
- To promote interoperability and procurement rationalization with U.S. forces
- To limit expansion of Japan's independent military R&D capabilities
- To ensure continuing U.S. government and industry involvement in major Japanese procurement programs
- To support the U.S. defense industrial base.

In the broadest political sense, all of these points were aimed at forestalling the eventual emergence of a more

autonomous Japanese security policy made possible in part by an independent Japanese defense industrial capability.

Under great political pressure, Japan agreed to cooperatively develop a modified General Dynamics (now Lockheed) F-16 with the United States. However, Japan also insisted on incorporating many of its own nationally developed subsystems and technologies into the aircraft. The U.S. side agreed but required free and automatic flowback of Japanese improvements to U.S. technology and access to new Japanese-developed technology.

Submission of the agreement to Congress in early 1989 led to a long and acrimonious debate in Congress, forcing the Bush administration to undertake extensive new negotiations to "clarify" the deal. The bitter controversy that year left an unprecedented residue of skepticism and suspicion on both sides of the Pacific. Many critics in Congress and elsewhere believed that the FS-X represented an unprecedented "give-away" of advanced U.S. aerospace technology to America's most relentless economic competitor, with few guarantees of anything significant in return. They resented Japan's refusal to purchase a U.S. fighter, which they advocated in order to provide jobs in the United States and help reduce the trade deficit. Pentagon officials worried that the dispute had undermined DoD's fledgling efforts to increase defense procurement cooperation with Japan and gain access to advanced Japanese dual-use technology, while bolstering the position of those in Japan advocating the further expansion of indigenous defense industry capabilities.

Our research found that these negotiations produced a flawed compromise solution that attempted to satisfy both the political/military objectives advanced primarily by the Pentagon and the economic objectives pressed most forcefully by Congress and the Department of Commerce as outlined above. These objectives were often in conflict with each other. Furthermore, basic U.S. objectives often ran counter to the primary goals of Japanese industry and significant elements within the Japanese security establishment. For example, the Pentagon goal of limiting Japanese indigenous R&D required the transfer of U.S. technology for licensed production. However, Congressional concerns over economic consequences led to severe restrictions on the transfer of U.S. technical data, thus promoting indigenous military technology development by the Japanese.

Economic Benefits: Short-Term Gains for the United States

The highly publicized Congressional debate and the forceful intervention of the Commerce Department in 1989 changed the nature of the program by increasing the relative political importance of the short-term U.S. economic objectives such as work share. Access to Japanese technologies, especially manufacturing technologies related to the active phased array radar

(APAR) and co-cured carbon fiber composite (CFC) wing, gained significantly greater political prominence. Program officials are rigorously implementing these objectives, particularly with respect to U.S. workshare during R&D, the strict control of U.S. technology transferred to Japanese industry, and access to Japanese technologies. As of mid-1993, U.S. industry is expected to receive more than its guaranteed 40 percent share of R&D work, valued in excess of 1.1 billion dollars. The FS-X agreements also guarantee American firms 40 percent of any future production work. U.S. participation in production could bring in as much as 2 billion dollars or more.

It is unlikely, however, that U.S. industry will benefit significantly from its access rights to Japanese technology on the FS-X program. After many initial difficulties, the Japanese are transferring a substantial quantity of technical data on the CFC wing and other aspects of the aircraft. Lockheed will manufacture four of the twelve CFC wings for the R&D program. Initial indications suggest that Japanese design and materials philosophy for the wing and other composite structures will be of little interest to the American military aerospace industry. Many of the basic Japanese material technologies and design methodologies are not as advanced as those found in U.S. industry. Contrary to typical U.S. practice, the Japanese approach appears to emphasize manufacturing ease over performance and other military requirements. Furthermore, since the U.S. contractors took little or no part in the design and development of the wing, it is difficult to determine the full rationale behind Japanese design decisions. Insufficient funds are available to properly catalogue and assess much of the other Japanese technical data being transferred. U.S. industry, however, may still learn some useful new manufacturing techniques for large co-cured CFC structures.

Until recently, the United States has found it very difficult to gain access to the Japanese active phased array radar and other domestically developed avionics systems. In 1993, the United States negotiated the purchase of several transmit/receive modules for the radar and is testing them. U.S. government teams have been visiting Japanese companies to examine aspects of this and other avionics systems. However, Japanese systems generally are lower in performance than comparable U.S. systems. In addition, much of the basic Japanese manufacturing technology appears to differ little from the U.S. approach. If the Japanese can achieve significant cost savings—which has not yet been demonstrated—it probably will be a result of the unique structure, management philosophy, and organization of Japanese industry that permits "spin-on" of manufacturing techniques from the commercial sector. These factors will be difficult to transfer to the U.S. defense industry.

Military R&D: Long-Term Gains for the Japanese

Although U.S. industry will probably not gain any significant long-term

technological benefit from the program, the Japanese aerospace industry should increase its military R&D capabilities substantially. Contrary to original U.S. expectations, the FS-X will be far more than a minimally modified F-16C. Ironically, this outcome arose partly because the political controversy surrounding FS-X in 1989 led to an increased U.S. emphasis on restricting Japanese access to F-16 technology, thus permitting the Japanese to develop and incorporate more of their own domestic designs and technologies into the aircraft. Japanese industry is using the F-16 design merely as a baseline for an aircraft that will differ significantly in design, structure, and subsystems from existing F-16s (see Figure 5). The FS-X program is providing Japanese companies with their first major experience since the Second World War in designing, developing, and integrating a world-class combat fighter. Although this experience will have little direct application to commercial aircraft, as feared by Congress, it will significantly increase Japanese military R&D capabilities in aerodynamic design, subsystems development, large load-bearing composite structures, the integration of complex weapon systems, and numerous other areas.

Nonetheless, the program does provide the U.S. government and industry with an unprecedented window on the Japanese military R&D process, which was formerly conducted out of view. It also establishes a precedent for U.S. access to Japanese defense-related technologies and may help pave the way for more mutually beneficial cooperative programs in the future.

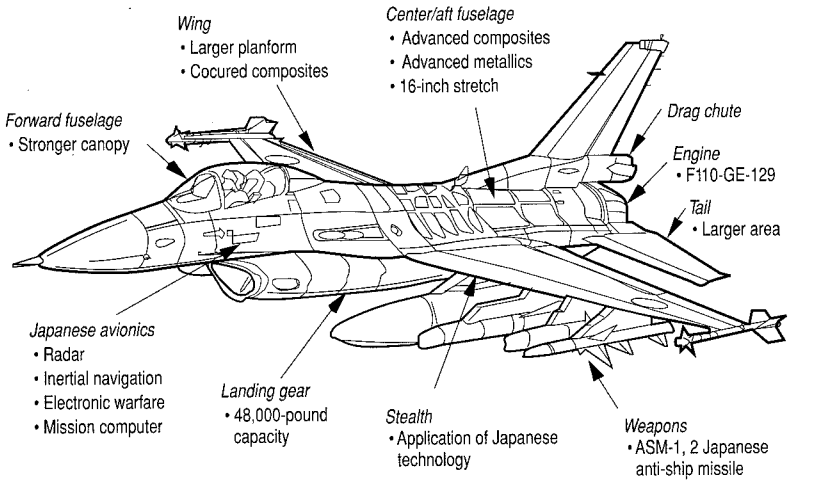


FIGURE 5

Main Differences Between the FS-X and the F-16

How To Do Better

We believe that the U.S. government can take further measures to improve the prospects of gaining real benefit from access to Japanese technology by organizing a much larger, better coordinated, and adequately funded effort on both industry and government levels to assess Japanese technologies, emphasizing low-cost, high-yield manufacturing techniques attained from the commercial sector.

Yet the most important challenge facing U.S. policymakers now is negotiation of an FS-X production agreement. The majority of the potential economic, technological, and political benefits of the program depend on a Japanese decision to enter into production. Yet nothing in the existing agreements prevents the Japanese from canceling the program after R&D and using the experience gained on FS-X R&D to launch an all-national effort to develop a new indigenous fighter. The U.S. government should begin now to develop a detailed high-level strategy for the future production negotiations. This strategy should be aimed at:

- Making clear that the only feasible alternative to FS-X production is purchase or licensed production of an existing U.S. fighter.
- Guaranteeing U.S. industry 40 percent—measured by total program expenditures—of all production of the FS-X and all future variants based on the FS-X. Because of a variety of technical and political issues, the task of winning the 40 percent of production work for U.S. companies mandated in the original agreements will not be easy.
- Increasing the prospects for gaining benefits from flowback and access to Japanese manufacturing technologies. The U.S. government should consider seeking a share of the production work on the CFC wing and even the APAR and other Japanese-developed avionics systems to ensure the more effective transfer of low-cost, high-yield manufacturing technologies.

Perhaps the single most important lesson of the FS-X is that the U.S. government needs to formulate and implement a single, coordinated policy on weapons system procurement collaboration that harmonizes U.S. military and economic objectives. Emphasis must be on the U.S. policy toward codevelopment as opposed to licensed production, where U.S. military design and development expertise, in addition to manufacturing processes, are transferred to the partners of the United States.

This research was led by Mark Lorell as part of the Acquisition Project of the Resource Management and System Acquisition Program.

The Twin Arcs of Crisis: New Strategic Challenges for the United States in Europe

With the end of the Cold War, the old strategic distinction between the center and periphery in Europe has disappeared. The new strategic challenges facing the United States in and around Europe exist almost exclusively along two "arcs of crisis" (see Figure 6): the eastern arc, the zone of instability between Germany and Russia, running from Northern Europe down through Turkey, the Caucasus, and Middle Asia, and the southern arc, running through Northern Africa and the Mediterranean into the Middle East.

This research examined the sources of instability along these arcs and their implications for the NATO alliance. The research suggests that the crises in these areas present Europe's most serious strategic challenge in the near future, that NATO as it now exists is ill-equipped to deal with this challenge, and that NATO's rationale and mission need to be redefined.

The New Strategic Challenge

The key strategic issue in post–Cold War Europe is whether the forces of democracy and integration that have dominated western Europe since the 1950s will now be extended to the east,

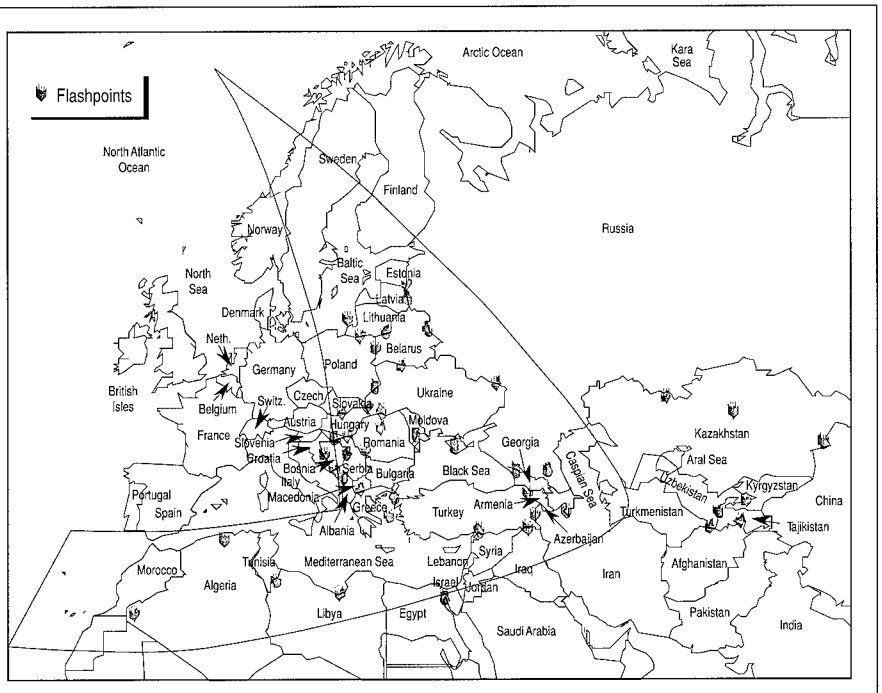


FIGURE 6

The Twin Arcs of Crisis

or whether rising nationalism and disintegration will destroy the new democracies in the east and potentially spill over into Western Europe, where the influx of refugees from the east and south is already creating a nationalistic backlash. This struggle between the forces of integration and disintegration will decide Europe's political destiny.

Such problems are exacerbated by the power vacuum that exists along the two arcs of crisis. Although the withdrawal of former Soviet Union forces some 1,000 kilometers eastward has led to enormous gains in western security, a significant imbalance of power in the region poses a major security dilemma. The countries in the region do not have the ability to defend themselves against the threat they fear the most: a resurgent Russia. The situation is fueling an almost desperate search for security, which is reinforcing competition, proliferation, and instability.

From the outset, the new democratic elites in these countries have emphasized that the lack of a stable security framework undercuts democracy and reform and thereby contributes to instability in the region as a whole. As the course of events in the former Yugoslavia has underscored, war can again become possible if a functioning security structure is not erected. The establishment of a security framework, on the other hand, would generate the stability that would smooth the transition to democracy and attract Western capital as well as providing a hedge against a possible resurgence of Russian neo-imperialism.

The area most immediately vulnerable to the twin dangers of nationalism and a power vacuum is east-central Europe—that geopolitically sensitive eastern arc of crisis running between Germany and Russia. However, a parallel set of issues also exists along the southern arc where the specter of proliferation of ballistic missile technologies on the northern coast of Africa and in the Middle East over the next decade threatens to put all southern European capitals within striking distance of ballistic missiles controlled by potentially unfriendly regimes.

The New NATO Debate

Europe's changing strategic landscape has fueled a dramatic shift in thinking about the future of the transatlantic alliance. Growing conflict on Europe's periphery, coupled with a growing realization of the limits of any future role for the United Nations and the European Community (EC), has focused attention on NATO as the only effective instrument for stabilizing European security.

At the heart of this debate is the question of how NATO might restructure itself both politically and militarily to "export security"—a term that refers to a spectrum of new missions including peacekeeping, peacemaking and peace enforcement, crisis management, and expanded membership beyond its borders. Four schools of thought have emerged in this debate:

- **Rome/Oslo NATO.** The Rome summit in November 1991 represented the first attempt to

update NATO for the post–Cold War period. While initiating a political transformation of the alliance, Rome retained the traditional alliance focus on border defense under Article 5. A subsequent ministerial meeting in Oslo in June 1992 added peacekeeping to the alliance's mission but did not embrace an explicit "out-of-area" mandate.

- **Power Projection NATO.** This view of NATO recognizes the new strategic challenges along the twin arcs of crisis and would embrace institutional reform to enhance NATO's power projection capabilities to meet these new challenges.
- **Revitalized NATO.** This view of NATO foresees internal reform to improve the alliance's ability to export security into the twin arcs and would also be willing to expand membership to include the new democracies in the East.
- **Residual NATO.** This view of NATO would recognize Europe's new strategic challenges along the arcs but would entrust these to an emerging European defense identity tied to the EC. NATO's role would be limited to hedging against a residual Russian threat.

This research suggests that a revitalized NATO would be better equipped than the other alternatives to address the root causes of Europe's new security problems. Expanded membership would help fill in the security vacuum along the eastern arc of crisis and contain nationalism as well as provide improved military capabilities. It would also address the looming question of the United States acquiring "back-door" security commitments through the expansion of the EC that would not be covered under the existing alliance. A revitalized NATO would also create a new transatlantic relationship by encouraging a "partnership among equals" between the United States and Europe that would facilitate a coordinated approach by both the EC and NATO toward Europe's new security problems. Finally, such a NATO is the only politically viable mechanism for the strategic maturation of Germany as a pro-western and active ally in the east.

Steps Toward Rebuilding NATO

Politically and militarily, seven steps are necessary to forge a new transatlantic bargain. The first and most important step is to transform NATO from an alliance based on collective defense against a specific threat into an alliance committed to projecting democracy, stability, and crisis management in a broader strategic sense.

The second step must be a new understanding between the United States and its European allies that harmonizes the interests of both sides. While Washington must recognize its interests along both arcs and understand the unique role it can play, future U.S. involvement will be predicated on Europe's willingness to bear its own share. Washington must also be willing to accept a stronger European identity, even in security affairs.

For its part, Europe—or in this case France—must abandon its exaggerated fear of U.S. hegemony. Franco-American rapprochement can set the stage for the third step in transforming NATO: Germany's strategic normalization. Germany must finally resolve the confused debate over its role in Europe and beyond. To be sure, residual fears concerning German power still exist. But only a strong Germany can facilitiate European integration and NATO's strategic transformation.

Reorganizing the West would set the stage for the fourth step in this process—a coherent and coordinated Western strategy for the integration of the Visegrad countries (Poland, Hungary, the Czech Republic, and possibly Slovakia) into both the EC and NATO. NATO membership, like EC membership, can come in phases and should be conditional. The criteria for membership need to be identified clearly in advance. Opening the EC to the east would help stabilize the process of political and economic reform and serve as the best guarantee against a revival of anti-Western nationalism.

The fifth step in the new transatlantic bargain concerns Russia. Helping to democratize Russia should be a top strategic priority of the West. Extending the alliance eastward should be seen as the West taking a step *toward* Russia, not against it. Whether NATO's eastward extension becomes a new offer for partnership or a move toward an anti-Russian alliance depends almost entirely on the outcome of Russia's own internal transformation. This process, over which the West has little control, is likely to take years. To hold the future of NATO hostage to the outcome of Russian politics is a recipe for the demise of the alliance.

The sixth step in rebuilding NATO requires the West to develop a constructive policy toward Ukraine. In light of the uncertainties surrounding Russian democracy, an independent Ukraine offers the best guarantee against Russian imperial restoration. Thus far the West has viewed Ukraine largely as a proliferation problem rather than a state with legitimate security concerns. A broader policy is needed.

Seventh, the alliance must be reoganized militarily. NATO's basic problem is the mismatch between its old mission and Europe's new strategic challenges. The dividing line between "in-area" and "out-of-area" crises, so clearly drawn in the Cold War, has become ambiguous and artificial. Redefining alliance commitments in both areas—and finding the proper balance between the two—is the fundamental issue facing the alliance.

The New Choices

Four years after the collapse of the Berlin Wall, the United States confronts new and difficult choices in its policy toward Europe and Russia. With pressing domestic concerns at home demanding attention, the United States must decide whether and how it should become engaged in resolving Europe's new strategic problems. As it becomes clear that the old NATO consensus is

increasingly overtaken by events, the stark choice facing policymakers may be whether to try to build a "new" NATO or to watch the "old" NATO fade away.

Building a new NATO will clearly entail costs, but these must be weighed against the cost of doing nothing.

This research was led by Ronald Asmus as part of the Strategy and Doctrine Project of the Strategy, Doctrine, and Force Structure Program, and was conducted jointly with the Arroyo Center's Strategy and Doctrine Program.

The Changing Spectrum of Air Force Missions

With the rapid restructuring of world economic, political, and military relationships in the aftermath of the Cold War, the relative proportions of Air Force noncombat and combat operations appear to be changing. In 1990, the Air Force Director of Plans asked Project AIR FORCE to explore the shift in the spectrum of missions, with emphasis on support missions and the changes that might be necessary for better performance. Our research into Air Force support missions focused primarily on three areas:

- Analyses of past Air Force operations for historical trends in the scale, scope, and character of support operations as compared with traditional combat operations
- Examination of world events and trends for evidence of changes in the qualitative and quantitative demands for Air Force capabilities in support missions
- Exploration of scenarios that seemed likely to stress current and future Air Force noncombat capabilities.

Our analysis demonstrated that a wide variety of support missions has constituted at least half the Air Force budget in recent years and that this portion is likely to grow for reasons that involve both Air Force capabilities and trends in projection of airpower. The research also revealed considerable disagreement within the Air Force about the desirability of making support operations an explicit and planned mission area.

The Historical Picture

An historical review[1] of more than 500 USAF operations from 1947 to 1989 indicates that the Air Force has averaged about one support mission per month since 1947, even during periods when combat operations were under way. These operations ranged widely in size and scope: from Operation Provide Hope (1992), which transported 2,300 tons of relief supplies to former Soviet republics, to the Berlin Airlift (1948 to 1949), which transported 1,000 times more tonnage to that Soviet-blockaded city; from dropping hay to starving cattle during the Western states blizzards (1948 to 1949) to dropping food and medical supplies to isolated communities in Bosnia (1993). In aggregate, such missions represent a substantial slice of the Air Force effort: Between 1962 and 1990, the support side of the Air Force program never fell below half of the total USAF budget.

Detailed analyses of a set of these operations revealed that the Air Force was involved because it had specialized capabilities not available from other government agencies or from the other military services. Of particular significance was its ability to carry people, supplies, and equipment, quickly, over long distances, to almost any place on the globe. Moreover, the Air Force had the unique capabilities required for a number of particular situations. One

[1]R. Lempert et al., *Air Force Noncombat Operations: Lessons from the Past, Thoughts for the Future*, RAND, N-3519-AF, 1992.

example was the need for high-altitude air sampling to track nuclear radiation, as after the Chernobyl disaster. In another instance, a complex array of Air Force air, space, and ground capabilities was employed in the search for Congressmen Mickey Leland, lost in an air crash in Ethiopia. It is noteworthy that the RAND analysis of Air Force performance in such operations revealed that the Air Force was frequently hampered by the lack of infrastructure at the destination.

A Shifting Spectrum

RAND research also showed that in recent years, important changes have occurred in the *places* where power must be projected, in the *kinds* of power to be projected, and in the *circumstances* where it can be projected. Typically, projection of air *power* has been viewed as projection of *force,* along with essential supporting elements. Indeed, the terms "power projection" and "force projection" are often used interchangeably. But power projection has always involved two components—the projection of *force* and the projection of *infrastructures*—and the long-term trend appears to be toward increasing projection of infrastructure. As combat aircraft and air operations have become more capable and sophisticated, the infrastructure component of airpower projection has grown in size and importance. Moreover, this growth has occurred not only in situations involving support of the force component. Examples of the independent projection of infrastructure include the Air Force operations over the Persian Gulf during the Tanker War of 1987 to 1988 (Operation Earnest Will) and in the Kurdish relief operations during 1991 (Operation Provide Comfort).

While the size of the strike forces probably will decrease during the next decade, the missions involving the rapid projection of infrastructures are likely to increase disproportionately. World trends are pointing toward an accelerating need for the rapid projection of security and civil infrastructures of all kinds (transport, communications, surveillance, rescue, medical, humanitarian assistance, civil emergency, and security), particularly into the less developed regions of the world and quite apart from the future prospects for combat operations.

This trend was in evidence during three large theater or tactical airlifts conducted during 1991. As Table 1 shows, two USAF humanitarian and relief operations in 1991 were comparable, by any measure, to the tactical airlift required to

Three Theater Airlifts in 1991

TABLE 1

Airlift operation	*Sorties*	*Passengers*	*Cargo (tons)*
"Left Hook" in Desert Storm	1,175	13,843	9,395
Kurdish relief in Provide Comfort	1,100	14,421	40,000
Mt. Pinatubo evacuation in Fiery Vigil	1,726	23,400	44,440

SOURCE: Air Force Secretary Rice, A New Air Force: Reshaping for the Future, *undated congressional testimony during 1992, pp. 20, 25.*

support the "left hook" of Desert Storm, the movement of substantial ground forces to the left flank as part of the initial operations plan.

Future Scenarios

To identify significant future requirements and desirable capabilities for U.S. Air Force support missions in light of the nation's changing needs for support response options, a workshop was held in June 1992 at the RAND offices in Washington, D.C. It focused primarily on exploring four possible scenarios that might stress Air Force support capabilities in the future:[2]

- A nuclear explosion of ambiguous origins in Tel Aviv
- A breakdown of civil order in Mexico, with spillover effects in the Southwest border states
- Organized piracy in the seas around the Malay Peninsula
- Ethnic conflict in the Caucasus, resulting in a United Nations decision for its partitioning by force.

Exploration of these scenarios suggested some capabilities that, if developed or strengthened, would enhance the accomplishment of future support operations. These include:

- Deployable infrastructures for remote areas where facilities, communications, housing, or medical capabilities are limited
- Command, control, communications, and intelligence where coordination with local authorities, foreign governments, or armed forces is necessary
- Psychological and civil affairs capabilities where not only a knowledge of the language but also an understanding of the culture are important.

In addition, workshop members raised a number of related issues for future consideration: To what extent should nonmilitary organizations be relied on to perform some of the support activities such as transporting supplies, personnel, and equipment by commercial carriers and using private or nonmilitary communication capabilities? To what extent will the Air Force and the United States operate under coalition arrangements where they are providing support but are not dominant in policymaking or command? To what extent might Air Force efforts to enhance its support capabilities be regarded with suspicion by the other services as a means of obtaining a larger share of the military budget? And, finally, to what extent can precrisis planning and arrangements be made for possible future support situations?

Uncovering a Deep Division

One of the most surprising—and possibly one of the most important—results of the workshop was the discovery that considerable disagreement existed among Air Force planners about the degree of U.S. military involvement in support operations other than combat

[2]Carl Builder et al., *Report of a Workshop on Expanding U.S. Air Force Noncombat Mission Capabilities,* RAND, MR-246-AF, 1993.

support. This disagreement indicates a deep division within the Air Force (and probably the other services as well) regarding the primacy of the traditional combat missions over support missions.

On one side are those who oppose making support operations an integral part of the Air Force mission. They see no problem in using available, existing combat or combat support capabilities for support operations, but they are strongly opposed to the Air Force dedicating any part of its training, force capabilities, personnel, or budget to deliberately expand or enhance capabilities specific to support missions. They hold that the basic mission of the Air Force is to fight and that emphasis on support capabilities will reduce its ability to perform this primary mission, particularly when reduced budgets are already cutting into the Air Force's combat capability.

On the other side are those who argue that the Air Force must expand its concept of itself and its role in supporting U.S. interests. It should embrace support operations as an important and growing segment of its mission spectrum in an era when the demands on the Air Force will focus as much on its support contribution to national policy as on its combat capabilities. Their view is that the nation's needs are changing and that the Air Force, as a servant of the nation, should broaden its vision beyond traditional combat roles.

This issue will need to be resolved before the Air Force can focus constructively on whether or how to expand or improve its capabilities for support operations in the future. If the Air Force does not resolve the issue for itself, it may be resolved, as with the U.S. military's involvement in drug interdiction, through budgets and mandates from outside.

This research was led by Carl Builder as part of the Strategy and Doctrine Project of the Strategy, Doctrine, and Force Structure Program.

Deterring Regional Adversaries

U.S. deterrence strategy was developed in the 1950s and 1960s in the context of the Cold War. Now the United States is faced with the problem of deterring regional or Third World adversaries. Given that the character of the potential adversary, U.S. requirements for credibility, and the military balance have all changed, U.S. strategy for regional deterrence may have to be quite different from what it has been. This research sought to clarify that difference. It drew on more than 60 case studies of 20th Century crises, focusing on those that have occurred since World War II.

Character of the Adversary

The USSR was a highly organized, developed state with government institutions of some durability. The Soviet leadership was experienced in modern war and understood the destructive potential of modern weapons—conventional and nuclear. Though Soviet leadership was nondemocratic, U.S. strategists believed that it placed a high value not only on its own welfare but also on the welfare of the Soviet population. Therefore, targeting Soviet urban-industrial targets as the hard core of U.S. deterrence strategy was deemed to exert a powerful inhibiting effect on Soviet decision-making. This inhibition was particularly strong, since it was widely held that the USSR was more or less satisfied with the status quo and had little taste for risk-taking.

Current regional adversaries of the United States are unlikely to share these characteristics of the USSR. There is no assurance that Third World leaders understand the deterrence capabilities of modern military forces, especially conventional forces. (Unlike the USSR, regional adversaries do not possess such modern forces.) Also, many Third World regimes may assign a rather low value to the welfare of their population and economy, at least by comparison to their own welfare. Threatening urban-industrial targets, therefore, may have little deterrent force. Finally, regional adversaries are often very dissatisfied with the status quo; hence they are likely to be high risk-takers.

U.S. Credibility Requirements

During the Cold War, the United States sought to deter attacks on its homeland and its major interests and allies abroad. The credibility of U.S. deterrence of attacks against itself was always high. But U.S. credibility in deterring threats to other states (even Europe) was less—unavoidably so. Indeed, the main task of the NATO strategy was to devise a way to "couple" the United States to Europe with sufficient credibility. Much of the U.S. nuclear strategy was intended to meet this problem. The problem was never entirely eliminated because, by definition, it was difficult to convince the USSR that the United States valued European security as highly as its own. Nevertheless, ambiguous credibility was

acceptable because of the importance of Europe to the United States and because uncertainty was thought to add to deterrence—the so-called threat of "leaving something to chance."

In the current period, the United States also faces an extended deterrence problem against regional adversaries. However, few, if any, of the U.S. interests threatened by regional adversaries have the same weight as Europe. Indeed, in many cases, the stakes and commitment of the adversary may be greater than those of the United States. Therefore, U.S. credibility requirements must be very high. Otherwise, regional adversaries are likely to test the United States by flouting the deterrent threat.

Military Balance

In the Cold War, U.S. deterrence was based on nuclear weapons. By the 1960s, these were reliable, numerous, and irresistible. Little skill was required to use them: Implementing nuclear operations was largely a technical exercise whose outcome could be calculated, seemingly with precision.

By contrast, U.S. deterrence of regional adversaries is based almost entirely on conventional forces, which are difficult to use well. For that reason, assessing their capabilities and likely battle outcomes can be difficult, since a seemingly inferior conventional force can prevail in many ways. The result is that deterrence based on conventional forces is likely to be less robust than that based on nuclear threat. Put another way, the threat posed by conventional forces probably has to be especially explicit and "easily read" to deter highly committed regional adversaries.

It is important to grasp, therefore, the extent to which these kinds of distinctions between nuclear and conventional forces can make an important difference in the way the U.S. devises strategy to deter regional adversaries.

Conclusions

Recent trends in U.S. military strategy, force structure, and deployments will most likely decrease U.S. capability to deter regional adversaries. The most important trend is the movement of U.S. forces back to the continental United States where it will be harder for them to play an important role in regional deterrence. Consequently, there is a risk that U.S. intervention in regional crises will come only after the adversary has reached some or all of his objectives—whereas prompt denial of his objectives is the most important factor in regional deterrence. The ability to respond promptly will also be complicated by increased U.S. emphasis on acting in coalitions, which require time to form. In addition, U.S. military forces are having to reduce operational tempo when frequent exercises and demonstrations are needed for regional deterrence. Finally, the United States is moving toward an entirely conventional regional military capability, thereby eliminating the element of deterrence created by the capacity for regional nuclear response.

This analysis has several implications for airpower. First, because of its speed and mobility, airpower will become the primary tool for establishing regional deterrence after U.S. forward-deployed forces return to the states. In a sense, airpower provides virtual forward deployment—so long as its capabilities are frequently and effectively demonstrated. The source of this airpower can be either the Air Force or the Navy, depending on the specific circumstances. Second, in the same vein, airpower must be the major component of U.S. prompt denial and punishment capabilities, unless the United States elects to begin deploying significant ground forces very early in a regional crisis and unless ground forces become much more rapidly deployable. Third, with the "denuclearization" of the U.S. Army, the Air Force and Navy will be the main instruments of retaining deterrence through the possibility of a nuclear response.

This research was led by Kenneth Watman and Dean Wilkening as part of the Strategy, Doctrine, and Force Structure Program and was conducted jointly with the Arroyo Center's Strategy and Doctrine Program.

Assuring Intelligence Support for New Weapon Systems

Often operators of newly developed weapon systems have complained that the intelligence support for their systems was "too little and too late." Problems of this nature were highlighted during the recent air operations in support of Operations Desert Shield and Desert Storm. For example, adequate intelligence products were not always available to support optimal F-117 employment and F-15E LANTIRN operations.[1]

If the intelligence data required by a weapon system are not available when needed, a priority target may not be attacked, and the successful completion of an air campaign may be delayed. Or, if sorties are sent against a target without adequate intelligence data, they may be unsuccessful for any number of reasons: the target's location is not accurately known, and the pilots cannot find it using onboard systems; the wrong critical aimpoint is selected; post-strike assessment cannot readily determine functional kill, etc. In such cases, additional sorties may be necessary that may put pilots and equipment again at risk and may result in an additional expenditure of expensive munitions.

Previous RAND research identified one reason for this intelligence support problem to be the lack of integration of the intelligence and operational communities with the acquisition community. We found that when advanced technology weapons, especially those developed within special access programs, emerged into the operational environment, they were not readily supportable by the intelligence community and sometimes possessed characteristics not desirable to the operational community. For example, data-access constraints partially caused the F-117 problem in the Gulf War. The intelligence community had little knowledge of the intelligence data being provided for development and testing. Consequently, it was unprepared to provide adequate support once the weapon became operational. Therefore, we recommended that the Air Force create a high-level oversight board, consisting of members of the intelligence, operational, and acquisition communities, to monitor intelligence support and mission planning activities during the acquisition of a new weapon system.

As a consequence of operational experiences during the Gulf War and as a result of our earlier recommendation, the Air Force Assistant Chief of Staff for Intelligence, in coordination with the Air Force Deputy Chief of Staff for Plans and Operations and the Assistant Secretary of the Air Force for Acquisition, decided that Intelligence Support Plans (ISPs) should be developed for designated weapon acquisition

[1]LANTIRN is an acronym for Low-Altitude Navigation and Targeting Infrared System for Night.

programs. Intelligence Support Working Groups are being convened to develop the ISPs. These groups typically include representatives from the Air Force headquarters organizations; the weapon system program offices; the requirements community; the operational community; service, joint-service, and national intelligence support agencies; the mission planning community; and the test community. They are charged with producing an initial version of an ISP at the end of the concept exploration and definition phase of acquisition. Thereafter, the ISP will be modified as necessary throughout the life-cycle of the weapon system—from acquisition, through operational capability, to retirement from inventory. When institutionalized, the ISP will join the Operational Requirements Document, the Test and Evaluation Master Plan, the Cost and Operational Effectiveness Analysis, and the System Threat Assessment Report as major acquisition documents.

Initially, the ISP development process focused on five major weapon system acquisition programs: F-22 fighter, B-2 bomber, Tri-Service Standoff Attack Missile (TSSAM) cruise missile, Joint Surveillance Target Attack Radar System (JSTARS), and Air Force Mission Support System (AFMSS) mission planning system.[2] Many of these programs are already in engineering and manufacturing development. Consequently, ISP development is proceeding rapidly so that any necessary modifications can be made before the weapons reach initial operational capability.

A Framework for Intelligence Support Plans

To support the Air Force ISP initiative, RAND researchers defined a framework for developing an ISP, using autonomous precision-guided weapons as a representative weapon system. As shown in Figure 7, the development of an ISP requires close working relationships among weapon developers (system program offices and the requirements community), operators (representatives from intended users: Air Combat Command, Pacific Air Forces, and U.S. Air Forces in Europe), and mission planning and intelligence personnel (service, joint-service, and national agencies).

In this framework, the nominal flow of information is as follows. The weapon developers keep operators informed of the technical characteristics of the weapon and its mission planning system. With this information, operators formulate a concept of operations that reflects the system's capabilities. Similarly, weapon developers work with the intelligence and mission planning communities to define the weapon's intelligence data requirements. With an understanding of the data requirements and the concept of operations, intelligence and mission planning personnel, assisted by operators and weapon developers, then prepare an ISP that will define the support required for the effective (and responsive) employment of the weapon system.

[2]Although not a "weapon" system, AFMSS was included because of its importance in the planning of missions for all Air Force weapon systems.

As Figure 7 shows, information flows in both directions. For example, if the technical capabilities of the weapon system cannot support the mission needs, the operators may (1) ask for modifications to the development program, (2) accept the initial shortcomings but require a preplanned product improvement program after the system reaches initial operational capability, or (3) ask that the development program be terminated. If shortfalls in the existing intelligence support and mission planning infrastructure cannot be corrected with available resources, intelligence personnel inform the operators so that they can either adjust the concept of operations or endorse the allocation of additional funding to correct the shortfalls.

Based on this framework, we have recommended that the ISP define the following:

- The intelligence data that will be provided to support mission planning and poststrike assessment
- The architecture (organizations and systems) that will provide these data to mission planners
- The intelligence personnel that will support the architecture
- The training that will be provided to those intelligence personnel
- The estimated procurement and support costs of providing the requisite intelligence support.

In addition, the ISP should fully describe any unresolved issues, define tasks to resolve them, assign organizations the responsibility for completing the tasks, and define timelines for their completion.

As a case study, RAND researchers looked at what the ISP framework

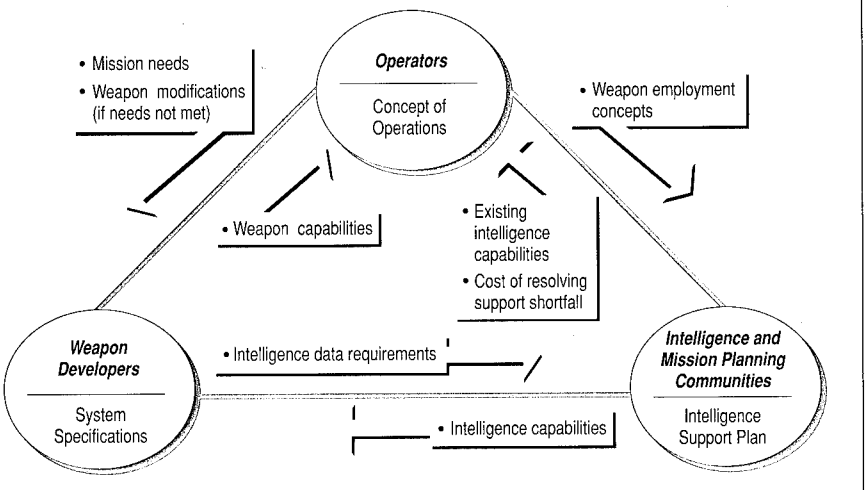


FIGURE 7

Framework for Intelligence Support Plans

suggested with regard to two categories of autonomous precision-guided weapon (PGW) systems now being considered for acquisition.

Autonomous PGWs

Most of the Air Force's conventionally armed PGWs are "man-in-the-loop": they require the assistance of an operator to reach their targets. Autonomous PGWs would enable the Air Force to attack high-value ground targets with high-delivery accuracy but without operator assistance. Moreover, standoff versions would reduce the vulnerability of non–low observable delivery aircraft to threats in the target area. RAND examined two categories of autonomous PGWs of particular interest to the Air Force.[3]

One category, seen in Figure 8, relies on an inertial navigation system (INS), aided by the Global Positioning System (GPS), to achieve high accuracy. The delivery accuracy depends only on the weapon's en route navigation accuracy and the accuracy with which the target's location is known; that is, the weapon's guidance system needs no other details about the target. Trained intelligence or

[3]Myron Hura, Gary McLeod, *Intelligence Support and Mission Planning for Autonomous Precision-Guided Weapons: Implications for Intelligence Support Plan Development,* RAND, MR-230-AF, 1993.

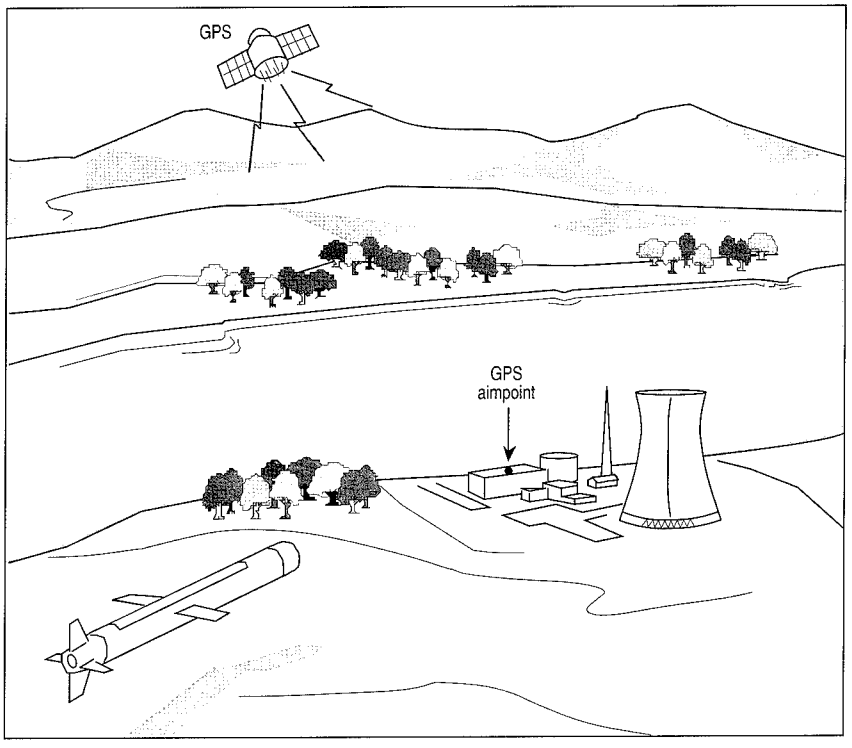


FIGURE 8

PGW with GPS-Aided Inertial Navigation System Guidance

aircrew personnel, using data from the Defense Mapping Agency, can provide the precise absolute target coordinates these PGWs need to achieve the required delivery accuracy. To do so, however, they must be provided with the critical aimpoint for the target; identifying this aimpoint may require substantial data to perform a detailed analysis of the target.

The other type of autonomous PGW, shown in Figure 9, relies, for precision delivery, on a target-imaging sensor that scans the area and a target-acquisition algorithm. The algorithm compares a sequence of preplanned target models (commonly called target templates) with information gathered by the sensor. Once the terminal guidance system acquires the target (i.e., identifies its location in the image), the PGW "homes" on the target. This novel guidance concept will enable these PGWs to achieve a very high delivery accuracy.

The delivery accuracy for this type of autonomous PGW depends on the performance of the target acquisition process, which, in turn, depends on the quality of target data available to the template builder. Previous research by RAND and others indicates that substantial amounts of target data (including imagery and physical characteristics, such as dimen-

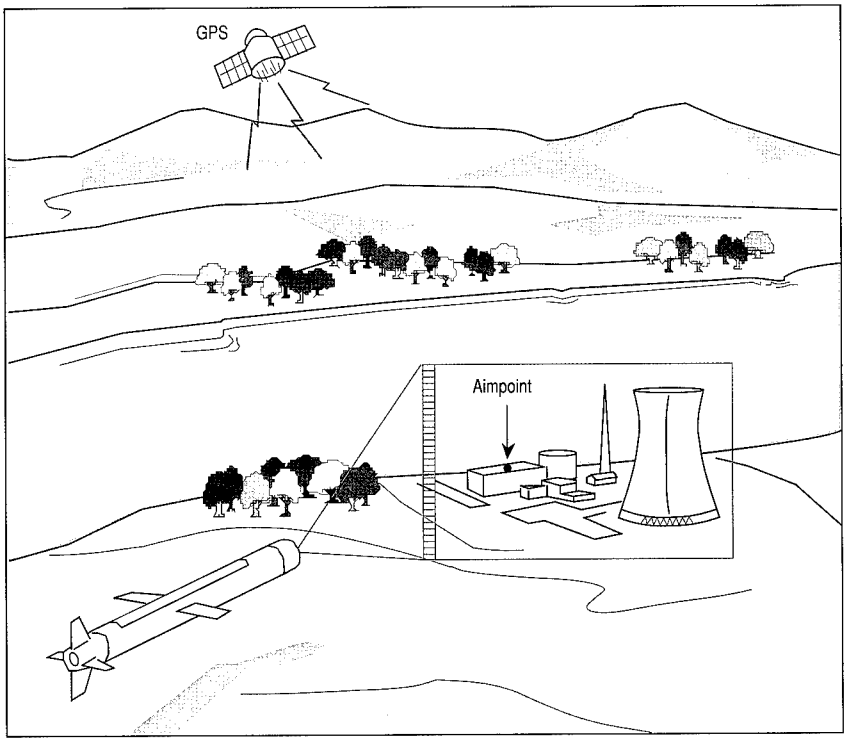


FIGURE 9

PGW with Target-Imaging Sensor

sions and construction materials) will be required to build target templates.

Key Issues for Autonomous PGWs

In conducting our ISP case study, we found two major unresolved issues related to the effective employment of autonomous PGWs with target-imaging sensors:

- No definitive specifications exist for the intelligence data required to support target template building
- The methodology for validating target templates has not been developed.

Although substantial data about the target are required to support target template building, weapon developers have not provided explicit specifications for the type and quality of target data. Without "definitive" requirements for intelligence data of the target area, the intelligence community cannot develop an effective intelligence support architecture for these weapons. Without a methodology for validating templates, mission planners will be unable to provide the operators with a figure of merit for mission success. Thus, operators will be reluctant to employ these weapons, especially if there is a high likelihood of collateral damage.[4]

Evolving Architectures for Autonomous PGWs

One RAND recommendation was that the ISP define the architecture that will provide intelligence data to mission planners. From an operational flexibility perspective, operators would like to have full control over their weapon systems. Thus, they would prefer that the required support capabilities be available at the wing or even the squadron level. Instituting such an architecture for autonomous PGWs with target-imaging sensors is likely to be costly. Considering current budget constraints and personnel reductions, an architecture that relies on one or more central facilities may be more appropriate. Such central facilities now support unified commands and the Air Combat Command; with few modifications (and thus little cost), they could support autonomous PGWs with target-imaging sensors.[5]

We propose an evolving architecture for autonomous PGWs with target-imaging sensors. The initial architecture would rely on central facilities (in the continental United States and at developed theater centers) to perform all the intelligence support and mission planning functions, except aircraft mission planning, integration of aircraft and PGW mission data, and loading of mission data into data-transfer devices. A key element in this and other centralized architectures is survivable and

[4]The Air Force is now addressing these two issues.

[5]Further savings may be realized if these centers are made available to support joint-service weapon systems. For example, the Atlantic Intelligence Command and the Joint Intelligence Center, Pacific, now provide intelligence support to two joint-service Cruise Missile Support Activities (one at Camp Smith, Hawaii and the other at Norfolk Naval Base, Virginia) for the mission planning of the Navy Tomahawk cruise missile. The capabilities of these centers to support other autonomous PGWs should be examined.

responsive communications between the central facilities and the operating units.

In the future, this centralized architecture could include a deployable PGW intelligence support and mission planning center linked directly to a deployable air operations center that supports the joint forces air component commander. The deployable PGW center would have the same capabilities as the above central facilities.

Using the experience gained at the central facilities and assuming that resources are made available, the architecture could then evolve, if required, into a more distributed architecture, with wings also capable of performing all the necessary functions to employ autonomous PGWs with target-imaging sensors. A major benefit of a distributed architecture is that it provides a hedge against loss of communications between the central facilities and the operating units. The most appropriate candidate for this distributed architecture is the recently created composite intervention wing.

Because autonomous PGWs with GPS-aided INS guidance require less intelligence data and mission planning than those with target-imaging sensors, any element (central facility, deployable air operations center, wing, or squadron) of the evolving architecture can support their employment. For this category of PGW, we recommended that wings perform the intelligence support and mission planning functions. (For targets that require detailed target analysis for aimpoint selection, the capabilities available at the air operations center may be required.)

Potential Benefits of a Common ISP for All PGWs

Because PGWs have many common support requirements, we concluded that substantial savings may accrue by using common organizations, systems, and personnel. In addition, we suggested that the ISPs the Air Force develops for joint-service weapon systems evolve toward Joint ISPs. The Air Force now has plans to follow this recommendation. For example, rather than ISPs for the Tri-Service Standoff Attack Missile, the Joint Direct Attack Munition, and the Joint Standoff Weapon, the Air Force intends to develop a single ISP for precision-guided weapons with appendices describing the unique requirements of specific systems. RAND research will continue to support the Air Force in institutionalizing the ISP process.

This research was led by Myron Hura and Gary McLeod as part of the C³I/Space Project in the Force Modernization and Employment Program.

Preserving Important Rivalries as the Military Aircraft Industry Consolidates

After Lockheed acquired General Dynamics' F-16 Division, only six U.S. firms survived with the demonstrated capabilities for developing and producing modern military aircraft: Lockheed, McDonnell-Douglas, Boeing, Northrop, Grumman, and Rockwell. Now Grumman has announced that it will no longer be a prime aircraft developer. Business prospects for these firms, in terms of new DoD aircraft developments over the next two decades, have never been so limited, and they may get worse. The consolidation process may not stop at five, four, or even three surviving firms. The next major merger proposal, or Grumman's announcement, could set off a cascading rush of corporate musical chairs.

Strong reasons exist for DoD to encourage the gradual consolidation of the industry. To achieve efficiency, industrial capacity should be brought in line with reduced business expectations. Equally important, though less widely recognized, the frequency of development efforts among the surviving firms needs to be maintained at a high enough level to adequately maintain the competencies of their design and development teams.[1]

Nevertheless, consolidation should not be indiscriminately encouraged because certain configurations would seriously restrict the alternatives available to DoD and the Air Force. This research examined the effects of different industry configurations. The results suggest that DoD should examine the potential consequences of proposed consolidation actions and discourage actions that would lead to undesirable industry configurations.

The Problem: Maintaining Competition

The primes are not interchangeable. Their depth of experience and levels of competency vary across areas. In several important areas, competencies are concentrated in just two of the six primes, creating a rivalry that DoD may well wish to preserve as the industry consolidates. For instance, McDonnell-Douglas and Grumman have a predominance of experience with developing carrier-based aircraft for the U.S. Navy. Only Lockheed and Northrop have demonstrated the capability to successfully produce a stealthy aircraft. Boeing and McDonnell-Douglas are the only major U.S. players in the global market for commercial aircraft. Another relevant rivalry relates simply to the market dominance of two firms, Lockheed and McDonnell-Douglas, in terms of their share of the military aircraft business (with current plans, these two firms will produce all five of the military aircraft scheduled to be in production in the year 2000). Still another significant rivalry is in the systems integration of avionics, in

[1]See J. Drezner et al., *Maintaining Future Military Aircraft Design Capability*, RAND, R-4199-AF, 1992.

which Boeing and Grumman have the most experience.

Two of these rivalries involve Grumman, which has just announced that it will no longer seek to be a prime aircraft developer. If Grumman's competencies are allowed to dissipate, then its rivalry with McDonnell-Douglas will be irrelevant, and DoD will be faced with just a single dominant firm in the area of carrier-based aircraft. It would be surprising, however, if Grumman does not attempt to exploit its resources by selling off its relevant divisions and facilities and transferring its capabilities to a surviving prime contractor. The issue thus arises: If Grumman transfers its expertise and facilities relevant to the development of carrier aircraft to another prime aircraft contractor, should DoD comment on which potential transfers are acceptable?

Where particular competencies reside in just two firms, DoD may wish to prevent any consolidation path in which those firms are ultimately joined. DoD has that power, if it chooses to use it. The Justice Department and the Federal Trade Commission, which enforce the antitrust laws that regulate mergers, have traditionally deferred to the wishes of DoD on mergers between defense firms.[2]

Approach

We analyzed all the consolidation possibilities to determine the combinations of rivalries that could be preserved, depending on how many firms ultimately survive. The rivalries (noted above) under consideration were:

- Carrier aircraft (McDonnell-Douglas vs. Grumman)
- Stealth (Lockheed vs. Northrop)
- Commercial (McDonnell-Douglas vs. Boeing)
- Market share (McDonnell-Douglas vs. Lockheed)
- Avionics integration (Boeing vs. Grumman).

To clarify, consider the case in which the relevant divisions of McDonnell-Douglas, Boeing, and Grumman have been joined, Northrop and Rockwell have merged, and Lockheed (having already absorbed the military aircraft division of General Dynamics) stands alone: This "three-survivor configuration" preserves the stealth and market-share rivalries but does not preserve the carrier air, commercial, or avionics rivalries.

Which combinations of the five rivalries noted above could be preserved? What steps would DoD have to take to ensure the preservation of a specific set of rivalries? The answers depend on the number of surviving firms and on the particular combination of rivalries under consideration. This analysis focused on the two most interesting cases, in which the industry contracts down to three, or even to two, surviving consolidated firms.

The possibilities can be succinctly described by ignoring Rockwell, which does not appear in any of the five

[2]In a recent proposed merger between Olin and Alliant Techsystems, the FTC appears to have broken with that tradition, but the circumstances of that proposed merger were highly unusual.

rivalries being considered. This omission, of course, has nothing inherently to do with Rockwell. We could have considered yet another rivalry, based on recent experience in the development of a heavy bomber, in which case Rockwell and Northrop would have been the relevant rivals.

Configurations That Preserve Rivalries

If just three consolidated firms survive, all five of the rivalries could be preserved. But as Table 2 shows, only four industry configurations would preserve all of them.[3]

Three-Survivor Configurations That Preserve Five Rivalries

TABLE 2

1.	McDonnell-Douglas	Lockheed + Grumman	Boeing + Northrop
2.	McDonnell-Douglas + Northrop	Lockheed + Grumman	Boeing
3.	McDonnell-Douglas	Lockheed + Boeing	Grumman + Northrop
4.	McDonnell-Douglas + Northrop	Lockheed + Boeing	Grumman

With just two survivors, it is impossible to preserve all five rivalries. A "Chinese menu" approach will characterize the possibilities:

Column A	*Column B*
Carrier-air	Stealth
Commercial	Market-share
Avionics	

To preserve four rivalries, pick "two from Column A" and "both from Column B." Every combination of three rivalries could be preserved, except for the combination listed under Column A. The asymmetry arises because the three rivalries listed in Column A involve just three firms: McDonnell-Douglas, Grumman, and Boeing.

Another, more surprising conclusion is that to preserve certain rivalry combinations, DoD would have to do more than just prevent those mergers that directly eliminate desired rivalries. Suppose, for instance, that DoD wishes to preserve the following four rivalries: carrier-air, avionics, stealth, and market-share. Only one two-survivor configuration will preserve all four rivalries:

McDonnell-Douglas + Boeing + Northrop	Lockheed + Grumman

To maintain the four rivalries, DoD obviously must prevent a McDonnell-Douglas and Grumman merger, so as to preserve the carrier-air rivalry. Similarly, it must prevent (at every stage of the consolidation process) mergers that join the relevant divisions of Grumman and Boeing, of Lockheed and Northrop, and of McDonnell-Douglas and Lockheed, so as to preserve the avionics, stealth, and market-share rivalries, respectively. But there is an additional surprise constraint:

[3]The four possibilities listed could be expanded by taking Rockwell into account. By allocating Rockwell to one of the three firms in each of the four cases, a total of 12 configurations are generated that satisfy all five rivalry restrictions (there are 120 possible ways to merge the six firms into three consolidated survivors). In 8 of the 12 configurations, Rockwell and Northrop would not be joined so that the heavy bomber rivalry would also be preserved.

two other mergers also must be avoided. Either a merger of Lockheed and Boeing or a merger of Northrop and Grumman would make it impossible to achieve either industry configuration shown above.

If DoD wishes to preserve these four rivalries, and wishes to preserve that option even if the industry shrinks to just two consolidated survivors, it can do so. But six mergers must be prevented—the four that are obvious as well as the two that might seem irrelevant. Table 3 lists all the two-survivor configurations that would preserve four rivalries, along with their surprise constraints.

Policy Implications

Although our discussion has been posed in terms of mergers, this term has been used for simplicity. The important question has to do with the capabilities of the aircraft primes and whether, as the consolidation of the industry proceeds, DoD will continue to enjoy competitive alternatives in certain important areas of expertise. For the narrow purposes of our analysis, the absorption by Lockheed of General Dynamics Fort Worth Division, which manufactures the F-16, was equivalent to a merger between General Dynamics and Lockheed. If the space industry were under consideration, of course, the two would not be equivalent at all.

Indeed, one policy alternative consistent with this analysis would require spin-offs rather than forbidding mergers. Suppose a merger between Grumman and McDonnell-Douglas were proposed, for instance. DoD might allow such a merger, as long as those facilities and design teams that give Grumman an unusual capability in designing carrier aircraft were spun off and absorbed by

Two-Survivor Configurations That Preserve Four Rivalries

TABLE 3

Rivalry NOT preserved	Industry configuration	Surprise constraints
Carrier-air	• McDonnell-Douglas + Northrop + Grumman • Lockheed + Boeing	• Lockheed + Grumman • Boeing + Northrop
Stealth	None would preserve all of the other four rivalries	
Commercial	• McDonnell-Douglas + Boeing + Northrop • Lockheed + Grumman	• Lockheed + Boeing • Northrop + Grumman
Market share	None would preserve all of the other four rivalries	
Avionics	• McDonnell-Douglas + Northrop • Lockheed + Boeing + Grumman	• Boeing + Northrop • Grumman + Northrop

some other prime aircraft developer.

Grumman has announced that it "can't stay in the business of making full jet fighters" and will "concentrate on making sophisticated components." This announcement implies that Grumman will cease to be an independent rival of McDonnell-Douglas in the carrier-air business but may or may not be a dominant rival of Boeing in the avionics integration business. It is not apparent yet, however, whether Grumman will seek to sell off assets that will effectively transfer its unusual competencies in these areas. If it does, our analysis suggests that DoD urgently needs to examine the rivalries it wishes to preserve as the military aircraft industry consolidates.

This study was not performed to demonstrate that certain rivalries should be preserved or to recommend which rivalries should have higher priority. That assessment will be made by the DoD and the military services. Nevertheless, we believe the assumptions about the significant rivalries made here are sufficiently realistic to demonstrate that DoD needs to carefully examine the issue and be prepared to take a position when mergers, or asset transfers, are proposed.

This research was led by Dennis Smallwood as part of the Acquisition Project of the Resource Management and System Acquisition Program.

The Reserve Role in Air Mobility

U.S. military forces have undertaken a wide range of missions in the wake of the Cold War, from turning back Saddam Hussein's aggression to protecting and sustaining the Kurdish minority in northern Iraq, from ending disorder and famine in Somalia to providing relief in the aftermath of Hurricane Andrew. To a great extent, the United States has depended on its airlift and tanker forces to provide the flexibility necessary for U.S. involvement to the degree and in the way deemed appropriate in each situation. Indeed, in the chaotic post–Cold War environment, the mobility forces of the Air Mobility Command (AMC) may define U.S. status as a superpower more than its strategic nuclear forces.

Not surprisingly, the varied demands of the post–Cold War era have strained AMC's shrinking active-duty resources and led the command to consider ways to lessen that stress. One possible alternative is to rely more on the Air Reserve Component (ARC)—the Air Force Reserve and the Air National Guard—to fly mobility missions. In FY 1993, PAF directly assisted AMC with an analysis of the reserve augmentation alternative.

In examining the problem, PAF researchers found that shorter warning times, rather than an increase in missions, have been the main reason behind AMC's new difficulties. The average monthly airlift missions flown per active-duty aircraft have remained relatively constant since the mid-1980s. In recent years, however, the number of flying hours scheduled with less than 30 days' notice has grown to more than half the total hours flown. The number of missions requested less than 10 days ahead of time has also increased substantially.

A Key Constraint: Availability of Reservists

Once the problem was understood, the researchers identified the key constraints and opportunities affecting AMC's greater use of the reserves. The focus was on the established role of the ARC and the availability of reservists, although some rough estimates were also made of relative costs.

A principal conclusion was that it is feasible to increase the reserve components' contribution to the mobility mission. AMC needs to be aware, however, of constraints that may be imposed by the ARC's current role and by the part-time nature of the reservist's service. According to current laws and regulations, the primary peacetime role of the reserve forces is to train to be ready for wartime mobilization. Peacetime military missions can be performed but only to the extent that they are compatible with training and do not interfere with the training role. In the case of the mobility system, the ARC has provided airlift as a "by-product" of training. Nonetheless, since ARC mobility forces need the same global training and experience as do the active forces, the reserves have been able to provide considerable peacetime

augmentation to AMC, representing 20 to 25 percent of the global missions. We believe that this contribution can be increased through planning and agreements with the reserve components.

As for availability, the average reservist in an ARC airlift unit already flies two to three missions per month to maintain proficiency and mission qualifications. Most of these missions have the long scheduling lead times, limited durations, and firm return dates that are compatible with the part-time nature of reservists' service. Because reservists need to arrange in advance to be away from their full-time employment, schedules must be kept firm: canceling training to support short-notice global missions means the training is often lost, usually until the following month. Regularly sacrificing training to current demand in this way could mean a rapid loss of reserve readiness.

Nevertheless, the change in the world environment has produced a change in the demand for airlift. Peacetime and wartime demands are becoming much closer to one another. The old wartime scenarios encompassing the rapid deployment of many Army divisions to Europe are no longer relevant, while the peacetime demand for contingency airlift seems to have expanded substantially. Planning has always assumed the availability of reserve forces to augment the actives in wartime. If the mobility mission is a special case, in which wartime rates of operation occur relatively often in peacetime, then it may be time to reconsider the traditional concept of the reserves as a force available in the main only after mobilization.

Relative Costs

In seeking to strike the proper balance between active and reserve forces in the mobility system, the relative costs must be studied. Traditionally, ARC units are thought of as being a less costly way to maintain forces for use in emergencies. As Figure 10 shows, ARC units (i.e., Reserve and Guard units) are indeed less expensive in terms of the annual cost per crew. When ARC units are actually used to support peacetime operations, however, their costs are similar to those of active-duty units.

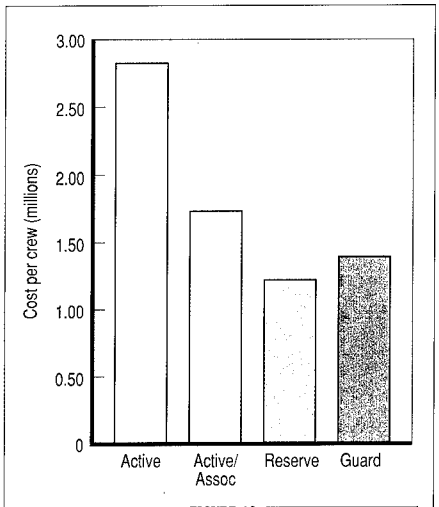


FIGURE 10

Reserve and Guard Units Are Less Expensive in Terms of Annual Costs per Crew

Figure 11 shows that the costs *per flying hour* are roughly comparable for four different unit types—active, Reserve

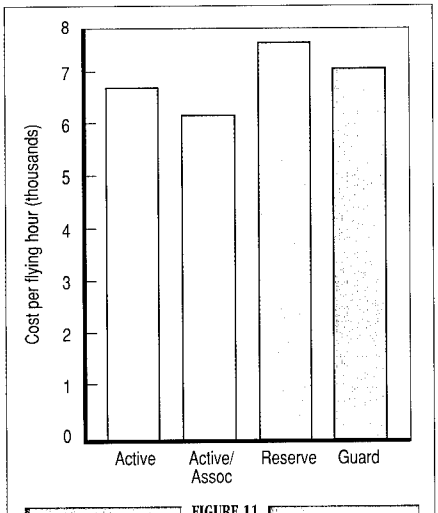


FIGURE 11

For the Peacetime Mission, Costs per Flying Hour Are Comparable

Associate,[1] Air Force Reserve, and National Guard. We expect that, with marginal increases in peacetime augmentation to the air mobility system, these relative costs should remain about the same.

Options for Change

The researchers identified a number of options that might alleviate the stress on AMC's resources:

- Modify the transportation priority system and tariff rates so as to induce better mobility management and motivate users to submit their airlift requests early. These actions would provide more of the long-lead missions that are compatible with reserve (and commercial) augmentation.
- Increase the use of reserve "floater" aircraft and crews, i.e., aircraft and crews available continuously to AMC over a period of time, such as two weeks, for short-notice scheduling.
- Increase the use of tanker aircraft for airlift. Active-duty and reserve tanker aircraft and crews are capable of substantially augmenting AMC, primarily in transporting bulk cargo and passengers.
- Consider broadening the ARC training mission to make ARC units more available to AMC for peacetime airlift.

The analysis concluded that, although the ARC does augment AMC substantially on an ad hoc basis, few if any formal agreements exist between AMC and the reserve components that allow AMC to plan for specific levels of support throughout the year. Given the dramatic changes in the airlift operating environment in recent years, it is time for AMC and the ARC to conclude formal agreements on levels of augmentation over time, tasking procedures, and funding sources.

This research was led by Paul Killingsworth as part of the Force Structure Project of the Strategy, Doctrine, and Force Structure Program.

[1]Reserve Associate units are collocated with active units and fly the active-duty-assigned aircraft for training.

Russian Airpower at the Crossroads

Russia's air force, the VVS (or *voenno-vozdushniye sily*), is in the grips of a painful metamorphosis. The many headaches and graver illnesses it inherited from the former Soviet system include:

- Severe housing shortages for officers and their families
- Glaring deficiencies in operational training
- A tyranny of bureaucracy at the regiment level
- Problems of honesty within flying units
- Poor equipment quality and reliability
- Sagging aircrew morale and retention.

Because of these and related problems, Colonel General Petr S. Deinekin, the VVS's commander in chief, faces an unusually daunting situation. He has been forced to put any serious thought of force modernization and training reform on the back burner while he grapples with the more immediate and pressing challenge of recovering from the collapse of the USSR, completing a radical downsizing, and defining a new role for his air force in the post-Soviet era.

The Enduring Importance of Russian Airpower

So what, one might ask? Why should Americans care any longer about an air force that not only no longer threatens our security but, indeed, finds its very survival in jeopardy?

Increasingly, the freedom of expression made possible by glasnost has made the VVS an open book. Throughout the Cold War, the Soviet air force was an elusive subject for Western analysts because of pervasive Soviet secrecy. Today, with the Cold War over and the USSR a fading relic of history, those barriers are slowly but surely coming down. As a result, Western airpower experts are increasingly able to study military aviation in Russia much as they would study it in any other country.

This new openness offers an unprecedented chance to update and, where necessary, correct our past impressions of the VVS. Beyond that, richer knowledge of Russia's aviation complex today can shed light on its possible future course once the post-Soviet reform process establishes a firmer footing. Whatever transition pains the VVS may be experiencing at the moment, the odds are good that Russia will emerge from the death of communism as a strong nation. There is also little doubt that airpower will constitute a key part of its capability.

By far the greatest payoff, however, is simply the opportunity for learning more about a potential fellow air force at a time when improved ties—and even the prospect of a functioning security partnership—between Washington and Moscow portend closer relations between the two services. With military-to-military contacts now an established feature of the Russian-American

relationship, it behooves the USAF to do everything it can to become better acquainted with its Russian counterpart.

The Soviet Legacy

Thanks to glasnost, the Russian military press since 1987 has printed an outpouring of highly candid self-assessment and self-criticism by VVS officers. This commentary has disproved earlier suggestions by many in the West that Soviet training and tactics were becoming increasingly analogous to those of the USAF, in consonance with the expanded performance capabilities of fourth-generation aircraft like the MiG-29 and Su-27. On the contrary, firsthand testimony from Russian pilots indicates that tactical applications have *not* changed fundamentally with the advent of new equipment and that air combat training continues to be conducted under close ground supervision.

Many of the complaints recently voiced by VVS pilots echo those long given recurrent airing by their Western counterparts. These include such perennial vexations as overly intrusive higher-headquarters supervision of flight operations, seemingly endless square-chasing at the squadron level, burdensome collateral duties for pilots, and continued tension between the imperatives of flight safety and the often conflicting demands of operational realism in peacetime training.

Russian airmen have expressed discontent over more fundamental concerns as well, including misplaced service priorities, rampant compromises of integrity by commanders at all levels looking mainly to "get ahead" within the system, and a consequent loss of vision and sense of purpose by the VVS institution as a whole.

The most glaring deficiency affecting the VVS, however, remains the pervasive rigidity in both operations and thought that the communist system, for years, imposed on line pilots and commanders who knew better but were obliged to pretend otherwise. *This* is the holdover from the now-discredited Soviet approach to operations and training that Russian airmen will have to work the hardest to overcome. Entrenched habits of a professional lifetime will not be discarded overnight.

Current Problems

What kind of Russian air force is emerging from the wreckage of Soviet communism? To begin with, it is but a remnant of the former Soviet air force. From 20,000 pilots and 13,000 aircraft in late 1991, it has now shrunk to some 15,000 pilots and only 5,000 aircraft. Many of the newest aircraft maintained by the Soviet air force were lost to Ukraine, Belarus, and Kazakhstan when the USSR fell apart in December 1991.

The VVS faces a severe problem with regard to force modernization. It has stated a requirement for a follow-on to the MiG-29 and Su-27. Yet, at least today, there is virtually no funding support for such a program. More than 70 percent of the VVS's budget is targeted for housing and social welfare,

with little left for R&D and procurement. As a result, financing has come to a near-halt for even *current*-generation force improvement, let alone a follow-on fighter. Because of Russia's acute cash shortage, first deputy defense minister Andrei Kokoshin has suggested that for the near term, the VVS may have to satisfy itself with upgrades to existing aircraft and defer the development of a new fighter until Russia reacquires a healthier economy.

The pilot-to-aircraft ratio has more than doubled as a result of the continuing withdrawal and deactivation of flying units from Eastern Europe. In some regiments, the ratio is as great as five to one. Coupled with skyrocketing fuel costs and a marked decline in fuel allocations, available flying hours have been reduced to crisis levels. Especially hard hit have been fighter pilots, who are now averaging only 40 hours a year. (Bomber crews are getting 80 hours and transport crews up to 150 hours.)

Maintenance is also suffering, with enlisted manning down to below the 50-percent level in many units and spares in increasingly scarce supply. Not surprisingly, as a result of these influences the accident rate has risen notably.

Finally, the sharp decline in the former appeal of military service life among Russian youth has severely undermined pilot recruitment and has raised disturbing questions about how the VVS will secure its successor generation. During the Soviet era, flight schools typically got six or more applicants for each vacancy. Today, the application rate is little better than one for one. As a result, no serious competition exists for pilot training slots. To make matters worse, entire graduating classes from VVS flight schools declined their commissions during the past year because of the bleak prospects for an air force career. Given the dearth of cockpits, many other graduates accepted their wings only to be "banked" for an indefinite future in nonflying assignments.

The Near-Term Outlook

Exactly what kind of VVS will emerge from these rocky straits remains hard to say. In the near term, much will depend on the extent to which Russia's faltering economy will permit the channeling of enough funds into the VVS's operations and maintenance accounts to underwrite a training regime commensurate with the new latitude for improvisation it has acquired. Farther down the road, much will also hinge on the extent to which the continued disestablishment of the old communist order will bring about a permanent change in practices and procedures at the unit level.

In light of the powerful role model provided for Russian tacticians by the Desert Storm experience, plus the easing of many restrictions that obstructed any serious effort at tactical reform in the Soviet air force, many impending changes in Russian operational practice could show a heightened Western orientation. Air-to-air training warrants special attention in this respect. Since improvement in air combat prowess is essentially cost-free (in that it turns

largely on altered procedures rather than on new equipment), the VVS is now poised to begin applying whatever inclinations its tacticians may long have harbored by way of desired changes.

The one constraint here, possibly serious in the near term, entails the extent to which even seemingly "low-cost" amendments to tactical training may be preempted by a diversion of already scarce operations and maintenance funds toward providing housing and other needed quality-of-life improvements for air force officers and their families. Another question is where the VVS will find a home-grown experience base for developing a fundamentally new approach to air combat.

In all events, Russia's air force now stands at the threshold of the most radical departure from its former ways since the earliest days of the Soviet state. The best of its new leaders have freely admitted their problems and indicated what they believe needs to be done to find solutions. Thus, a major obstacle has been removed from the road to recovery. Also, the stage has been set for a time of creative ferment that could begin at any moment, once the Russian armed forces emerge from their current crisis with a measure of fiscal solvency.

This research is led by Benjamin Lambeth as part of the Strategy and Doctrine Project of the Strategy, Doctrine, and Force Structure Program.

TLC/NLC Modeling and Implementation

The dissolution of the Soviet Union set in motion major changes in thinking about the role of the Air Force in the types of conflict likely in the foreseeable future. Previously, the role of air forces in campaigns was largely to defeat the opponent's tactical air force and to prepare the battlefield, while ground forces were responsible for the decisive phase of the ground battle. The Gulf War indicated that air forces may be capable of a much greater share of that decisive phase; for example, the long air bombardment of the Iraqi ground forces seriously undermined their capability and will to fight.

Post–Cold War developments have also suggested new scenarios, ranging from major to limited regional conflicts and the necessity of new concepts of operation to address them, not only new roles and missions for the Air Force and Army but the frequent involvement of coalition forces, new demands on logistics, command and control, sensors and intelligence, and new constraints on deployment, casualties, and collateral damage.

Current theater and operational level force models are only able to capture a few of these new dimensions of warfare scenarios, operations, and alternative roles. The Air Force and Army asked RAND to develop the Theater-Level Campaign model/Non-Linear Combat (TLC/NLC) tool kit. The model consists of a set of modules and tools that can be used in a variety of combinations to simulate combat in various locations, involving an array of force structures, mobilization requirements, transportation means, and support postures. It can simulate conflicts between conventional and unconventional forces and equipment, deployment from the United States, and employment of new technologies. Five unique features are described below.

- *Analytic Resource Allocation Processes.* TLC/NLC allows the user to specify ground and air resource allocation in detail or to rely on optimizing algorithms that capture many of the dynamic and interactive features of resource allocation for combat. In the latter case, the user specifies the objectives to be maximized (such as opponent's attrition) or minimized (such as own attrition) and the algorithms allocate resources to best meet these objectives.

  Figure 12 illustrates tactical air campaign allocations generated by the model for two different ground campaign situations. In the first situation, the air forces focus on the attack of strategic targets and offensive counter-air activities while the ground forces build up. This allocation strategy reflects operations against an attacker who is not initially conducting offensive operations. In the second situation, the air forces focus on the ground battle at the expense of some

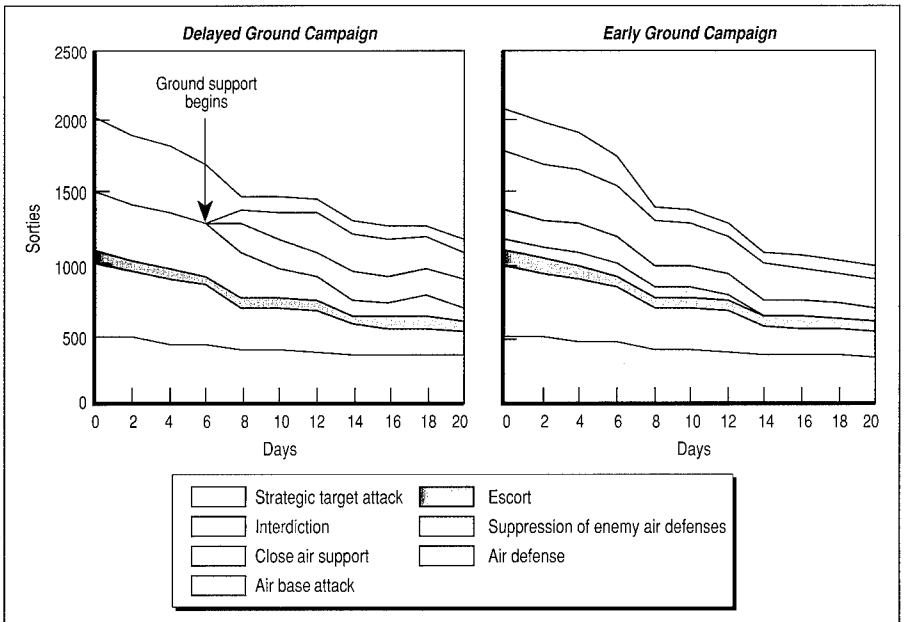


FIGURE 12

Alternative TLC/NLC Air Allocations for Different Ground Campaigns

strategic target attacks and some offensive counter-air activities to stop a ground-force aggressor while friendly ground forces build up. In both cases, the TLC/NLC algorithms generated these air strategies automatically based on two scripted aggressor strategies. The advantage of such algorithms is that they adapt to the capabilities and scenario without requiring user intervention and reflect the "best use" of force given specific objectives and constraints.

- *Network-Based Gameboard and Graphic/User Interface.* These highly interactive tools allow the user to create and place objects on a map using an interactive graphics software called MapView. They then process the overlaid objects to set up a simulation by using the Terrain-Oriented Network Generation System (TONGS) software. User-specified objects include a variety of natural, man-made, and operational features, including terrain, road, and rail networks, in addition to surface-to-air missile and air flight networks. Data on facilities and locations can also be imported directly to the graphics processors from a large database.
- *Object-Oriented Construction.* TLC/NLC has been constructed using MODSIM II, an object-oriented simulation language. The high degree of modularity of this software makes it easy to alternate

between different levels of resolution and add new objects to the existing simulation. Figure 13 illustrates some of the object components of the model.

- *Ground and Air Attrition Processes.* TLC/NLC uses situation-dependent attrition processes for both ground and air combat. For ground combat, it uses the Calibrated Differential Equation Methodology (CADEM), a refinement of the U.S. Army Concepts Analysis Agency's ATCAL attrition calibration methodology. Air attrition calculations use tables from TAC Brawler and take into account the geometry and situational context of combat.
- *Joint Forces and Dynamic Coalitions.* Rather than emphasizing detail in either ground or air at the expense of the other, TLC/NLC represents air and ground forces at the same detailed level of resolution. For example, it models ground forces at the brigade level, but for movement and combat it represents them at the battalion level. Similarly, air forces organized into squadrons can be configured in flight packages of one or more aircraft. Instead of focusing solely on two monolithic opposing forces (e.g., red and blue), TLC/NLC can represent a variety of national and subnational forces. These forces may have different objectives and characteristics and

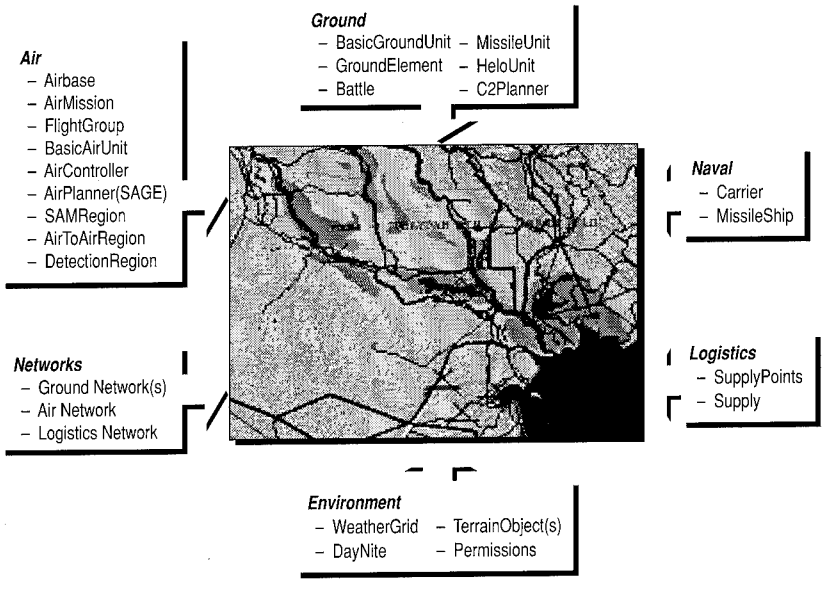


FIGURE 13

TLC/NLC Objects

may exhibit complex and differentiated behaviors toward friends, foes, and neutrals. Further, coalitions are treated dynamically, subject to user-specified rules for entry into and exit from a coalition. For example, permission may be given to land aircraft but not to rearm; by the same token, permission may be given to use force defensively, but not to undertake offensive operations.

Taken together, these features of TLC/NLC provide a robust simulation environment that should contribute substantially to meeting the emerging requirements for future defense policy analyses.[1] The TLC/NLC model is currently undergoing testing and validation exercises at RAND. It will be applied to two RAND projects beginning in 1994.

This research was led by Richard Hillestad as part of the Force Employment Project of the Force Modernization and Employment Program.

[1]A description of key features of the air combat model can be found in *Air Combat Model Engagement and Attrition Processes High Level Design,* N-3566-AF/A. The scenario graphic user interface software is described in *MapView User's Guide,* MR-160-AF/A. See also *New Issues and Tools for Future Military Analysis: A Workshop Summary,* N-3403-DARPA/AF/A.

DSP or FEWS: The Operational Consequences

Tactical warning satellites detect ballistic missiles during powered flight to warn of an imminent attack. The current Defense Support Program (DSP), originated in the 1970s, uses infrared sensors to spot the plumes of long-range ballistic missiles. The latest proposed alternative system, the Follow-on Early Warning System (FEWS), offers additional capabilities, including on-board data processing to speed warning, crosslinks with other satellites to avoid dependence on ground stations, and a faster scan rate to improve detection of smaller missiles.

These capabilities make FEWS expensive. Its high cost, and the fact that many of its capabilities were originally motivated by the Soviet threat, makes FEWS an attractive target in the current budget debate. Whether to continue the FEWS program or simply improve the current DSP system is one of the most important choices the Air Force faces in its space budget.

This research compared the operational performance of FEWS with the performance of both DSP and a third alternative: DSP combined with a regional satellite capable of detecting small missiles—a system that requires little further development time or cost. The results show that FEWS is marginally more effective in two cases. In all other cases, FEWS offers no significant operational edge over the third alternative.

Satellite Alternatives

DSP satellites are large and heavy and thus require an expensive Titan IV to launch and place in geosynchronous orbit. Each satellite spins in orbit, which enforces a particular signal processing scheme and scan rate and limits the satellite's power, since solar power arrays cannot be pointed at the sun. Because ballistic missiles can only be detected when they rise above any clouds—and because smaller tactical missiles, like Scuds, are not above the clouds for long—an early warning satellite must have a fast scan rate if it is to reliably detect these smaller theater ballistic missiles.[1] DSP, although still adequate to detect the larger strategic missiles, has no natural growth path to increase its capability against smaller theater missiles.

FEWS is the planned replacement for DSP. As a three-axis stabilized satellite, it can easily accommodate different scanning patterns. It can also point its solar arrays at the sun and gain more power for the same weight. Although many of its features are rooted in Cold War requirements, FEWS will perform more effectively in regional conflicts than DSP because it has a very rapid scan rate and can concentrate its time in a limited area to detect the smaller, dimmer missiles used in theater combat. It can also provide global coverage for detection

[1]Still smaller tactical missiles that may burn out below the clouds cannot be detected under all weather conditions by any of these alternative systems.

of small missiles. In other words, it can detect the launch of theater ballistic missiles in areas where regional satellites are not present.

The regional DSP, the third alternative, would have the sensitivity and rapid scan rate of FEWS. Unlike FEWS, however, the smaller satellite would offer only regional—not global—coverage, roughly one smaller satellite per region.

Table 4 summarizes the advantages and disadvantages of these three systems. Two advantages of DSP and regional DSP are that they have no development costs and are available now. FEWS has very high near-term development costs and would not be available until the next century. In contrast to FEWS, however, systems with an unchanged DSP satellite offer no potential to reduce future operational costs. FEWS can be designed to be a lighter, cheaper satellite that would be less expensive to launch and operate. Similar opportunities exist to reduce future costs by redesigning DSP, but such redesigns would not address the operational issues examined in this research.

Summary of Advantages and Disadvantages of Alternative Early Warning Satellites

TABLE 4

System	Advantages	Disadvantages
DSP	Provides global coverage of large missiles	Does not provide reliable coverage of small theater ballistic missiles
	Available now	No clear growth path
	No additional near-term expense	No reduction in future costs
FEWS	Offers global coverage of both large missiles and small theater ballistic missiles	Expensive development program
	Growth path available	
	Potential to be lighter, cheaper satellite, reducing future costs	
DSP + smaller regional system	Adds regional coverage of theater ballistic missiles	No global coverage of small theater ballistic missiles
	Available now	No reduction in future costs
	Growth path available	
	Modest near-term expense	

Differences in Performance

This research assessed the differences involved in fielding these three different early warning satellites in specific theater operations. Rather than assessing them in terms of official military requirements, some of which have no clear operational justification in the new era, we took as our criterion how well each system performed a specific function in support of a particular operational task.

The first step was to analyze all the functions performed by tactical warning systems in support of a wide variety of military tasks, from warning of attack in a theater to gathering of intelligence. In most combat operations, we found that the performance of the three systems was essentially the same. In fact, only two cases showed measurable differences in the satellite contribution:

- Enhancement of defenses against ballistic missiles, specifically, the enhancement of advanced systems like the Theater High-Altitude Air Defense (THAAD) system

- A counterforce attack against the missile launchers using Joint STARS and F-15Es.

In both cases, we constructed detailed technical and operational models to measure the effectiveness of the three types of satellites.

Effects on Defenses. Figure 14 illustrates both the concept of operation and the steps of the analysis in the first case. The first step was to estimate the uncertainty in the position of the tactical missile, which as the figure shows, gets larger as the missile travels along its trajectory. We passed that estimate on to a model of the THAAD radar, whose beam time in any given area we assume is optimized for the best detection. With the cue, the THAAD radar can focus its energy on a restricted area and, as a result, detect objects further away, and detect them more quickly. Once the radar determined the flight characteristics of the missile, we could calculate whether an interceptor could get to any point along the missile trajectory by the time the missile arrived at that point. Using each alternative tactical warning satellite system, we identified the areas where a defense could be sited and still intercept a given attacking missile. We also calculated the locations that would allow for a single intercept and for two intercepts (shoot-look-shoot).

We reached several conclusions:

- DSP alone, as expected, could not reliably detect smaller theater ballistic missiles.
- The other two systems—FEWS and the DSP regional system—could both reliably detect smaller theater ballistic missiles. The distance of

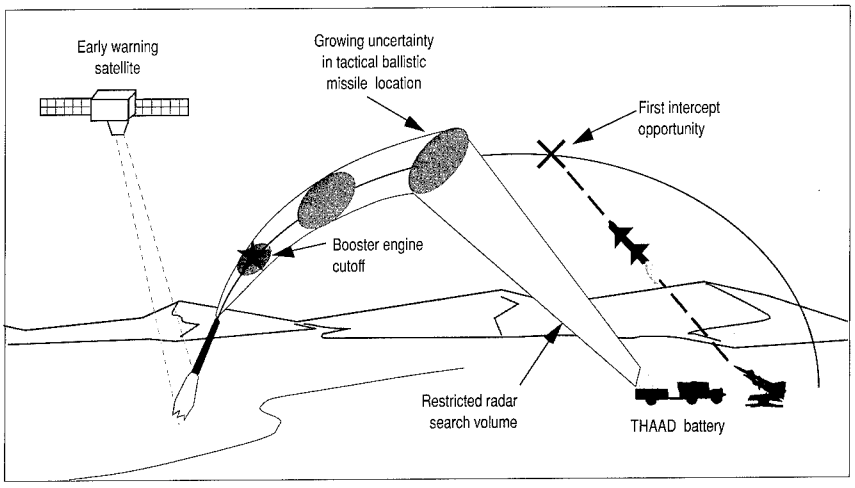


FIGURE 14

Effect of Early Warning Satellite on Defenses

defense sites from the threat and the opportunities for intercept opportunities were almost identical using these two systems.

- FEWS alone is more robust in one situation: when the THAAD radar is faced with many targets and, therefore, must spread its energy over many individual missiles. In this case, FEWS allows the defense to engage more targets in a short time before saturating.

Effects on Counterforce. Figure 15 illustrates the concept of operation for the counterforce task we examined—locating and destroying launchers after launch. This concept of operations was chosen because it is the only counterforce concept that makes essential use of tactical warning satellites. As the figure shows, the tactical warning satellite provides the general location of a launch vehicle on the basis of its detection of a missile plume. Joint STARS then tracks all vehicles leaving that specific launch area and guides F-15Es equipped with LANTIRN to each suspicious vehicle. What follows is a race in which the F-15Es try to run down all vehicles before the launcher reaches a hiding place. Clearly, the outcome depends on the distance to the hiding place, the number of F-15Es available, and the number of other vehicles leaving the area, among other factors.

The results of this analysis showed that FEWS outperformed both DSP-based alternatives. FEWS's superiority in this context is that it can identify the point of

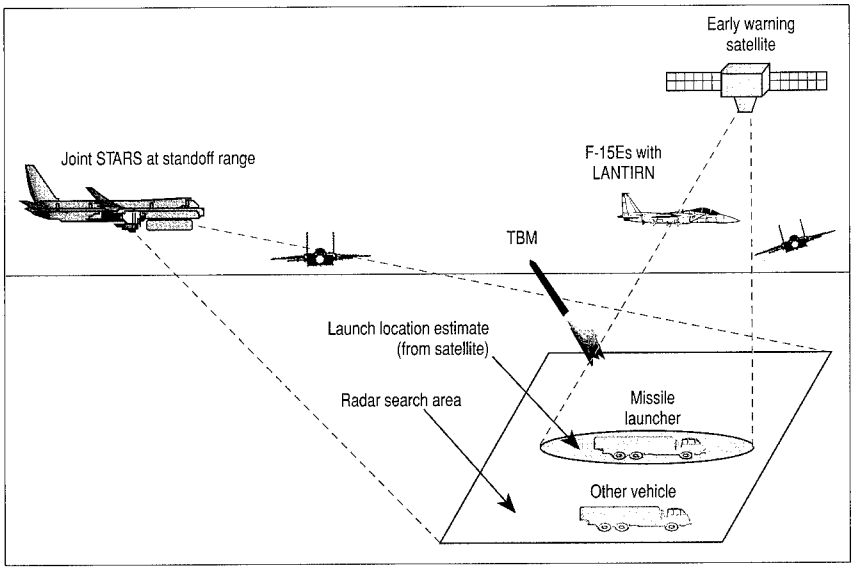


FIGURE 15

Counterforce Operation Involving Early Warning Satellite

origin of the launch more precisely than the other satellites. In other words, Joint STARS and F-15Es would have to track fewer false targets leaving the area to identify the actual launch vehicle.

The superiority of FEWS in performing this function, however, needs to be qualified by the limitations of this concept of operations:

- The concept of operations may fail except in open terrain, such as a desert. If the enemy is launching missiles from an urban area such as Baghdad or a heavily forested area, such as much of Korea, then this concept of operations is impractical, whatever the space system.
- The concept of operations is only effective if hiding places are far enough from the launch site that the launchers can be attacked before they reach the hiding places or if the hiding places themselves are vulnerable.
- The concept of operations is reliably effective only if the ballistic missiles do not have the capability to maneuver under any clouds.

In fact, this counterforce operation could be confused by the simple tactic of using decoys: that is, driving a dozen vehicles away from the launch point at the same time, although gathering vehicles in that way could introduce other sorts of vulnerabilities that an attacker might be able to exploit. In general, alternative approaches to solving the counterforce problem exist that do not rely on infrared satellites at all. Some of these could prove adequate, or even preferable, regardless of what happens to FEWS.

Conclusions

All three alternative tactical warning systems satisfy the demands of many military tasks. Most notably, all can fulfill tasks involving strategic missiles or longer-range theater missiles in the new world. The differences occur in a class of smaller theater missiles.

FEWS did demonstrate clear superiority in two limited operational situations: defending against a simultaneous barrage of theater missiles and locating launchers in a specific environment. Its more general advantage is that it provides worldwide coverage of ballistic missile activity. With this capability, FEWS could identify the use of ballistic missiles in regional conflicts not already covered by other satellites or gather intelligence on third-world testing of ballistic missiles.

The Air Force and DoD must now assess whether the capabilities of FEWS are worth the price. As this research demonstrates, DSP plus a smaller regional satellite can perform all the other functions we considered necessary to support combat operations against regional adversaries with ballistic missiles. Whatever the decision on FEWS, the DSP-based alternative remains the only effective early warning satellite that can be fielded in this decade. It is reported that the Office of the Secretary of Defense has cancelled FEWS, but this action has not been ratified by congressional action.

This research was led by James Bonomo as part of the C³I/Space Project in the Force Modernization and Employment Program.

Finding the Right Mix of Civil and Military Airlift

Although DoD plans in 1992 called for doubling the outsize capacity of military airlift—from about one-third to two-thirds of the cargo capability—the experience of the Gulf War showed that the greatest need for airlift was not outsize but bulk. Figure 16 shows that the demand for transporting bulk—i.e., materiel loaded on standard 463L pallets—ranged from nearly half the total cargo airlift in the early stages of the deployment to nearly two-thirds of all cargo in the peak month (January).[1] Reinforcing this trend is the shift toward increased prepositioning of equipment and the growing capacity for fast sealift that can carry outsize (i.e., extremely large and heavy) equipment, such as tanks, large helicopters, and Patriot batteries.

[1]The greatest activity occurred during the three periods depicted in Figure 16.

These developments, along with intense pressure to invest scarce resources as wisely as possible, led the Air Force to request research on the question: What would be the best mix of civil and military airlift assets to provide the Air Force with sufficient airlift capability to support future combat operations, assuming that cost is an important consideration?

The Contribution of Civil Transports in the Gulf War

Because of their payload advantages, large civil transports like the 747 were a major contributor in the Gulf War. As Figure 17 shows, the 747-400F, the latest version of the 747 modified to carry freight, is more capable than any military transport in carrying heavy payloads long distances. The 747-400 does not bear

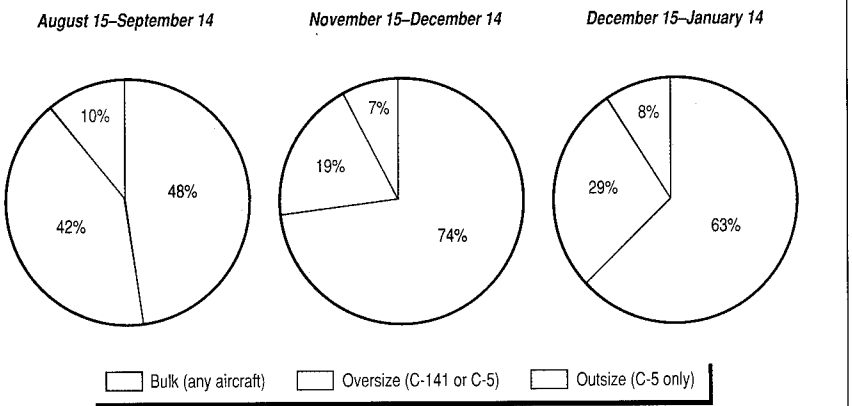


FIGURE 16

Mix of Gulf War Cargo Loads

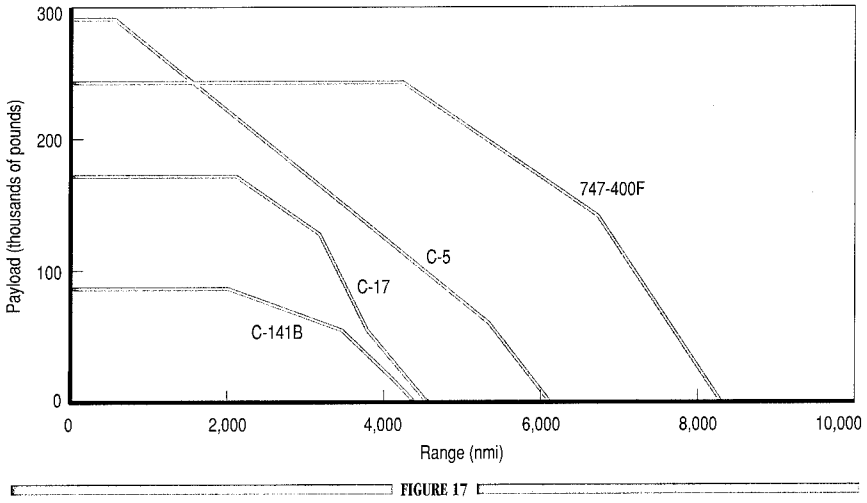


FIGURE 17

Payload as a Function of Range for Transport Aircraft

the weight of special ramps and strong floors necessary to withstand the heavy loads of wheeled and tracked vehicles, and it does not require a ramp and doors that open in-flight for air drop, allowing its aft fuselage to be better tapered to minimize drag. It is also considerably less expensive, even if it is owned and operated by the government.

Figure 18 compares the cost of carrying 1,000 tons per day in three different transports: the C-17, the C-5, and a 747-400F.

The civil transports that played such a significant role in the Gulf War deployment were made available to the Air Force by activating the Civil Reserve Air Fleet (CRAF). Although the Military Airlift Command asked for a Stage III activation, which would have provided three times more aircraft than were eventually called up, the government bowed to pressure from the commercial carriers and activated only Stage I for passenger aircraft (providing eighteen 747 equivalent aircraft) and Stage II for cargo aircraft (providing twenty-eight 747-200 freighter equivalent aircraft). Altogether, these aircraft supplied two-thirds of the passengers and one-fifth of all the cargo carried by aircraft to Saudi Arabia for the

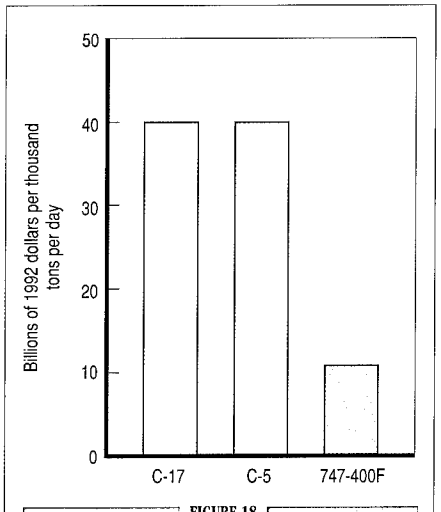


FIGURE 18

Life Cycle Cost (25 years) per Standard Unit of Capacity to Airlift Cargo to Southwest Asia

war. Among the civil transports, the 747 was the most heavily used for both passengers and cargo.

Although CRAF performed successfully in this contingency, it is not certain that it can be called on to the same extent in the next national crisis. This research and other PAF studies have raised questions about the long-term viability of a very large CRAF. Major commercial carriers have learned from this first activation of CRAF in its 40-year history that it is extremely disruptive of normal business. These carriers tend to operate at high utilization rates on scheduled routes with secure markets to recover their considerable investment costs. CRAF activation threatened their schedules, market, and ultimately the long-term sources of funds required to run their fleets. Changes in the global strategic environment are also weakening the incentive for carriers to participate. The amount of overseas peacetime business offered to those who volunteer for CRAF is declining as U.S. military presence overseas declines.

Besides the uncertainty of future CRAF participation, two other trends may affect the availability of large civil transports to the military in crises. One is that U.S. carriers are moving away from large transports like the 747 in favor of small (757) and midsize (767, MD-11) transports that are better suited to hub-and-spoke operations and better matched to frequent service on many international routes. The other trend is that U.S. carriers are increasingly turning to international partners to share ownership and operation of their airlines.

Because the demand for civil carriers appears to be growing and large-scale commercial participation in future crises cannot be guaranteed, our analysis explored the possibility of augmenting the current military fleet with large civil transports, as shown below.

Assessing the Options

The inventory of current transports projected to be in service after the year 2000 includes 109 PAA C-5s and 80 PAA C-141s.[2] For this analysis, that inventory was assumed as the baseline, along with the commercial aircraft equivalent of those activated in the Gulf War (eighteen 747 equivalent passenger aircraft and twenty-eight 747-200 equivalent cargo aircraft). Table 5 shows the five options we examined for augmenting that inventory. These options represent a spectrum of possibilities from full reliance on the C-17 on the one hand (Option A) to full reliance on a militarized version of the 747-400F (Option E). All the options would enhance total throughput capacity of the baseline fleet by an order of magnitude at vastly different costs:

- Option A represents the Air Force's 1992 plan, which included replacement of all but 80 PAA C-141 transports with 120 C-17 (102 PAA) transports.
- Option B reduces the C-17 buy to 60 and compensates by increasing the size of the C-5 fleet.

[2]Primary authorized aircraft are assigned to operational units. In addition, there are about 10 to 15 percent more aircraft in the inventory to compensate for aircraft lost to attrition or in maintenance.

Additional Throughput and Costs for Each Option

TABLE 5

Options

Type of aircraft	Number of aircraft added				
	A	B	C	D	E
C-17	120	60	60	0	0
C-5C	0	60	0	0	0
747-400F	0	0	28	28	42
KC-10*	0	0	0	59	0

*These aircraft need not be purchased but are added here to refuel the C-5.

Comparative throughput

	Added throughput in thousands of tons				
	A	B	C	D	E
Deliverable to short (<5000') runways	0.96	0.48	0.48	0	0
Deliverable as outsize	0.96	1.04	0.48	0.37	0
Total tonnage to theater	0.96	1.04	1.41	1.30	1.39

Comparative costs

	Added costs in billions of 1992 $				
	A	B	C	D	E
25-year life-cycle costs	39	43	30	36	15

- Option C consists of the reduced C-17 buy mixed with buying twenty-eight 747-400 transports.
- Option D assumes no C-17s and proposes buying twenty-eight 747-400 transports and using existing KC-10 tankers for aerial refueling of the C-5 to compensate for the loss of the outsize capacity of the C-17.
- Option E would augment the current fleet by buying forty-two (thirty-six PAA) 747-400 transports.

To compare the performance of these options, we assumed a major deployment of the Army's five rapid deployment divisions to a theater in Southwest Asia. We measured performance in terms of three main criteria: (1) average daily tons that could be delivered directly to a runway less than 5,000 feet long, (2) average daily tons of outsize cargo that could be delivered, and (3) average daily total tons delivered to the theater. As the table shows, Option A offers the greatest access to short airfields, Options A and B are most capable in delivering outsize equipment, and Option E is most attractive, considering its low cost, in terms of overall throughput.

Airfield Access: An Unresolved Issue

The C-17 was designed to offer certain unique capabilities: It was to have greater ground agility so that it could use small portions of ramps for maneuvering, and it was to be able to land on short runways in remote parts of the world. This analysis found that the C-17 required the same

ramp space as the 747-400F, if calculations are made on the basis of ramp space per ton delivered. Moreover, the analysis raised serious questions about the C-17's ability to land on many of the world's short, austere runways.

Although the C-17 has a clear advantage over other transports in its ability to land on short, narrow runways, its ability to repeatedly use such runways depends on the strength of the runways' pavement and subgrade. Since short runways in out-of-the-way places also tend to be weaker runways, the C-17 may not be able to land without damaging them. Although we could not conclusively measure the airfield access capabilities of the different transports, we could draw some overall comparisons. Our results show, for example, that the C-17 and the C-141 require much stronger runways than the C-5 and C-130 for most combinations of pavement and subgrade conditions. Finally, when runway strength and durability considerations are addressed, it is unclear that the C-17 can access significantly more airfields than the C-5, because our best estimate is that their access capabilities are comparable.

Because a good deal of inconsistency exists in the way various organizations calculate these technical characteristics, this study calls for a systematic review of the methods used to measure runway strength and durability, weight-bearing characteristics of military transport aircraft, and accelerated wear of runways. Unless standard guidelines for such calculations are agreed on, the differences between the transports cannot be calculated conclusively for this important issue.

Conclusions

A thorough review of airlift requirements should be conducted by the Joint Staff. If improving total tonnage capacity is more important than improving flexibility, such as direct delivery or outsize capabilities—which seems to be the lesson of the Gulf War—our analysis suggests that Option E would provide the optimal mix of airlift aircraft. About forty-two 747-400s should be purchased and modified to include (1) seating pallets that would allow rapid conversion to a passenger configuration, (2) aerial refueling capability, and (3) special radio and navigation equipment. C-130s should also be modernized and used to replace retiring C-130s to maintain needed intratheater airlift capability.

If the requirements review confirms that additional airlift in the future should concentrate on bulk cargo—and that the existing fleet of C-5Bs can satisfy the need for outsize cargo well beyond the turn of the century—then the Air Force could save more than 20 billion dollars over the next 25 years by stopping the C-17 procurement and purchasing the large civil transports. Over half the savings would accrue over the next ten years.

This research was led by Jean Gebman as part of the Logistics Project in the Resource Management and System Acquisition Program.

The Civil Reserve Air Fleet in the Gulf War

At the start of Operation Desert Shield, the Military Airlift Command (MAC) activated the Civil Reserve Air Fleet (CRAF) for the first time in its history. From August 1990 to May 1991, CRAF-committed assets as well as volunteered civilian aircraft supported the deployment of troops and supplies to the Gulf region and their redeployment after the war. The contribution of these commercial airliners was significant: They flew more than 5,000 missions, carrying more than 60 percent of the troops and 25 percent of the supplies airlifted in and out of the theater (see Figure 19).

A recent RAND study,[1] based on interviews with MAC and airline representatives and analysis of mission data, examines CRAF's participation in support of Operation Desert Shield/ Desert Storm. The study concludes that, overall, the CRAF operation was a success. Although MAC's air service contract with the airlines anticipated many of the difficulties that could arise when civilian aircraft are called into service, the operation highlighted a number of unanticipated problems as well. This study discusses these problems and the kinds of changes that the Air Mobility Command (AMC)—MAC's successor organization—is considering as it continues to provide for a robust CRAF for the future.

[1]Mary E. Chenoweth, *The Civil Reserve Air Fleet and Operation Desert Shield/Desert Storm: Issues for the Future,* RAND, MR-298-AF, 1993.

Initial Problems

The period leading up to and shortly after the activation of CRAF uncovered two difficulties that complicated the start-up of flights by civilian carriers: (1) uncertainties in government-sponsored liability insurance exposed airlines to potential risks, and (2) the transport of hazardous materials was complicated by inexperience on the part of some airlines in handling such cargo and by the fact that few airports had formally agreed in advance to accept flights carrying materials of this kind.

Liability Insurance. From the start of the operation, commercial insurance rates made flying to the Gulf region increasingly cost-prohibitive. The government had the authority to step in and cover CRAF missions with two insurance programs managed by separate agencies, one by the Department of Transportation and the other by the Department of Defense. These programs were activated, but various coverage gaps and ambiguities created serious concerns for the carriers. While some of these problems were bridged during the war, others continued even after the CRAF deactivation. In October 1992, a five-year reauthorization of the Department of Transportation's War Risk Insurance under Title XIII closed many of the gaps that existed under that program. Various liability issues, however, still remain unresolved, and both AMC and civilian agencies are working to link adequate insurance coverage to the CRAF and to airlift volunteered for military missions.

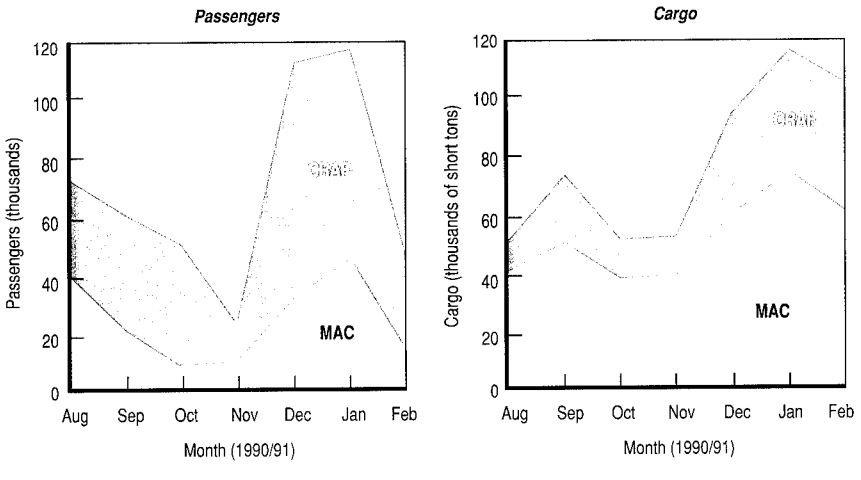


FIGURE 19

Passengers and Cargo Moved in Peak Months of the Persian Gulf War

Hazardous Materials. FAA regulations require airlines to have qualified crews and certified aircraft for moving hazardous materials. At the start of operations, some airlines in the CRAF lacked the necessary certification. Complicating the problem with hazardous material flights was that only a few commercial airfields in the United States or Europe permitted such flights in the early days of deployment. In response to rushed appeals, several U.S. airports were approved to receive hazardous material cargoes. In Europe, a few airfields were made available to carriers, but stringent restrictions limited the number of hazardous material flights that could access these locations.

To reduce problems with hazardous material transport, AMC hopes to rely on better information systems in the future so it can assign those missions only to airlines holding proper certification, something that was difficult to do during Operation Desert Shield. AMC also intends to continue the process MAC started before the Gulf War of concluding domestic airport arrangements that would allow for hazardous material transit under emergency conditions.

Cargo Operations

Practices aggravating CRAF cargo handling persisted throughout the operation, creating difficulties for airlines and arguably affecting MAC's actual lift rate. As cargo lift requirements mushroomed during the war, a number of factors combined to create serious backlogs. Some delays were caused by bad weather and increases in traffic at key airfields. More significant problems, however, were created by the complex pallet requirements of commercial aircraft and by the lack of sufficient material handling equipment at important loading and unloading sites.

For ground crews, CRAF missions differed from military missions because the former involved many different pallet requirements. The several types of aircraft used by the airlines had varying cabin dimensions that implied differences in pallet height and shape. For loads assigned to CRAF, ground crews needed to know the exact aircraft model and series in order to build the proper pallet in advance. Since this information was not always available, crews sometimes had to rebuild pallets after an aircraft arrived unexpectedly. MAC's initial preference for one type of aircraft, the B-747, for transatlantic flights might have simplified matters if several airlines had not protested on the grounds of fairness, pointing out that they were getting fewer missions because they owned a different type of wide-body aircraft. MAC addressed both problems—a persistent lack of prior notification about expected aircraft type and the entitlement issue—by sending different kinds of CRAF airplanes to different airfields and thus enabling each airline to have its fair share of the overall business while mitigating pallet configuration problems. In the future, such complications should be easier to manage because AMC plans to automatically incorporate CRAF flight information provided by airline systems into the Global Decision Support System that will give ground crews greater advance warning on the type of commercial aircraft to expect.

Insufficient material handling equipment affected air flows in two ways: (1) the military had to tie up some of its human and lift resources to move equipment around to the right airfields, and (2) the lack of equipment for even short periods created considerable delays in loading and unloading aircraft and disrupted flight schedules. Despite the fact that the MAC Crisis Action Team assigned a group of experts just to coordinate equipment movements, the loading equipment problems were never adequately resolved with either commercial or military aircraft. To avoid similar delays and backlogs in the future, the Air Force must procure sufficient ground equipment that is compatible with commercial aircraft to match its airlift planning needs.

Increased Operational Efficiency

The rapidly shifting military threat in the Gulf theater and the frequent changes in command priorities meant that MAC often received lift requirements only four to five days before units deployed. MAC, therefore, frequently had to pass on short leadtimes to the airlines. These short leadtimes resulted in inefficient aircraft and personnel scheduling and positioning, a recurring problem that frustrated many CRAF participants even though they understood its source. AMC continues to respond to participants' complaints on this matter. Although AMC may not have any more control over leadtimes in future operations than MAC had, it can ensure some form of compensation for the higher costs incurred by the airlines through no fault of their own. The new CRAF contract takes a step in the right

direction by providing for a standby rate, thus shifting more of the cost of delays onto the military. AMC must continue to address problems of operational efficiency to the satisfaction of the airlines if it hopes to maintain their participation in the CRAF.

Communications with Command and Control

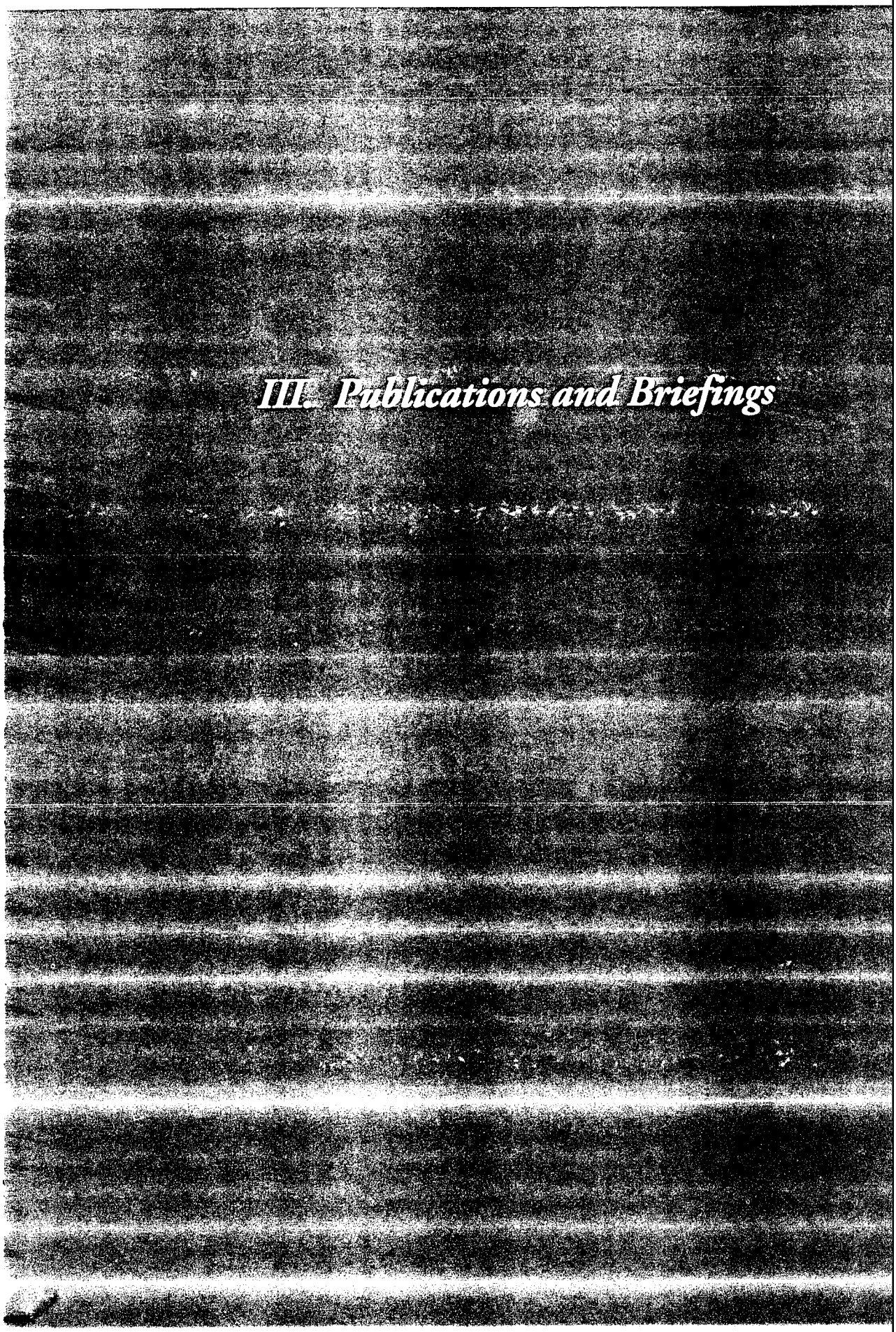
The airlines believe that communications between their air crews and military command and control in the theater were not effective enough because crews could not always receive in-flight information about possible dangers to their mission. Fortunately, these "blackouts" did not lead to serious problems, primarily because coalition forces gained air superiority early in the war. Lack of information about other dangers, however, such as Scud missile attacks, remained a concern for crews. According to AMC, one of the most cost-effective ways of minimizing such problems in future contingencies is to work with airlines and take advantage of the satellite technologies that may come on line within the next few years. AMC's current plan is to monitor these developments and perhaps invest in this type of equipment should the industry go this way. Procuring that hardware is vital.

The Importance of Incentives for CRAF's Future

The CRAF program depends on incentives to draw in volunteers. Before the Gulf War, the main incentives were contracts for peacetime military airlift given to carriers who agreed to provide aircraft for the CRAF. Paradoxically, now that the CRAF has proven its usefulness, budgetary constraints and reduced peacetime lift requirements are weakening traditional incentives for program participation. To maintain a strong CRAF, therefore, AMC is working not only to eliminate the main disincentives uncovered during its first activation but also to add additional incentives that would make it attractive for carriers to maintain or increase their commitment to the reserve fleet.

One innovative approach to incentives involves connecting non-DoD air service contracts with participation in CRAF. Another possibility would be to reward CRAF commitments with greater access to foreign routes and markets that could result from successful government-to-government agreements, although this is problematic. Joint use of military airfields is a third option: in the future, as some airports have trouble keeping up with demand for landing rights and slots, alternative airfields will become an attractive incentive. Such policies, of course, could be adopted only through sustained efforts not only on the part of the Air Force and DoD but also by other departments of the government. CRAF's proven capability has shown that such efforts would represent a good investment for AMC in particular and for the nation as a whole.

This research was led by Mary Chenoweth as part of the Force Structure Project of the Strategy, Doctrine, and Force Structure Program.



III. Publications and Briefings

Selected Unclassified Publications, FY 1993

Monographs/Reports

MR-101-AF, *The Wary Warriors: Future Directions in Japanese Security Policies,* N. D. Levin, M. Lorell, A. Alexander, 1993

This report assesses how changes in the domestic, regional, and international environments are likely to affect future Japanese security policies and defense cooperation between Japan and the United States. The expectation that Japan will "inevitably" move toward major rearmament and an independent defense posture appears questionable. The authors conclude that Japan will lack both the will and the capabilities to achieve such a status at least for the rest of the decade. Given recent trends in the former Soviet Union, they conclude that the order of magnitude of Japanese capabilities is appropriate, which suggests that the United States should emphasize greater integration, interoperability, and sustainability rather than major quantitative increases in Japan's force structure and military power. In addition, they suggest that both sides would gain from any progress toward achieving a two-way technological exchange.

MR-127-AF/A, *New Political Realities and the Gulf: Egypt, Syria, and Jordan,* M. E. Morris, 1993

This monograph assesses the relationships between three key Middle Eastern states—Egypt, Syria, and Jordan—and the Gulf states. While the traditional economic, religious, and security interdependencies endure, external and internal problems challenge those interdependencies and could lead to future internal and regional instability. These challenges include the increasing influence of radical Islam on politics, economic dislocations, mounting systemic pressures, and increasing divisions with and resentment of the Gulf states. The prognosis, at least for the short term, is for an uneasy calm, masking inherent and unresolved instabilities, punctuated by periods of conflict. The potential threat to U.S. interests in the region suggests the need for the United States to act to promote stability. The author suggests that assistance to these states must utilize a nuanced approach, based on an understanding of the context, and might best be handled through international, national, and regional associations and groups.

MR-149-AF, *The New Calculus: Analyzing Airpower's Changing Role in Joint Theater Campaigns,* C. Bowie, F. Frostic, K. Lewis, J. Lund, D. Ochmanek, P. Propper, 1993

This report focuses on means of improving airpower's capabilities in the context of joint operations in future major regional conflicts. The authors examined future U.S. national military strategy and a range of potential military

threats to U.S. interests. Using a number of scenarios, they simulated the deployment and use of a joint U.S./allied force to estimate the time required to achieve operational objectives. This simulation allowed them to compare various operational strategies and modernization programs in terms of their impact on U.S. ability to achieve these objectives. They concluded that airpower's ability to contribute to the joint battle has increased. Not only can modern airpower arrive quickly where needed, it has become far more lethal in conventional operations. Equipped with advanced munitions either in service or about to become operational, and directed by modern C^3I systems, airpower has the potential to destroy enemy ground forces either on the move or in defensive positions at a high rate, while concurrently destroying vital elements of the enemy's warfighting infrastructure. To exploit airpower's potential, the United States needs to focus on selective modernization. Among those items needed are advanced munitions, additional long-range fighters capable of carrying heavy payloads, and a rapidly deployable theater C^3I system.

MR-158-A/AF, *Measuring the Leverage: Assessing Military Contributions to Drug Interdiction,* C. H. Builder, 1993

The U.S. military has a lead role in aerial and maritime detection and monitoring of illegal drug traffic into the United States. This report examines how the effectiveness of these operations should be measured. A review of past interdiction campaigns, such as the Berlin blockade and that of arms supplies to Afghanistan, suggests that such assessments have always been difficult and that clear successes or failures have been few. In some instances, interdiction operations have even displaced the flow of contraband to routes less amenable to interdiction and more favorable to smuggling. The author suggests that assessment should proceed task by task, with the commander who assigned the task being responsible for assessing the contribution of each task to the next larger objective. This procedure continues up the chain of objectives and commands until it passes to civilian authorities. The author notes the difficulty that commanders will have in making such assessments as a result of the exposure to the controversies resulting from the abundance of public information presented by the news media.

MR-160-AF/A, *MapView User's Guide,* L. McDonough, S. Bailey, A. Koehler, 1993

This document is a user's guide for MapView, a general-purpose, object-oriented graphics program that was developed as part of the Theater Level Campaign/Nonlinear Combat project at RAND. It is written in the C programming language and runs under the X11 Release 5 windowing environment with Sun Microsystems' OPEN LOOK Toolkit. The program allows scenarios to be generated through a flexible, user-friendly interface that defines graphic objects, places them on an underlying image, and modifies or queries them as desired. In addition, MapView can process a file of commands that defines and modifies graphic objects and creates

animated simulation output. MapView has proven useful in checking database validity, generating scenarios, constructing run-time animation frames, and providing post-processing analysis.

MR-167-AF/A, *Political Dynamics and Security in the Arabian Peninsula Through the 1990s,* J. A. Kechichian, 1993

This report identifies and analyzes the political dynamics of the Arabian Peninsula after the Persian Gulf War. The author examines the current status of Iraq and the six conservative Arab Gulf monarchies (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) and highlights points of vulnerability in each state that could lead to future instability in the Gulf region. Four major postwar developments are identified: (1) Iraq is reestablishing its authority and rebuilding its ties to the Arab world; (2) Saudi Arabia is pursuing an assertive course in domestic and foreign affairs—including a steady military buildup; (3) the smaller Gulf shaykhdoms, out of concern with the Saudi rise, are exploring alternatives ranging from a rapprochement with Iran to signing bilateral military agreements with Western powers; (4) the political-military rapprochement between the Gulf Cooperation Council states and the United States should continue to grow for the foreseeable future, but internal pressures in those states could fuel anti-American sentiments.

MR-168-AF, *Russo-Japanese Relations and the Future of the U.S.-Japanese Alliance,* H. Gelman, 1993

This report traces the factors that have perpetuated the territorial dispute between Russia and Japan and the consequences of a stalemate or settlement for U.S.-Japan relations. The old common anti-Moscow rationale for the U.S.-Japan alliance has now vanished. Meanwhile, the task of building a new basis for the alliance is being hindered by the widening gap between U.S. support for Yeltsin's Russia and the icy relationship between Moscow and Tokyo because of the Northern Territories impasse. The United States, therefore, has a growing vested interest in the settlement of the dispute. The author recommends that the United States encourage Japan to renew (and improve) the offer to Yeltsin of economic aid in exchange for the Northern Territories that had been made to Gorbachev in 1991. The author notes that both Japan and the United States have strong incentives for maintaining the U.S.-Japanese alliance, including offsetting economic tensions, reassuring Japan's Asian neighbors, and deterring nuclear proliferation in Japan and Korea.

MR-175-OSD/AF/A, *Military Applications of Microelectromechanical Systems,* K. W. Brendley, R. Steeb, 1993

Microelectromechanical systems (MEMS) are small devices on the scale of a few millimeters or less. This monograph reports the results of discussions with U.S. researchers about potential military applications for MEMS. To indicate the range of possibilities, the authors describe five applications: chemical sensors for

soldiers, devices to identify other soldiers as friends or foes, active surfaces, distributed sensor nets, and microrobotic electronic disabling systems. Since planned U.S. investments in MEMS lag an order of magnitude behind investments in Japan, Germany, and the Netherlands, the authors recommend that the United States develop and pursue reasonable target applications for demonstration in three to five years. Thus the military potential of the technology could be assessed, and the United States could capitalize on breakthroughs elsewhere and develop countermeasures as necessary.

MR-178-AF/A/OSD, *The Independent European Force: Costs of Independence,* M. B. Berman, G. M. Carter with R. W. Robinson, D. B. Kassing, R. Buenneke, R. W. Hess, M. Hura, M. Nelson, P. S. Steinberg, 1993

Some European Community nations desire a military capability that could be employed out of the area under West European rather than NATO control. Given current European capabilities and the assets that would be needed to deploy and support such an independent force, the Europeans would have to augment their force projection capabilities, enhance their intelligence capabilities (especially space-based), and create new command and control mechanisms. This report examines the costs of generating these capabilities. Light-, medium-, and heavy-force packages are discussed with regard to four scenarios. The authors found that conceivably costs for all cases could be accommodated by the combined annual defense budgets of NATO's European nations. The modest systems for the low-case provide some independent capability, but for many contingencies, the European force would require the aid of robust U.S. systems to minimize risk. The high-systems case would provide more robustness but still would not match U.S. capabilities in force projection. In addition, the costs for this case would require the funds to be diverted from other national and regional concerns.

MR-187-AF, *Route Planning Issues for Low Observable Aircraft and Cruise Missiles: Implications for the Intelligence Community,* M. Hura, G. McLeod, 1993

Low-observable (LO) aircraft and cruise missiles give U.S. military forces the technical capability to attack ground targets with less risk of engaging enemy defenses. But full use requires an intelligence infrastructure that can support their special capabilities. The authors suggest the need for dialogue among the intelligence and mission-planning communities, the aircraft developers, and the aircraft operators addressing issues in nine areas: (1) threat data requirements to support LO platform development, testing, and employment; (2) types of threat data currently available and additional types needed; (3) constraints on data security and access; (4) validation of threat models used in penetration analysis; (5) interface of unit-level intelligence support workstations with mission-planning systems; (6) route-planning that considers mobile threats, airborne

interceptors, and anti-aircraft artillery; (7) operational alternatives to enhance LO penetration capabilities; (8) use of automated procedures for route planning; (9) route-planning capabilities on board LO aircraft. The report also presents initial solution directions for some of the preceding issues.

MR-203-AF, *Security in North Africa: Internal and External Challenges,* I. O. Lesser, 1993

Trends in Morocco, Algeria, and Tunisia have an important bearing on north-south security relations. In this report, the author examines internal and external stresses affecting these relations. Since these countries face massive demographic and economic problems, militant Islam poses an immediate political challenge. With nonaligned status no longer carrying weight in the post–Cold War era, nuclear and ballistic missile programs have emerged as potent sources of geostrategic weight. Algeria might become the leading actor in the region because of its size, energy resources, penchant for international activism, military potential, and nuclear ambitions. The author concludes that U.S. interests in regional stability will be served by a restoration of the democratic process in Algeria; future economic and security assistance initiatives should be predicated on progress in this direction. U.S. interests throughout the region will also be served by expanded political and commercial ties, but an expanded security presence in North Africa would expose the United States and local regimes to new risks. U.S. presence in and around the Mediterranean, however, is regarded favorably by those regimes as a contribution to regional stability and a counterbalance to Europe.

MR-221-AF/A, *From Eastern Europe to Western China: The Growing Role of Turkey in the World and Its Implications for Western Interests,* G. E. Fuller, 1993

Located for decades in a corner of Europe, today Turkey lies at the center of a rapidly evolving new geopolitical region of Turkish peoples that stretches from the Balkans across Turkey, Iran, and Central Asia, up into the Russian heartland of Tatarstan and into western Siberia, deep into western China, and to the borders of Mongolia. This position challenges Turkey's orientation toward the West, as do Europe's movement toward integration and uncertainties about NATO's role. The report suggests that Turkey's relationship with the United States may change as well, since challenges on its borders no longer carry the global threat that concerned the United States. While a new orientation is suggested by economic and political ties such as the Black Sea Consortium and the proposed Union of Turkic States, the author concludes that the influence in this area of a country characterized by moderation, responsibility, and commitment to democracy and a free-market economy is likely to serve Western as well as Turkic interests.

MR-230-AF, *Intelligence Support and Mission Planning for Autonomous Precision-Guided Weapons: Implications for Intelligence Support Plan Development,* M. Hura, G. McLeod, 1993

Most Air Force precision-guided weapons (PGWs) require the assistance of an operator to reach their targets. Autonomous PGWs, now being developed, require substantial intelligence data to support mission planning and employment and to achieve high delivery accuracy. The authors of this report examined the support requirements for two categories of PGWs: those with target-imaging sensors and those that rely on an inertial navigation system aided by the Global Positioning System. They found that the latter require much less information about their targets than the former but need much more precise absolute coordinates for their targets. These can be provided readily from existing data by trained intelligence personnel. The use of PGWs with target-imaging sensors, however, is hindered by a lack of definitive specifications for target data to support target-area planning and a lack of a methodology for validating target-area products (commonly known as target templates). Existing centralized intelligence-support and mission-planning organizations are currently best equipped to provide the required support. As resources allow and if required, similar capabilities could be developed at deployable air operations centers or possibly wing operations centers. This research supports the recent Air Force initiative in developing an intelligence support plan for autonomous PGWs.

MR-246-AF, *Report of a Workshop on Expanding U.S. Air Force Noncombat Mission Capabilities,* C. Builder, R. Lempert, K. Lewis, E. Larson, M. Weiner, 1993

This report describes a workshop held in June 1992 on expanding U.S. Air Force noncombat mission capabilities. The major result of the workshop was the unexpected highlighting of a division among the participants about whether noncombat missions should become an integral part of Air Force capabilities and whether they would seriously degrade U.S. combat capabilities. Related issues were whether Air Force noncombat activities could be performed by nonmilitary organizations and whether efforts to enhance Air Force noncombat support capabilities may be regarded as only a means of obtaining a larger share of the military budget. The participants, however, did identify some noncombat capabilities likely to be needed: adequate infrastructure in remote areas; improved command, control, communications, and intelligence capabilities in remote areas and for coordinating with local authorities; and psychological and civil affairs capabilities where knowledge of the indigenous culture as well as language is important.

MR-248-AF, *Barriers to Managing Risk in Large Scale Weapons System Development Programs,* T. Glennan, S. J. Bodilly, F. Camm, 1993.

This report integrates the findings of seven case studies of major efforts at managing the development of weapon systems—which is largely the management of risk. The analysis groups the seven programs into three categories. Three—the B-1B, AMRAAM, and

LANTIRN—experienced substantial acquisition difficulties during deployment. Three others, the AFE, GPS, and F-16 MSIP, proceeded fairly smoothly. The final program, Joint STARS, experienced modest difficulties. The research concludes that the key ingredient to successful risk management is a qualified technical staff possessing sufficient flexibility (or slack) to respond to both expected and unexpected difficulties with the program. The programs experiencing difficulties did not consistently possess such flexibility. These programs were so important to the Air Force that it was sometimes willing to make optimistic promises and to agree to funding levels and schedule guarantees that were unrealistic and that squeezed out the program slack needed for effective risk management. The more successful programs did not involve the same level of promises, were far less visible, *evolved* out of strong SPOs, and proceeded with comparatively broad specifications.

(See also N-3616-AF, *Case Study of Risk Management in the USAF B-1B Bomber Program,* S. J. Bodilly, 1993; N-3617-AF, *Case Study of Risk Management in the USAF LANTIRN Program,* S. J. Bodilly, 1993; N-3618-AF, *The Development of the F100-PW-220 and F110-GE-100 Engines: A Case Study of Risk Assessment and Risk Management,* F. Camm, 1993; N-3619-AF, *The F-16 Multinational Staged Improvement Program: A Case Study of Risk Assessment and Risk Management,* F. Camm, 1993; N-3620-AF, *The Development of the Advanced Medium-Range Air-to-Air Missile: A Case Study of Risk and Reward in Weapon System Acquisition,* K. R. Mayer, 1993.)

MR-264-AF, *Data and Data Processing Issues in the Estimation of Requirements for Aircraft Recoverable Spares and Depot Repair,* J. B. Abell, F. W. Finnegan, 1993

The data system that supports the estimation of requirements for aircraft recoverable spares and depot repair is fraught with errors. The result is that many components are promoted from their correct levels of indenture to higher levels, so that the requirements computation overvalues the items. Consequently, the system overinvests in these items, resulting in a less effective mix of spares. This report discusses the kinds of errors observed in the data and suggests an approach for cleaning up the database, coupled with a system of audits and a training program to keep the database relatively error-free.

MR-271-AF, *A New Concept for Streamlining Up-Front Planning,* G. A. Kent, D. E. Thaler, 1993

DoD processes for enhancing U.S. military capabilities take an inordinate amount of time and energy. In this report, the authors propose a framework for streamlining up-front planning. The framework consists of three elements: (1) a Mission Need Statement by the Chairman of the Joint Chiefs of Staff to identify deficiencies in the ability to achieve objectives and call for an exploration of operational concepts to remedy them; (2) a distinction between those responsible for concept development and those responsible for

realization of the concept: the military departments (not those responsible for science and technology or for system development and acquisition) should be responsible for concept development; and (3) senior operations officers realize this responsibility by convening Concept Action Groups, consisting of operators, development planners, technologists, intelligence personnel, cost analysts, acquirers, and other analysts, to match mission needs with technological opportunities in the form of alternative operational concepts. The authors emphasize that concept demonstrations differ from technology and engineering/manufacturing demonstrations. The first shows proof-of-principle of operational concepts; the second verifies the viability of a scientific principle or technique; the third shows that engineers can design and manufacture a system within criteria. Concept demonstrations must be devoid of competition; engineering demonstrations are the forum for competition between prospective contractors.

MR-293-AF, *Military Planning Today: Calculus or Charade?* C. H. Builder, 1993

The military planning calculus introduced in the mid-1960s still provides the structure for defense planning today. Built into that calculus is the idea that we start with our national objectives and the threats to those objectives and proceed logically through the design of military forces to the bottom line—the presentation of the bill to the U.S. public. Now, post–Cold War, the U.S. public is expressing preferences about the size of the insurance policy it wants for national security. Defense planning, instead of totting up the bill to meet declared objectives and threats, may instead have to offer alternative military capabilities (and risks) over a range of prices. Among other suggestions, the author recommends allowing the services to compete for funding and giving explicit consideration to the judgments that inform defense planning, such as the availability of resources and the likelihood of various threats.

R-4210-AF, *Estimating Requirements for Aircraft Recoverable Spares and Depot Repair,* J. B. Abell, G. M. Carter, K. E. Isaacson, T. F. Lippiatt, 1993

The Air Force spares and repair requirements estimation system is large and complicated. This report describes extensive analysis and evaluation of that system. Its principal goal was to understand better the implications of management adaptations for spares requirements. Such adaptations include cannibalization, lateral supply, withdrawals of assets from war readiness spares kits, and expedited repair, processing, handling, and transportation. These and other management initiatives enhance the performance of the logistics system in the face of uncertainty in resource demands and as item characteristics evolve over time, but they are not now accounted for in the computation of spares requirements. The authors conclude that the Air Force could achieve satisfactory levels of aircraft availability with substantially less

expenditure on spares procurement by taking explicit account of the payoffs of management adaptations, by making certain improvements in the computations and processes involved in determining spares requirements, and by implementing certain policy changes.

R-4211-AF/OSD, *Modeling and Forecasting the Demand for Aircraft Recoverable Spare Parts,* J. L. Adams, J. B. Abell, K. E. Isaacson, 1993

This report explores issues in forecasting and modeling the demand for aircraft recoverable spare parts to improve the Air Force's estimation of spares and repair requirements over quarterly, annual, and longer-planning horizons. Specifically, it demonstrates the utility of approaches that account explicitly for nonstationarity and their superiority over current methods being used by the Air Force Materiel Command. The authors recommend using a weighted regression, a special case of the Kalman filter, for forecasting demand for high-demand items. This approach is a logical extension of Bayesian statistics, which explicitly account for nonstationarity in stochastic processes, assigning greater weight to more recent than to less recent demands. Coupled with an improved version of variance estimation that assigns greater uncertainty to longer planning horizons than to shorter ones, this approach holds the promise of reducing the cost of spares investments while achieving adequate levels of system performance.

R-4213-AF, *Estimating Aircraft Recoverable Spares Requirements with Cannibalization of Designated Items,* D. P. Gaver, K. E. Isaacson, J. B. Abell, 1993

To estimate requirements for primary operating stocks (POS) of aircraft recoverable spare parts, as a matter of policy, the Air Force has not assumed that parts shortages can be consolidated among aircraft (cannibalized). It does, however, assume some consolidation of shortages in its computation of war readiness spares requirements, designating the parts that are relatively easy to cannibalize and those that are not. The research described in this report shows that a policy of designated cannibalization in estimating POS requirements is cost-effective. The authors present a computational model that incorporates designated cannibalization while maximizing, subject to a budgetary constraint, the probability of meeting a specified aircraft availability goal with a specified confidence. They conclude that a designated cannibalization policy for POS can reduce safety stock requirements while maintaining traditional levels of system performance.

R-4214-AF, *Dyna-METRIC Version 6: An Advanced Capability Assessment Model,* K. E. Isaacson, P. M. Boren, 1993

This report describes Version 6 of the Dyna-METRIC capability assessment model that RAND developed to support logistics planning. Using information about the planned usage of aircraft, the characteristics of the aircraft components, and their demand for logistics resources, Dyna-METRIC assesses the

effects of wartime dynamics, produces operational performance measures, and identifies potential problems. Version 6 improves on earlier versions by incorporating a more fully developed representation of the repair process and its constraints. It also considers the effects of additional sources of uncertainty and some strategies that might mitigate that uncertainty. The report provides users with a comprehensive description of the model's motivation, capabilities, methodology, and use. A sample analysis based on 30 avionics components of the F-16C/D aircraft illustrates the model's use.

R-4215-AF, *Estimating Requirements for Aircraft Recoverable Spares and Depot Repair: Executive Summary*, J. B. Abell, 1993

Aircraft recoverable spares and depot-level component repair are major Air Force annual expenditures. In the mid-1980s, they absorbed roughly $5 billion annually. This executive summary suggests initiatives that will enable the Air Force to reduce its investments in aircraft recoverable spares while maintaining roughly its traditional levels of aircraft availability. These initiatives include fundamental changes in policy as well as improvements in requirements estimation techniques. One policy recommendation is to improve the responsiveness of depot-level component repair. This includes repairing the components that are the most important to the achievement of aircraft availability goals, minimizing the time parts are in the repair pipeline, and responding quickly to urgent, unanticipated demands. A second policy recommendation is to consolidate the storage and management of war readiness spares.

R-4254-AF, *The Military and Political Succession in China: Leadership, Institutions, Beliefs*, M. D. Swaine, 1992

The highly unstable and unprecedented conditions confronting China today are marked by widespread social discontent and extremely low party prestige; a weak, divided, and unpopular leadership; and the imminent passing of the original revolutionary generation of elder Chinese powerholders. These factors, combined with the historical centrality of Chinese military power and the legacy of communist rule by a fused party-army political structure, suggest that it is virtually impossible to assess the dynamics of China's coming succession struggle and China's future political evolution without fully analyzing the role of the People's Liberation Army in elite politics. This report examines three components of China's politico-military system: party-military leadership, military organizations, and military beliefs and attitudes toward political involvement. Based on these analyses, the author evaluates possible scenarios for succession following the death of Deng Xiaoping. He concludes that younger military officers could serve as guarantors of long-term stability for a nondemocratic Chinese regime marked by expanding economic regionalism and overall growth or could serve as the facilitators of radical social and economic change and political liberalization.

R-4268-AF/A, *Post–Cold War U.S. Security Strategies for the Persian Gulf,* M. Agmon, 1993

The end of the Cold War has presented the United States with an opportunity to adopt a new strategy toward the Persian Gulf region. In the past, the strategy has been one of close and enduring political, military, and personal ties. An opportunity now exists for a more distant, "insulating" strategy. This report analyzes the potential costs and benefits of four strategies—two traditional and two insulating—and reaches three conclusions. First, whatever strategy is pursued, the United States needs to maintain sufficient military resources to serve as a balancing force in the region. Second, the two alternatives that emphasize either all-Arab or Saudi defense of the region pose the highest risk in terms of political instability. Finally, regional arms control makes all alternatives less costly and more beneficial.

R-4269/4-AF, *Project AIR FORCE Analysis of the Air War in the Gulf: An Assessment of Strategic Airlift Operational Efficiency,* J. Lund, R. Berg, C. Replogle, 1993

The airlift during Operation Desert Shield/Desert Storm moved ten times the daily ton-miles of the Berlin Airlift. In the main, this airlift operation was successful but did not attain its expected performance. Operations began without a feasible transportation plan and requirements changed frequently as the situation developed. Half the Air Mobility Command's strategic aircrews are in the reserves; the callup did not begin until 16 days into the deployment and then proceeded over a six-month period (even then the callup was not complete). The entire airlift system was sensitive to disruptions at en-route and off-load bases. Maintenance problems were endemic. Among other suggestions, the authors recommend that (1) tools and data systems for rapid planning be emphasized, (2) access to adequate bases be ensured both en route and in the theater, (3) measures be taken to ensure that the U.S. Transportation Command or the Air Mobility Command has sufficient aircrews in a crisis, and (4) the aging C-141 fleet be replaced.

Notes

N-3403-DARPA/AF/A, *New Issues and Tools for Future Military Analysis: A Workshop Summary,* R. J. Hillestad, R. Huber, M. G. Weiner (eds.), 1992

This note reports on a workshop held at RAND in May 1991 to discuss the new concerns analysts must face following the changes that have taken place in Central and Eastern Europe and Southwest Asia since 1989. The workshop produced a number of specific recommendations to the military analysis community and its sponsors: (1) continue to discuss issues of military analysis in open forums; (2) develop a quick reaction analysis approach with supporting tools; (3) reinstitute basic principles of systems analysis (attention to uncertainty, multiple scenario analysis, parametric analysis, comparative analysis, etc.), which may have atrophied because of the

relatively stable planning scenario of the Cold War era; (4) promote basic research on complex phenomena, such as qualitative factors (training, morale, and leadership), behavior of C^3I systems, and new types of conflict; (5) promote multiorganization analysis of complex issues as well as multiple analyses of the same issues; and (6) promote education of analysts in the synthesis and solution of defense problems and education of decisionmakers in the use and limitations of analysis.

N-3542-AF, *Of Tanks and Toyotas: An Assessment of Japan's Defense Industry,* A. Alexander, 1993

Japan's technological capabilities are at or above world levels in many areas that are critical for military systems. Moreover, its spending on military hardware and R&D has grown at double-digit rates since the mid-1970s. This note examines whether the Japanese defense industry could supplant U.S. systems and technology in Japan's force structure and concludes that it could not. Despite their rapid growth, Japan's expenditures for military development and acquisitions are modest compared with those of NATO countries. Aircraft, missiles, and armored vehicles cost up to three times more than comparable foreign systems and lag their performance by as much as a decade. Continued funding restraints, poor incentives, inadequate requirements, and inexperience in the specialized R&D of complex military systems are likely to keep Japan dependent on U.S. military systems.

N-3566-AF/A, *Air Combat Model Engagement and Attrition Processes High Level Design,* P. D. Allen, 1993

This note presents an air combat design for the theater-level or nonlinear combat (TLC/NLC) model and for the RAND Strategy Assessment System (RSAS). The design includes many qualitative factors not traditionally included in air combat models, such as a representation of how intelligence affects the frequency and distribution of specific types of air-to-air, ground-to-air, and air-to-ground engagements. The design is intended to be implemented as either a stochastic or a deterministic model, with either low resolution or high resolution, depending on the needs of the user. The results of each version of the model should be readily comparable, given similar inputs.

N-3579-AF/A, *Azerbaijan, Central Asia, and Future Persian Gulf Security,* T. Karasik, 1993

This note examines the economic, religious, and ethnic connections between Azerbaijan, the Central Asian Countries (CACs), and the Persian Gulf states. The study found growing linkages between Turkey, Iran, and Saudi Arabia and the former Soviet republics. As a result of the influences of these states, Azerbaijan and the Central Asian Countries are likely to embrace conflicting national policies; central authority is also weakening as a result of the ethnic coalitions forming under this influence. Russia, which is becoming estranged from the former Soviet republics, perceives their changing relationship with the Persian Gulf states as a religious and ethnic threat to its

security. The author recommends that the United States encourage relationships that will limit outbreaks of violence (such as emerging international economic organizations) and that it recognize the risks of isolating Iran or siding with Turkey or Saudi Arabia against Iran in the battle for influence. He also warns that the potential for proliferation of conventional and nuclear weapons in Iran will remain high as long as Azerbaijan and the CACs remain unstable.

N-3589-AF/A/OSD, *U.S. Space-Based Remote Sensing: Challenges and Prospects,* D. J. Johnson, M. Nelson, R. J. Lempert, 1993

During the last decade, data from space-based remote sensing systems have become increasingly useful in many areas, from national security and emergency planning to civil engineering, weather forecasting, media coverage, and environmental protection. This expanding use of remote sensing data and systems is creating tensions among various user communities that in turn affect the development of U.S. remote sensing policies. This note presents a survey of remote sensing policy issues for the 1990s. The authors make a number of recommendations regarding governmental policy: (1) develop remote sensing policies from a comprehensive view, embracing national goals, user needs, and the diverse organizations that can meet those needs (e.g., NASA, NOAA, and DoD); (2) determine where broadening needs or new technologies allow better coordination or consolidation of effort among programs; (3) determine which endeavors would best be public, which areas under government authority would be better pursued as commercial or private endeavors, and how to handle the boundaries between them; and (4) make remote sensing systems more responsive to user needs.

N-3610/3-AF, *The Air Force Rapid Response Process: Streamlined Acquisition During Operations Desert Shield and Desert Storm,* M. G. Anderson, 1993

During Operations Desert Shield and Desert Storm, the United States Air Force realized that the normal peacetime requirements approval and acquisition process could not meet the time-urgent mission needs in the theater of operations. As a result, the Air Force instituted the Rapid Response Process to acquire munitions, communications, computers, and avionics. The process submitted, assessed, approved, and funded a validated Combat Mission Need Statement (C-MNS) within 24 days and implemented procedures to field the desired capability in less than six months. This note describes the Rapid Response Process and examines its effectiveness during the Gulf War. By the time the process was terminated, C-MNS processing averaged 13 days and the time to field averaged 1.8 months.

Issue Papers

IP-102, *"The Day After . . . ": Nuclear Proliferation in the Post–Cold War World,* M. D. Millot, R. Molander, P. Wilson, 1993

A nation with a small, survivable nuclear arsenal has the potential to undermine

current U.S. national military strategy for dealing with regional conflicts. So concluded government officials and defense analysts who participated in a series of exercises to explore U.S. policy options in response to nuclear proliferation. Among the suggestions reported in this issue paper are to dramatically enhance conventional counterforce capabilities, to develop very high confidence theater ballistic missile defenses, and to implement operational concepts for power projection that minimize the exposure of U.S. personnel to attack.

IP-103, *Is Consolidation Being Overemphasized for Military Logistics?* M. K. Brauner, J. R. Gebman, 1993

As the Defense Department has been reducing its size, its emphasis on consolidation to reduce costs has increased. Lessons from the private sector suggest that other ways to reduce costs also need to be considered, especially because when consolidation is implemented in large operations, the resulting system can be less responsive and thus, in the case of military logistics and support, be unable to sustain warfighting capabilities. Innovative business practices, such as technology exploitation, process redesign, inventory reduction, and delegation of decision authority, have a proven track record in reducing costs and improving service. This issue paper suggests that such practices also need to be considered as supplements or alternatives to consolidation, so that the DoD may deliver responsive logistics at the least cost. The benefits that such a broader view can provide are likely to outstrip what can be achieved by continuing to place the major emphasis on consolidation.

IP-104, *Do We Need Special Federal Programs to Aid Defense Conversion?* C. R. Neu, M. Kennedy, 1993

It is in the national interest to ease the transition of industrial resources from a military to a civilian focus. Are special federal programs necessary to accomplish this? This issue paper examines arguments that defense conversion requires a different response than does normal industrial turnover. The authors conclude that no good justification exists for programs designed to aid only the conversion of defense industries. They suggest that government assistance should be triggered by any economic dislocation, regardless of its cause or the particular industry affected. They claim that the economy would be better served by policies that improve the quality and flexibility of all U.S. workers and that reduce barriers to the movement of people and resources among all its sectors. They also caution that to the extent that government policies shield workers, managers, or investors from the consequences of changing economic circumstances, these policies weaken incentives for the decisions that will finally result in the conversion of resources to new and productive uses. Excessive efforts to ease the pain of conversion only slow it.

IP-105, *Germany's Geopolitical Maturation: Strategy and Public Opinion After the Wall,* R. D. Asmus, 1993

This issue paper describes the results of a recent RAND-sponsored survey of German public opinion. One key finding is that a majority of Germans view a more concerted effort by the United States to confront its own domestic problems as a prerequisite for a strengthened U.S.-European relationship. On the other hand, German public support for NATO, an American military presence in Germany, and a broader "out-of-area" role for the alliance is on the rise. Germans also support European integration and see a strengthened European Community as a basis for a new "partnership among equals" across the Atlantic. Another important finding is that the German public overwhelmingly supports the government's efforts to combat right-wing extremism in Germany.

IP-120, *DoD Centralization: An Old Solution for a New Era?* G. Donohue, M. Lorell, G. Smith, W. Walker, 1993

In response to enormous pressures to economize, the Department of Defense has set out to reform the logistics and acquisition system. One option being considered is to centralize acquisitions to reduce overhead, improve management, eliminate duplication, increase economies of scale, and tighten controls to minimize cost growth and schedule slippage. This issue paper explores the idea through a summary of the history of the U.S. acquisition reform, a review of the centralized acquisition bureaucracies of some U.S. allies, and a discussion of current management theory and industry practice and how they might apply to defense acquisition. The authors suggest that instead of being centralized, the acquisition system should be reformed to encourage self-managed teamwork, efficient information technologies, flatter internal organizations, and integrated external networks of responsive suppliers.

Selected Briefings, FY 1993

Trends in the Global Balance of Airpower

Briefer: Chris Bowie

Analyzes prospects for potential adversaries to increase their emphasis on airpower and successfully challenge the United States. Provides an overview of the global balance of airpower at the close of the Cold War (measured in inventories of helicopters, surface-to-air missiles, and fixed-wing aircraft) and an assessment of the prospects for regional powers to shift this balance in their favor.

Insights Into the Russian Federation Air Force

Briefer: Benjamin Lambeth

Explains the continued importance of monitoring Russian airpower trends in the wake of the Cold War's end. Reviews operational and training problems inherited from the former Soviet Air Force, confirming Western suspicions that the Soviet pilot was severely constrained by a rigid, top-down system of operational control. Emphasizes that the problem was Soviet communism, not the man or his equipment. Explores the manifold challenges currently faced by the Russian Air Force leadership as it seeks to rebuild and modernize for the post–Soviet era. Considers the prospects for a successful recovery and the factors that will weigh most heavily in determining the outcome.

Deterring and Coercing Regional Adversaries

Briefers: Kenneth Watman, Dean Wilkening

Develops strategies for deterring regional adversaries from endangering U.S. interests with conventional forces or weapons of mass destruction. U.S. deterrence strategy is largely a product of the Cold War with the USSR. The study found that deterring regional adversaries is different from deterring the Soviet Union. These differences are the product of the character and motivations of regional adversaries, the high credibility requirements the United States must meet, and the difficulties of relying in the main on conventional forces to deter.

"The Day After": Nuclear Proliferation in the Post–Cold War World

Briefers: Roger Molander, Peter Wilson

Explores the implications of nuclear proliferation for the USAF during the post–Cold War era. Examines the nexus of policy, intelligence, military operations, and R&D issues through an exercise series that involved more than 1,000 domestic and foreign participants from 1991 to 1993. The exercises placed members of the policy community in future nuclear crises and then allowed them to explore current policy initiatives that might mitigate, if not neutralize, future nuclear threats to the United States and its interests.

Weapons of Mass Destruction and the Persian Gulf War

Briefer: Stephen T. Hosmer

Attempts to determine why Iraq did not use chemical or biological weapons in the Gulf War and draws lessons from the war's experience for possible future contingencies. Discusses (1) the difficulty of devising appropriate responses to chemical and biological attacks, (2) the military and political shortcomings of preemptive attacks as an effective means of neutralizing weapons of mass destruction, (3) why the Coalition's perception of the Iraqi chemical and biological threat failed to limit Coalition options in Operation Desert Shield/Desert Storm, (4) how an Iraqi nuclear capability might have changed the Coalition response, and (5) the possible impact of the Gulf War on the proliferation of nuclear weapons and missiles in the Third World.

Twin Arcs of Crisis

Briefer: Ronald Asmus

Attempts to define Europe's future strategic landscape, arguing that Europe is beginning to unravel along "twin arcs of crisis." Considers the implications of this unraveling for the future of NATO, suggesting that NATO as it now exists is ill-equipped to deal with this challenge and that its rationale and mission need to be defined anew. Describes the steps that can be taken to revitalize NATO. Explores the political and military implications of NATO's transformation for the United States.

Guard and Reserve Participation in the Air Mobility System: Roles and Constraints

Briefer: Paul Killingsworth

Examines historical peacetime activities of Guard and Reserve airlift forces. Shows that while the peacetime role of Reserve components has been to train for wartime mobilization, there are no legal barriers to their performing more of the peacetime flying burden of Air Mobility Command. Recommends increasing Guard and Reserve support of short-notice missions, giving airlift users incentives to make their requests earlier, continuously rotating "floater" reserve crews and aircraft, setting up aircraft, and formalizing a peacetime Reserve role beyond that of training.

Strategies-to-Tasks: A Framework for Linking Means and Ends

Briefers: Glenn Kent, David Thaler, David Shlapak

Describes the "strategies-to-tasks" framework, which provides an audit trail from the broadest national objectives and strategies down to operational activities at the tactical engagement level. Describes the hierarchy of objectives that underlies the framework and the key function of operational concepts in identifying both deficiencies in mission performance and opportunities for its enhancement. Also highlights ways in which the Air Force would benefit from employing the framework for top-down force planning.

Strategic Airlift Operations for the Gulf War: An Assessment of Operational Efficiency

Briefer: Ruth Berg

Assesses strategic airlift operations during ODS. Based on interviews with participants and on a comparison of data from the airlift operation with expectations derived from planning factors, the study concludes that operational performance of the airlift system was affected by a variety of problems, many of them beyond MAC's control. The study analyzes these problems by grouping them into four broad categories: planning, aircrew availability, bases, and aircraft performance.

The New Calculus: Analyzing Airpower's Changing Role in Joint Theater Campaigns

Briefers: Chris Bowie, Fred Frostic

Evaluates the capabilities of future U.S. forces for achieving key operational objectives in major regional conflicts. A balanced joint military force will be needed to support U.S. national military strategy in the demanding and highly uncertain future environment. Results of the analysis indicate that the calculus has changed and that airpower's ability to contribute to the joint battle has increased. In short, the mobility, lethality, and survivability of airpower make it well suited to the needs of rapidly developing regional conflicts. These factors taken together are changing the ways Americans think about military power and its application.

RF Signature and Air-to-Air Armament Trade-offs for Multirole Fighters

Briefer: Gary Liberson

Assesses the need for improving the next multirole fighter's (MRF) capabilities in the air combat arena using the TAC Brawler air combat model. Illustrates the air-to-air capability of the F-16C and parametric excursions to the F-16C baseline in a two-Blue versus four-Red Defensive Counter Air (DCA) scenario against current and postulated future threats. Evaluates how improvements in two selected areas—improved radar missile armament and parametric reductions in RF signature—can influence engagement outcomes.

Air Force Fighter Modernization in a Declining Budget Environment

Briefer: William Stanley

Describes the results of project assessing fighter modernization strategy options for the USAF. Shows relationship of sustained fighter investment needs to system life, force structure size, and aircraft costs. Assesses affordability by comparing sustained fighter investment needs to funding availability for various budget scenarios. Examines schedule and funding consequences of fighter force and compares the affordability of several notional modernization plans. Assesses affordability of Air Force and Navy fighter force structures collectively for various assumptions about modernization funding availability.

Measuring Effects of Payload and Radius Differences of Fighter Aircraft

Briefer: William Stanley

Measures how differences in F-15E and F-16C Block 50 payload and radius characteristics influence their ability to deliver GBU- and CBU-class weapons against a variety of target sets. For most of the air-to-ground cases examined, the effectiveness advantage of the F-15E relative to the F-16C was more than commensurate with its higher procurement and operating costs. The larger, heavier F-15E was most cost-effective in larger theaters where its payload and radius capability were best demonstrated. The smaller, lighter F-16C performed at its best in more compact theaters where combat radius was not as important.

System Concept for a Mission-Level Model

Briefers: Bart Bennett, Greg Born, Tom Lucas

Provides a review of various approaches to mission-level modeling and analysis. Describes in broad terms the manner in which modeling and analysis support the decisionmaking process. Examines the analytic requirements for a model that derives mission-level measures of effectiveness, along with the manner in which mission-level analysis must often be integrated with analyses at other levels of detail or aggregation. Presents alternatives for improving current community models. Also presents an initial high-level design for a new model that would improve the flexibility of objects represented in the model and take advantage of state-of-the-art advances in computer technologies.

The RAND Theater Level Conflict/Nonlinear Combat Model

Briefer: Richard Hillestad

Provides the motivation for development and demonstrates key features of the theater level conflict/nonlinear combat (TLC/NLC) model. Describes how the model can simulate conflicts in various locations, with varying coalitions and with joint forces. Illustrates how the object-oriented construction of the model permits variable resolution and various representations of the command and control processes. Also describes how the model permits reactive opponents and automatic changes in strategies for both the air and ground forces in response to new battlefield situations and the flow of intelligence. (This briefing is available in electronic form with "movie" playback of simulated scenarios.)

The Effective Air Campaign Study

Briefer: David Shlapak

Identifies ways to extract leverage from airpower application. Focuses on strategic attacks against infrastructure targets and the effects on adversary military capabilities. Will provide a framework to assist planners in developing and executing effective campaigns.

Planning and Conducting Air Campaigns Under Uncertainty: A Computerized Exercise Approach

Briefer: David Taylor

Demonstrates the interactive Air Campaign Exercise System, which is designed to provide an effective, economical air campaign planning environment to help educate air campaign planners through interactive exercises. Discusses the exercise emphasis on the effects of uncertainty on the planning process. Explains how a computerized approach combines the necessary degree of control, real-time interactivity, and cost-effectiveness.

Intelligence Support and Mission Planning for Autonomous Precision-Guided Weapons

Briefers: Gary McLeod, Myron Hura

Provides a framework for developing an Intelligence Support Plan (ISP) for advanced precision-guided weapons (PGWs), focusing on autonomous PGWs with target-imaging sensors. (The ISP is a new acquisition document that defines the intelligence infrastructure to support a specific weapon system or class of systems.) Discusses the intelligence data required to support autonomous PGWs and identifies key unresolved issues. Examines existing intelligence infrastructure elements (functions, organizations, systems, and personnel) and proposed future systems that may be integrated into alternative support architectures. Recommends an evolving architecture, initially relying on centralized intelligence facilities.

Theater Missile Defense

Briefer: David Vaughan

Summarizes RAND's work on countering theater ballistic missiles (TBMs). Describes an end-to-end operational concept event structure used to identify all the generic functions that must be enabled to perform these operations. Estimates requirements for a canonical threat scenario similar to the Desert Storm Scud campaign. Identifies critical requirements and their technical difficulty. Based on these analyses, estimates the prospects for developing the capabilities required to enable each phase of attack operations and active defense and identifies the most promising near-term, evolutionary, and new systems developments.

Whither the Bomber Force? The Budget Crunch and the "New World Order"

Briefers: The Bomber Project Staff

Addresses two questions: What roles might bombers play in the evolving future, and how can the United States use its heavy bomber force most effectively? Also addresses the implications of further bomber force reductions, the contributions of 20 B-2s, possible improvements to the bomber force, and operational concepts for using heavy bombers in conjunction with other forces for conventional power projection.

Rivet Joint/EP-3E Consolidation Study

Briefers: Daniel Gonzales, Leland Joe

Provides an overall comparison of the tactical intelligence support capabilities

of the Air Force RC-135 RIVET JOINT and Navy EP-3 systems. Assesses the collection and processing performance of both platforms, their coverage, their computer and database systems, and their tactical communications capabilities. Briefly reviews the missions conducted by both platforms, including some of their taskings by the national community during peacetime and by tactical commanders during wartime. Examines the required force structure levels needed to support two major regional contingencies and discusses the cost and capability trade-offs and potential mission limitations for various options for consolidating the RIVET JOINT and EP-3 fleets.

The DSP/FEWS Choice: Operational Consequences

Briefer: James Bonomo

Reviews alternative satellite systems that could provide tactical warning. Identifies key operational tasks that can differentiate the alternative systems. Analyzes the performance of the alternative satellite systems in those tasks and shows the operational differences. Summarizes the capabilities, costs, and risks of the alternative satellite systems.

Whither Milstar?

Briefer: Daniel Gonzales

Examines issues involved in continuing the Milstar program. (Milstar is the most expensive military communications satellite ever built; originally designed to operate in the midst of a global nuclear war, it may be canceled as part of DoD's downsizing and restructuring.) Examines the changing military needs for satellite communications in the post–Cold War era by analyzing communications usage observed in Operation Desert Storm and findings of related RAND studies. Contrasts these needs against Milstar's capabilities. Analyzes a number of Milstar alternatives by examining their capabilities and technical risk. Describes advantages and disadvantages of proceeding with Milstar or a less expensive alternative.

Distribution and Repair in Variable Environments (DRIVE): Policy and Implementation Issues

Briefer: John B. Abell

Describes DRIVE, a computer-based optimization algorithm that prioritizes the repair of recoverable spare parts and allocates the serviceable assets to locations worldwide. The Air Force is implementing DRIVE in its depot repair management system and at major air commands. It has also been implemented at centralized intermediate repair facilities and at the Ogden Air Logistics Center's Detachment 35 in Okinawa as the theater repair and distribution execution system (TRADES). Its application is being extended to the prioritization of transportation of both repairable and serviceable assets and carcass induction at the depot. As demonstrated, DRIVE can provide higher aircraft availability than the current depot repair management system.

Contract Maintenance Policy Study

Briefer: Mary Chenoweth

Indicates that contract repair practices are often inconsistent with the principal logistics measure of merit: meeting aircraft availability goals through an effective and efficient use of resources. Whatever the role of the private sector in the future, if current contract maintenance policies remain, the hoped-for benefits of improved system-wide performance at less cost will not be attained. We suggest ways the Air Force could greatly enhance its contract maintenance policies and practices.

Modern Business Practices for Logistics

Briefers: Ray Pyles, I. K. Cohen

Focuses on six new business practices that could begin to "reinvent logistics" to address the twin challenges of the post–Cold War era: (1) increasingly uncertain taskings for future operations and (2) increasing pressure on logistics budgets. The current, mass production–oriented logistics system is ill-equipped to meet both of these challenges simultaneously. New business practices have emerged in the last decade that have enabled U.S. businesses to compete more responsively to changing markets at increasingly competitive costs. This briefing suggests how these practices can be applied to Air Force logistics.

Reinventing Reparable Component's Operations

Briefers: Ray Pyles, Tim Ramey

Examines a modern business practice that would fully redesign the logistics system that supplies, repairs, and distributes reparable components for aircraft. (The approach would increase the responsiveness of that system by at least an order of magnitude and also substantially reduce costs.) Presents a strawman design that streamlines and simplifies the current worldwide component operations system. An initial evaluation of that design in the context of an F-16C force suggests that it would outperform today's system against a wide range of operational taskings (e.g., flying at Desert Storm optempos) and simultaneously reduce both initial spares and annual replenishment requirements by more than 60 percent.

Empowering the Commands to Provide Logistics Support

Briefers: I. K. Cohen, Ray Pyles

Part of the study of modern business practices as applied to Air Force logistics, this briefing proposes to expand the growing role of combat commands in the logistics process by holding them responsible for readiness and sustainability (R&S). Commands would either perform or formally contract all support activities related to R&S. Initially, they would take over stock repair and distribution decisions from AFMC. Support activities with less direct effect on daily R&S would be contracted through AFMC and other agencies, with explicit standards and measures of performance, and with appropriate rewards, sanctions, and corrective actions to assure that the contracts' goals were met.

Issues Regarding Depot-Level "Make-or-Buy" Decisions

Briefer: Frank Camm

Addresses the question of how the Air Force should decide whether to perform specific depot-level logistics activities in-house or to contract for them. Reviews experience in the private sector to determine how private firms have made this decision in the past. Identifies a small set of factors that systematically affect private-sector decisions and explores the implications of these factors for Air Force decisionmaking. Posits six working hypotheses about how to split the work load between the Air Force and outside (public or private sector) sources based on these factors.

Is Consolidation Being Overemphasized for Military Logistics?

Briefer: Marygail Brauner

Drawing on insights from recent private-sector practice and past DoD efforts to consolidate activities, this briefing notes that consolidation often fails to achieve its goals of reducing cost and improving coordination. Explains that consolidation is most cost-effective when equipment and personnel are being grossly underutilized. But consolidation of already vast operations runs the risk of creating a system that is less responsive to the customer and, therefore, less able to sustain warfighting capabilities. The DoD should consider some private-sector innovations that have allowed business to achieve economies.

When Prices and Costs Differ: How Stock Funding of Depot-Level Reparables Affects Decisionmaking in the Air Force

Briefers: Frank Camm, Hy Shulman

Asks whether the implementation of the Defense Business Operating Fund (DBOF) has provided a set of internal transfer prices that support effective decisionmaking in the Air Force. As an illustration, uses a specific issue that recently generated significant intercommand disagreement: the question of where to screen depot-level reparables before initiating repair at the depot. Shows that the disagreement is a direct product of DBOF pricing. Presents a short list of specific costing and pricing factors that account for this disagreement and shows that these are likely to be relevant to a wide range of Air Force decisions about resource allocation. Suggests alternative ways to approach internal transfer pricing that would support decisionmaking more effectively.

F-16 Avionics Two-Level Maintenance: Assistance to Coronet Deuce III and Full-Scale F-16 Implementation

Briefer: Lionel Galway

Describes results of two analyses performed in support of the Air Force's transition to two-level maintenance. The first analysis computed the number of test stands required for Ogden ALC to handle F-16 avionics repair during the full phase-in of two-level maintenance. If screening line replaceable units (LRUs)

were still to be done at the bases, their potential need for additional test stands would increase. Since other units would be cannibalized to repair the failed LRUs, those returned to the depot might contain several bad shop replaceable units (SRUs) and thus be harder to repair. However, there were also indications that demand rates in the field were decreasing, thereby counteracting the first effect. In the second analysis, Dyna-METRIC was used to assess the capability of two-level maintenance to support F-16 avionics in a two-contingency scenario. The results showed that the process worked.

Civil Augmentation of Military Airlift

Briefer: Jean Gebman

Summarizes the results of a direct assistance effort that examined a broad set of questions aimed at finding a best estimate for the right mix of civil and military airlift for future needs. Examines the changing demand for airlift, the changing supply of civil airlift that the DoD can depend on, and the need to change the military supply. Also examines the comparative capabilities of different transports to use the world's airfields in possible alternative mixes of civil and military transports.

Tour of the Horizon for Two-Level Maintenance

Briefer: Jean Gebman

Reviews the rationale for adopting a two-level maintenance posture. Surveys the prospects for the Air Force's implementation and addresses issues appearing on the horizon. Draws on 12 years of RAND research on ways to improve airbase maintenance by reducing the mobility footprint, cutting costs, and improving quality. Two-level maintenance is providing important new opportunities to pursue such goals. Successful implementation, however, requires tackling several emerging issues. These include criteria for equipment that is best suited for two-level maintenance, backup sources for maintenance, and certain perverse incentives created by the current implementation of the Defense Business Operating Fund.

Cooperative Development of the FS-X: Issues and Problems of Technology Transfer

Briefer: Mark Lorell

Reviews and assesses the Pentagon's 15-year effort to gain access to Japanese dual-use technology and examines how that effort became a central component of the controversial U.S.-Japan program for the development of the FS-X. Shows how the differing objectives of the Pentagon, Congress, the Department of Commerce, and Lockheed (GD) throughout the FS-X program have made it difficult for the USAF to manage the program so as to maximize benefits to the United States. Discusses how the effort to gain access to Japanese technology has so far proved disappointing because of Japanese resistance, inadequate resources committed by the Pentagon, and differences in industry structure between the two countries. Presents possible options for new policy approaches.

Issues of Technology Transfer: Case of the FS-X Radar

Briefer: Ike Chang

Examines whether the U.S. industrial base could benefit from access to Japanese active phased array radar (APAR) technology. Japan leads the United States in many enabling technologies for APAR, especially in process technology. Japan also has demonstrated sound system integration capabilities in APAR. Japanese capabilities, if transferred successfully, could provide enormous benefits to U.S. interests. The transfer of Japanese APAR technology, however, is hindered by problems of access, complex transfer procedures, and divergent program requirements. Also, since Japan's technological strengths are largely a result of its industrial structure, which is difficult to transfer, U.S. benefits from FS-X technology transfer programs are highly questionable.

Maintaining Military Aircraft Design Capability

Briefers: Jeff Drezner, Giles Smith

Examines one portion of the larger industrial base issue: how to maintain U.S. capability to design and develop advanced military aircraft. Maintaining design capability requires both a sufficient number of design organizations and a core group of engineers and technical managers with adequate levels of experience. Project budgets seem adequate to support several design organizations, but the experience base of future design organizations is declining, thereby threatening the quality of future design capability. Suggests that maintaining future capability requires an increase in design and development activity rates to provide adequate experience and the consolidation of the industry in a rational manner.

Strategies to Sustain Military Aircraft Design and Development Capabilities

Briefers: Jeff Drezner, Giles Smith

Considers the future of military aircraft design and development capability, which is at risk because the experience base of engineers and managers in industry design teams is degrading. There are currently too many firms and too few activities to sustain the necessary experience level. Examines policy options for addressing this issue, including increasing the use of flight vehicle demonstration programs and considerations surrounding industry consolidation.

Aircraft Industry Consolidation: DoD/Air Force Management Dilemmas

Briefer: Dennis Smallwood

Examines possibilities for preserving certain significant rivalries (relating to carrier aircraft, stealthy aircraft, avionics integration, commercial aircraft, and the market share for military aircraft) as the aircraft industry consolidates. Several reasons exist for DoD to encourage the progressive consolidation of industry, but it is also clear that certain consolidation outcomes may have serious consequences in terms of the alternatives available to DoD and the USAF.

The Military Departments and Up-Front Planning

Briefers: Glenn Kent, David Thaler

Proposes a framework for substantially streamlining that part of the acquisition process normally known as "up-front" planning. According to the framework proposed, this planning begins at Milestone 0—when an authority mandates that a particular mission deserves increased emphasis—and ends at Milestone I—when a decision is made to develop and procure systems to equip force elements to implement the "concept" defined and demonstrated during Phase 0 (Concept Development). This process responds to a statement by proper authority that a particular mission area needs increased focus and attention. It takes the place of a Mission Need Statement (MNS) for a particular system.

Planned Maturational Development in the New Acquisition Environment

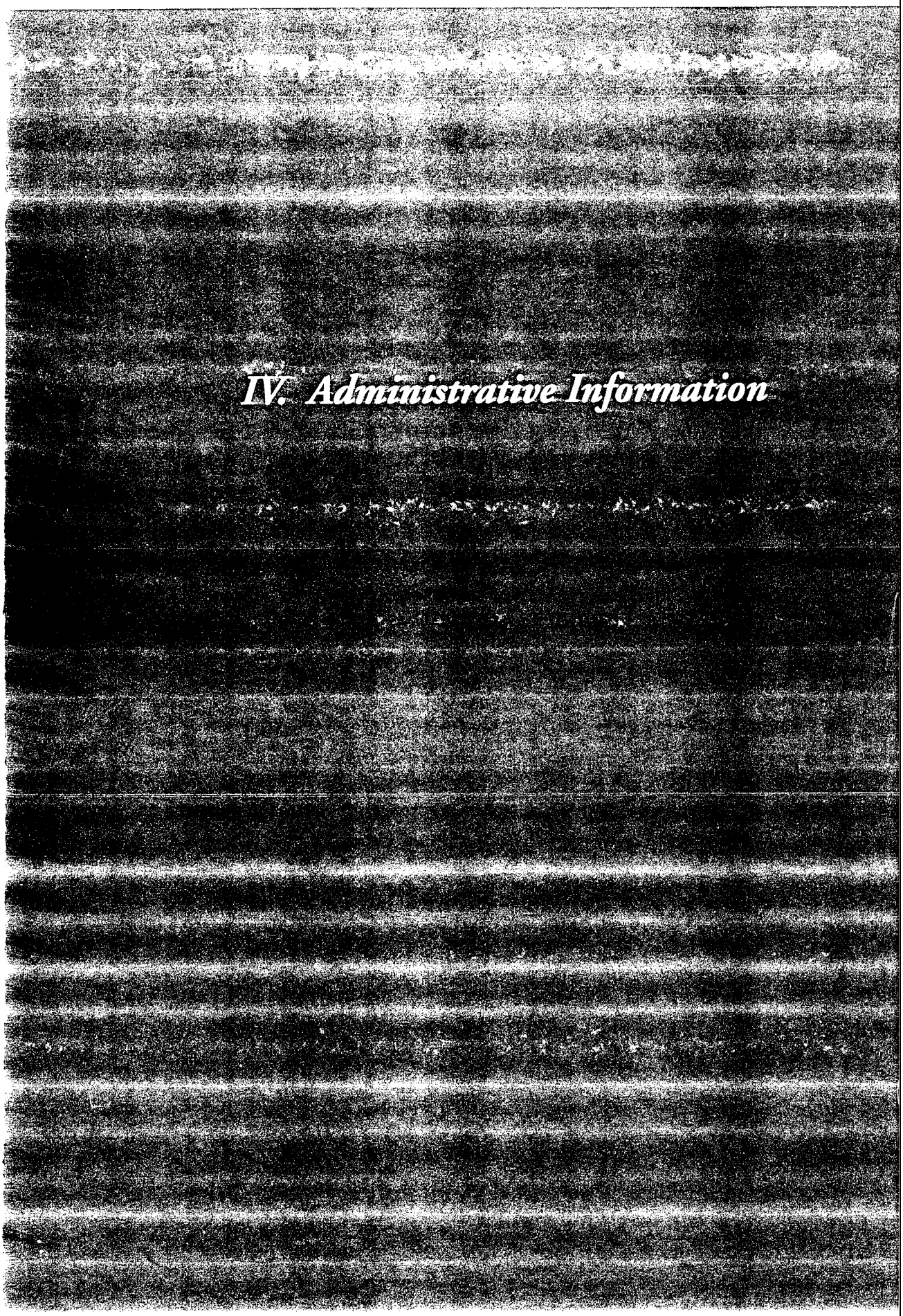
Briefer: Frank Camm

Explains the maturational development phase in an acquisition cycle and the preparation required to facilitate such a phase. Explains the activities required during such a phase and during the preceding period that make it possible. Shows how these activities depend on assumptions about how the Air Force acquires a weapon system. Posits three alternative ways to acquire new weapon systems that span the range of proposals being considered for future acquisition policy. Suggests how these alternatives would affect planned maturational development and how the Air Force should adjust its approach to maturation in response to such effects. Proposes an empirical analysis of modifications of the F-117 to test hypotheses developed in the conceptual analysis conducted to date.

An Assessment of the DoD Management Reform Process

Briefer: Michael Kennedy

Assesses the Defense Management Report Decision (DMRD) process that aims to reduce military spending without decreasing military effectiveness (force structure and mission capability) by directing management reforms in DoD. Empirical analysis of five selected DMRDs shows little evidence that the DMRD goals are being reached. The DMRDs have two thrusts: providing military support functions to users on a fee-for-service rather than free-issue basis (which is good) and consolidating the provision of such support into large centralized organizations with monopoly power (which is so bad that it negates the benefits of the first). A better approach to management reform in DoD is proposed. It empowers the user (in this case, the operational commander) to obtain support from the source that leads to the most cost-effective accomplishment of the mission.



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