NDRI

National Defense Research Institute

Annual Report 2001

RAND

NDRI Research Clients—2001

CLIENT	POLICY CENTER			
	Acquisition and Technology	Forces and Resources	International Security and Defense	Intelligence Policy
Assistant Secretary of Defense (Command, Control, Communications, and Intelligence)	▲		●	◆
Defense Finance and Accounting Service		■		
Defense Information Systems Agency	▲		●	
Defense Intelligence Agency				◆
Department of Veterans Affairs		■		
Deputy Secretary of Defense Office of the Special Assistant for Gulf War Illnesses		■		
Director of Net Assessment			●	
Joint Staff			●	
National Security Agency				◆
National Imagery and Mapping Agency				◆
Under Secretary of Defense for Acquisition, Technology, and Logistics				
Defense Advanced Research Projects Agency	▲			
Defense Threat Reduction Agency	▲		●	
Director, Acquisition Resources and Analysis	▲			
Director, Defense Research and Engineering	▲			
Director, Strategic and Tactical Systems	▲			
Deputy Under Secretary of Defense for Industrial Affairs		■		
Deputy Under Secretary of Defense for Installations		■		
Missile Defense Agency	▲			
Under Secretary of Defense (Comptroller)				
Director, Program Analysis and Evaluation	▲	■	●	
Under Secretary of Defense for Personnel and Readiness		■		
Assistant Secretary of Defense for Health Affairs		■		
Assistant Secretary of Defense for Force Management Policy		■		
Assistant Secretary of Defense for Reserve Affairs		■	●	
Deputy Under Secretary for Defense Program Integration		■		
TRICARE Management Activity		■		
Under Secretary of Defense for Policy				
Principal Deputy Under Secretary of Defense (Policy)			●	
Assistant Secretary of Defense for International Security Affairs			●	
Assistant Secretary of Defense for International Security Policy			●	
Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict			●	
Unified Commands				
U.S. Joint Forces Command			●	
U.S. Pacific Command		■	●	
U.S. Transportation Command		■		
U.S. Southern Command		■	●	
U.S. Space Command		■		
U.S. Marine Corps		■	●	
U.S. Navy	▲	■	●	

Dealing with uncertainty is arguably the central challenge of defense planning today. On the heels of the September 11 attacks, the 2001 Quadrennial Defense Review laid out a new defense strategy aimed at confronting and managing uncertainty. As the war on terrorism unfolds, it becomes increasingly clear that new dangers, some unforeseen at this point, will play a larger role in defining and shaping future U.S. forces.

To confront these new dangers, the United States needs new defense capabilities that will protect not only American interests at home and abroad, but also those of U.S. allies and, in some cases, coalition partners. Harnessing these capabilities would make U.S. forces more adaptable than in the past to a broader range of missions, operating environments, and enemy tactics. Realizing such capabilities takes time, of course, so the United States can ill afford delay in addressing these and other challenges. It must identify, evaluate, and put in place a range of programs now that will lead to greater capabilities down the road. Tough investment choices that balance near-term and longer-term needs will be required. Thus, it must also understand and manage risks to our forces along the way.

Faced with such pressures, U.S. decisionmakers will require clear, cogent, and coherent plans and options. They will need rational data on which to base decisions. They will need objective counsel, a broad menu of policy alternatives, and imaginative solutions to nettlesome problems.

For some three decades, the National Defense Research Institute and its predecessors at RAND have been delivering such assistance to our national security community. We have provided clients throughout the Department of Defense with creative and disciplined research and analytical support on some of the most difficult and pressing national security problems facing the nation. Our focus has been on strategy, technology, people, intelligence, and their interrelationships—the nexus of elements from which national security policy derives.

As we have done from our start, in 2001 we provided clients with a broad spectrum of support—evaluating new policy options; defining and suggesting ways to implement current policy alternatives; and preserving a pool of talent, knowledge, theory, and methods. Most of this support was provided by our four interrelated research centers—International Security and Defense, Acquisition and Technology, Forces and Resources, and Intelligence Policy. This latter center was established in 2001.

This annual report outlines the National Defense Research Institute's agenda and highlights selected research activities in 2001, including timely studies on defense strategy, network-centric operations, the military health system, and counterterrorism. These are but a small sampling of the Institute's breadth and depth of capability. As the report spells out, the need for our work has never been greater. Nor has its relevance.

Jeffrey A. Isaacson
Director
National Defense Research Institute

RAND is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

National Defense Research Institute

The National Defense Research Institute (NDRI) is a federally funded research and development center at RAND that provides studies and analyses to policy-makers in the Office of the Secretary of Defense, the Joint Staff, the Unified Commands, the defense agencies, and other clients. It brings science, analytical rigor, and an understanding of world and national security affairs to the study and choice of policy.

NDRI's primary function is research on policy, strategy, and complex problems, where multidisci-plinary capability, objectivity, independence, and an explicit national-interest charter are essential. In 2001, the Institute performed this function by carrying out a well-rounded research agenda that cor-responded closely to the responsibilities of three of the undersecretaries in the Office of the Secretary of Defense—Policy; Acquisition, Technology, and Logis-tics; and Personnel and Readiness—who have been the main supporters and consumers of NDRI studies and analysis. As in past years, three well-established research centers—the International Security and Defense Policy Center, the Acquisition and Technology Policy Center, and the Forces and Resources Policy Center—conducted much of this research.

NDRI's newest research center, the Intelligence Policy Center, also pursued this agenda. Formed in October 2001, the Center enabled NDRI to more com-prehensively anticipate, assimilate, and address the analytic needs of a broader range of defense clients as they confront new and emerging challenges in the 21st century.

NDRI's agenda depends on symbiotic and mutually beneficial relationships with clients. The Institute's four centers in 2001 helped clients identify and evaluate new policies; framed alternate ways to implement current policies; and provided other ana-lytical and technical assistance, including specific aid to decisionmakers following the terrorist attacks of September 11. In so doing, NDRI was able to sustain and invigorate core investigational, theoretical, and methodological capabilities—organizational character-istics that well position the Institute to pursue vital national security research in the future.

NDRI's Four Policy Centers

Acquisition and Technology Policy Center
Eugene C. Gritton
Director

International Security and Defense Policy Center
Stuart Johnson
Director

National Defense Research Institute
Jeffrey A. Isaacson
Director

Intelligence Policy Center
Kevin O'Connell
Director

Forces and Resources Policy Center
Susan S. Everingham
Director

NDRI's Research Centers in 2001

- The **International Security and Defense Policy Center** explored how the world's security landscape was changing before and after September 11; how these new global conditions affect U.S. interests; and policies, strategies, and terms of engagement that the United States requires to shape the environment and protect vital interests at home and abroad.

- The **Acquisition and Technology Policy Center** addressed opportunities and challenges presented by new technologies, in particular those enabled by the information revolution, and assessed ways to identify and thwart technological threats posed by terrorists and other rogue actors. These analyses aimed to preserve U.S. military advantages as economically as possible.

- The **Forces and Resources Policy Center** focused on issues affecting the effectiveness and quality of life of U.S. uniformed personnel, on the forces the United States needs to execute military strategies, and on ways the DoD can optimally use resources. It concentrated on policy options that help ensure that the United States is able to attract and retain high-quality military personnel.

- The **Intelligence Policy Center** maintained a broad, substantive focus spanning international security, acquisition, and manpower issues for clients in the DoD intelligence community and warfighters in the field. It helped clients assess the impact of the information revolution on society and security, understand key technologies connected with satellite systems, and analyze strategy and policy issues in key countries around the world.
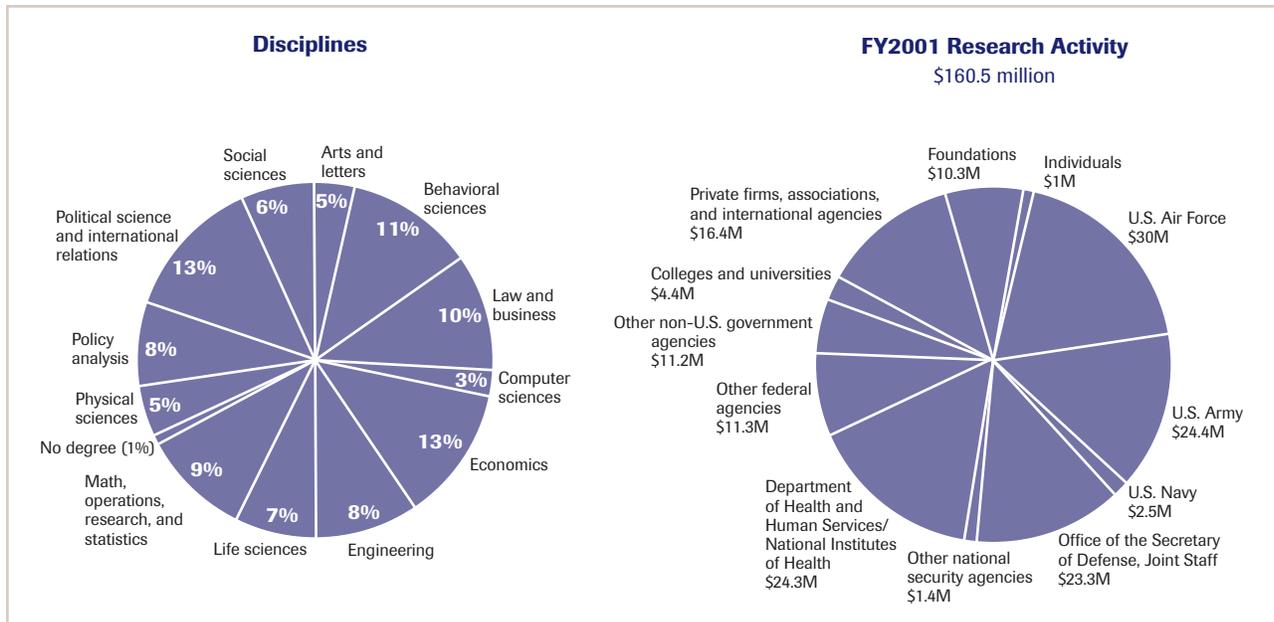
The RAND Environment

NDRI is part of RAND, a private, nonprofit institution whose mission is to improve policy and decisionmaking through research and analysis. Since its founding with private capital in 1948, RAND has studied the most pressing public policy problems of the day, producing in-depth, objective policy analyses, basic and applied research, and analytic tools used in government, academia, and the private sector.

Today, RAND studies assist public policymakers at all levels and the public at large in efforts to strengthen the nation's economy, maintain its security, and improve the quality of life of its citizens. Clients rely on RAND for help in analyzing choices and developments in many areas—including national defense, education and training, health care, criminal and civil justice, labor and population, science and technology, community development, international relations, and regional studies. RAND also offers several advanced training programs, including the RAND Graduate School's doctoral program in policy analysis and its intensive advanced defense analysis seminars geared toward mid-career decisionmakers.

In addition to NDRI, two other DoD federally funded research and development centers that offer additional analytical resources are housed at RAND. Project AIR FORCE—RAND's oldest studies and analysis organization—has helped U.S. leaders determine the size, shape, and missions of the U.S. Air Force. RAND's Arroyo Center helps the U.S. Army focus on similar mid- and long-range policy questions.

NDRI also draws upon research talent from throughout the organization. RAND employs more than 700 research professionals, 85 percent of whom hold advanced degrees, most commonly the doctorate. Staff disciplines include economics, mathematics and statistics, medicine, law, business, physical sciences, engineering, operations analysis, social sciences, arts and letters, and computer science. RAND possesses analytical depth in psychology, sociology, and demography, all of which NDRI harnesses in conducting studies of personnel issues, for example.

RAND Health, one of the world's largest and preeminent health care policy research organizations, brings crucial insight into questions connected with

Disciplines

Social sciences 6%
Arts and letters 5%
Behavioral sciences 11%
Political science and international relations 13%
Law and business 10%
Policy analysis 8%
Computer sciences 3%
Physical sciences 5%
No degree (1%)
Economics 13%
Math, operations, research, and statistics 9%
Life sciences 7%
Engineering 8%

FY2001 Research Activity
$160.5 million

Foundations $10.3M
Individuals $1M
Private firms, associations, and international agencies $16.4M
Colleges and universities $4.4M
Other non-U.S. government agencies $11.2M
Other federal agencies $11.3M
U.S. Air Force $30M
U.S. Army $24.4M
U.S. Navy $2.5M
Office of the Secretary of Defense, Joint Staff $23.3M
Other national security agencies $1.4M
Department of Health and Human Services/National Institutes of Health $24.3M

RAND's Multidisciplinary Staff Provide Breadth and Depth to Research Activities
as of December 31, 2001

the provision and management of military medical services, the possible causes of Gulf War Illness, and the clinical implications of the use of weapons of mass destruction by terrorists or rogue states. RAND's Science and Technology Policy Institute investigates national policies regarding scientific and technical education, research and development, and regulatory practices that inhibit or promote technology and investments. Numerous other RAND research centers provide specialists with skills that prove particularly useful when investigating policy issues. These specialists are in areas such as

- surveys, statistical analysis, and information systems
- computer modeling and simulations
- scenario design, analysis, and testing

RAND's International Programs—comprising the Center for Asia Pacific Policy, the Center for Middle East Public Policy, and the Center for Russia and Eurasia—house additional research talent on security, economic, political-social, and other matters relating to key regions of the world. Work on allied defense issues done in part through RAND's independently

chartered European subsidiary, RAND Europe, provides perspective that is relevant to both national security and non-national security work.

RAND research is supported by a broad range of sources, from charitable foundations to combinations of private firms. The largest share of support comes from agencies of the U.S. government. RAND also conducts projects for foreign governments, when such work supports U.S. interests. In addition, RAND pursues some research using funds from its own endowment.

International Security and Defense Policy Center

The International Security and Defense Policy Center (ISDP) analyzes the effects of international political, strategic, economic, and technological changes and assists U.S. national security decisionmakers in developing policies to deal with those developments. Its research agenda in 2001 focused on emerging challenges that continue to recast U.S. national security policy: the emergence of terrorism and other new threats to the United States at home and to its forces and allies abroad, the proliferation of weapons of mass destruction and other technologies, and the pervasiveness of information and its effect on military strategy and operations.

As spelled out below, four themes guided ISDP's research in 2001:

International Engagement

Helping U.S. defense policymakers develop a strategy to manage NATO enlargement and prepare for the 2002 NATO summit was a major focus of ISDP in 2001. The Center continued to assist the Joint Staff in evaluating challenges that Pentagon planners face in developing and implementing theater engagement plans in and around Europe, helped policymakers evaluate options for U.S. military presence in southeast Europe, and explored steps for enhanced U.S. security cooperation with Mediterranean allies. Beyond Europe, it helped the DoD examine shortfalls in interoperability between U.S. and key allied forces, helped assess security implications of adverse developments in China's economic growth, and assisted defense planners in outlining the shape of the United States' security alliance with the Republic of Korea. Center analysts also examined the

role of the military in Indonesia's political evolution, explored emerging threats to democracy in the northern tier of South America, and helped the U.S. Southern Command design a disaster management and humanitarian assistance program.

Understanding Emerging Threats

ISDP investigated how U.S. interests may be threatened by mass casualty weapons, by the proliferation of technology, by the United States' increasing reliance on information systems, and by terrorists and other nonstate actors. The Center provided special assistance to the Office of the Secretary of Defense on issues involving terrorist threats to the United States and investigated ways America and its allies can phase and coordinate efforts to counter such weapons and protect U.S. forces at home, on the Korean peninsula, and in other theaters. It also helped policymakers evaluate the capability of DoD medical resources to respond to chemical or biological weapons attacks in the United States. On the information front, the Center looked for clues to help DoD policymakers determine whether and how the information revolution is changing the abilities of state and nonstate actors to threaten U.S. interests.

Defining New Defense Strategies

ISDP research explored how to formulate U.S. defense strategy to shape the international environment, address emerging threats to U.S. interests, and accommodate new technologies and tactics. Center analysts continued to directly support the Commander-in-Chief, U.S. Joint Forces Command in developing joint warfighting studies and experiments. They explored

enduring sources of U.S. military advantage and developed a framework to help U.S. defense leaders think through deterrence in strategic warfare. The Center reviewed and analyzed how the U.S. submarine force has been employed since the end of the cold war. And it developed a new strategic concept for U.S. policies toward Colombia.

Defense Planning

In 2001, ISDP supported DoD across a broad spectrum of planning efforts. Working with NDRI's Forces and Resources Policy Center, ISDP provided analytic support to a congressionally mandated panel assessing the United States' ability to respond to domestic acts of terrorism involving the use of weapons of mass destruction. It helped defense planners think through the basic elements of a theoretical framework for information warfare. Center analysts explored the implications of alternative U.S. defense strategies on European defense planning and of alternative European strategies on U.S. planning. And the Center continued to evaluate the Marine Corps' urban ground reconnaissance capabilities.

Iran's Security Policy in the Post-Revolutionary Era

The 1997 election of Mohammed Khatami as president of the Islamic Republic of Iran was thought by many observers to be a watershed event that would trigger profound changes in Iran's political debate and its foreign policy. But more than four years later, the exact nature and direction of change in Iran remains murky, and the implications of such change for U.S. security policy have yet to be fully defined.

NDRI, working on behalf of the Defense Intelligence Agency, has been helping U.S. defense policymakers gain a fuller understanding of how Iran's attitudes and actions are changing. NDRI has found that Teheran has begun to cultivate foreign governments, sometimes at the expense of long-standing revolutionary principles, to preserve regional stability and to improve Iran's global standing and economic status. The result? Iran now often favors far more cautious policies than its Islamic and nationalist ethos might otherwise dictate.

While Iran's decisionmaking process continues to be characterized by two competing trends—seemingly chaotic complexity and consensus—Teheran has adopted increasingly prudent policies toward its neighbors. In recent years, the Islamic regime has supported the territorial status quo on its borders, avoided major military provocations, and preferred to work with governments rather than substate movements—all of which suggests that it is adopting a classic post-revolutionary stance. As depicted in the accompanying table, Teheran also has made a particular point of wooing the Gulf states and encouraging stability in Central Asia, even if this requires slighting local Islamic movements. Although Iran at times may support Shi'a radicals and other Islamic movements throughout the world—and champions the anti-Israel front—its motives and priorities are increasingly dictated by cold national interest concerns.

This prudent posture is supported by Iran's security forces, particularly the regular military. Today, these forces often are voices of restraint, fearful that almost any broad conflict would be costly and deeply unpopular. When tensions with neighbors have escalated, Iran's military forces have conducted maneuvers and massed troops, but deliberately have avoided open confrontation.

Moreover, differences between Iran's regular armed forces and its revolutionary armed forces are decreasing. As the revolutionary forces' commitment to professionalism has grown, and its Islamic ardor waned, it increasingly conducts business in a manner similar to the regular forces.

These findings about Iran's security policy have important implications for the U.S. government and the U.S. military. First, they suggest that Iran is likely to use caution regarding force, even if the provocation is considerable. Second, Iran's military is likely to continue facing serious problems. Although its forces are more integrated than in the past, the dual military structure and the ambiguous chain of command will complicate any operations. Third, any U.S. concerns about unauthorized terrorist or military actions are probably overstated: Iran's civilian leadership exercises firm control over the military, and a strong informal network ensures that all major decisionmakers are aware of key decisions and actions.

Comparing Iran's Foreign Policy Drivers

Issue	Revolutionary Islam	Geopolitics	Nationalism	Ethnicity	Economics	Actual Policy
Defense spending	–	Low	High	–	Low	Low
Ties to revolutionary movements	Strong ties to Muslim groups, particularly Shi'a	Ties to groups in key states, such as Iraq	Ties to groups in Gulf region, Central Asia, and other historical areas of interest	Reject most ties; strong ties to governments	Reject most ties that might hinder trade or stability	Cautious ties to various religious groups; declining support in recent years
Relations with Gulf states	Competition and rejection of legitimacy	Attempt to decrease U.S. influence	Seek recognition of Iran's leadership	Avoid policies that might anger Arab Iranians	Seek close ties to gain goodwill of West, improve oil cooperation	Steady rapprochement
Relations with Central Asia/ Caucasus	Support for religious groups	Balance Azerbaijan (and Turkey) with Armenia	Seek influence in Tajikistan, other Persian areas	Strong ties to governments to prevent irredentism	Pursue close economic ties	Pursue economic ties; good relations with regional governments
Relations with United States	Reject ties	Recognize U.S. power; avoid confrontation; minimize U.S. influence	Reject ties, particularly if perceived as subordinate	–	Seek good relations	Continued resistance to normalization

A Framework for Strategy Development

This NDRI study laid out a promising new framework that U.S. policymakers can use to formulate defense strategy. Many observers have noted that past formulations of American military strategy—such as the "Shape, Respond, Prepare Now" approach that the DoD used from 1997 until 2001—have been longer on philosophy than on practicalities. To overcome such shortcomings, this study sought to better link strategy with resource priorities and more accurately frame key investment choices.

Completed before the September 11 terrorist attacks, the analysis took cues from portfolio planning methods that are widely used in investment circles. First, it identified six *themes*, or strategic directions, that are likely to dominate U.S. defense policy over the next several decades. These themes, laid out in the table below, cover a broad spectrum of strategic objectives, rationales, and potential contingencies.

In a second step, the analysis combined the above themes into three pairs of distinct *strategic constructs*. It developed the constructs by mixing a bottom-up view of the themes with a top-down perspective of the various approaches to defining the U.S. role in the world. While there are numerous possible combinations of themes, the

Possible U.S. Strategic Themes 2002–2020

Theme	Rationale	Objective	Operational Contingencies
Ambitious Shaping	Because the world's core of democratic, market-economy nations is growing, much of the globe's future will turn on whether transition states remain on the path toward democracy.	Turn U.S. allies into full partners in shaping the world and devote special attention to helping ensure the move of large transition states (especially China and Russia) to pluralistic political systems and market economies.	Field expeditionary operations to decisively defeat potential adversaries and pursue engagement activities of all sorts targeted on allies and transition states.
Countering Rogues	Rogue states will continue to threaten the United States and may resort to asymmetric measures such as weapons of mass destruction (WMD), anti-access strategies, and short-warning attacks.	Deter and, if required, defeat rogues.	Counter WMD attacks and build combat capabilities that include strong projection forces, forward stationing, and the ability to defeat anti-access strategies.
Protecting the Homeland	United States should be less concerned about the world and be more concerned about homeland defense.	Elevate the importance of protecting U.S. territory and citizens.	Defend against missiles, countering WMD and major non-WMD terrorism, and protect U.S. and allied information systems.
Countering New Dangers	Because the positive aspects of globalization and U.S. military superiority are likely to continue, the United States should focus on unfamiliar, transnational threats to U.S. security.	Prevent and deter such new, unconventional challenges to the global system.	Counter WMD terrorism and non-WMD terrorism by nonstate actors, illegal drug trafficking, and information warfare.
Preparing for China	Among transition states, only China can pose anything like a peer-level threat to the United States in the long run. This does not presume that China will be an enemy, only that its emerging capabilities will determine the benchmark by which U.S. forces should be judged.	Prevent Chinese military ascendancy by making U.S. military superiority clear and by shaping China into a true strategic partner.	Maintain continuing capacity to project military power into Asia, enhance interoperability with regional allies, and bolster defense against China's medium- and long-range missiles.
Policing Instability	Positive aspects of globalization continue and U.S. strength continues to deter major state-centered threats, and terrorism (both conventional and WMD) is muted by global economic growth and U.S. military power.	Lead coalitions of willing allies to preserve and restore order in places where "good" globalization fails to take root.	Concentrate on multilateral stability and engagement activities.

Illustrative U.S. Security Portfolios

	Force Postures/ Capabilities	Focus on Key Responsibilities	U.S. Multilateral Leadership	Protecting an Essential Core
Force postures	Traditionally configured forces	Important	Important	Less important
	Expeditionary forces	Very important	Very important	Very important
	Forces-after-next focus	Very important	Less important	Very important
Capability packages	Stability operations	Important	Very important	Less important
	Missile defense	Very important	Less important	Very important
	Countering WMD	Very important	Important	Very important
	Countering transnational threats	Important	Important	Very important
	Information operations	Very important	Very important	Very important
	Environment shaping	Very important	Very important	Important
	Nontraditional missions	Less important	Very important	Less important
Blue = Invest/Maintain		White = Divest		

analysis used the following constructs for illustrative purposes:

- **Focus on Key Responsibilities.** This construct roughly combines the attributes of Countering Rogues and Preparing for China. It posits that the United States has a distinct position with special historical responsibilities and must confront the most demanding current and future security challenges: dealing with hostile states that have WMD and the means to deliver them; addressing threats to world energy supplies; maintaining peace in regions that are vital and potentially insecure; and managing the emergence of a powerful China.

- **U.S. Multilateral Leadership.** This construct roughly combines the attributes of Ambitious Shaping and Policing Instability. It posits that the future of major tran-sition states is far from clear; instability remains high, from the Balkans through Africa, the Middle East, and Asia; and, while high-intensity conflict is unlikely, smaller-scale contingencies likely will persist.

- **Protecting an Essential Core.** This construct roughly combines the attributes of Protecting the Homeland and Countering New Dangers. Broadly speaking, it posits that international trends are favorable, and U.S. military supe-riority will protect traditional interests from traditional threats. National security will face demands from un-familiar challenges to U.S. territory, citizens, and global economic systems.

In a third step, the analysis assigned a distinct *port-folio* to each construct, based on the relevant *force postures* (traditionally configured forces, expeditionary forces, or forces-after-next) and *special capability packages* (stability

operations, missile defense, countering WMD, countering transnational threats, information operations, environment shaping, or nontraditional missions) that each would require. As shown in the table above, the portfolios emerged from a comparison of the importance of various force postures and capabilities in each construct—postures and capabilities rated as "very important" or "important" were candidates for investment and are shaded in the table. Those that were rated "less important" were candidates for divestment and are not shaded.

Ultimately, the framework can help decisionmakers prioritize needs. Core forces and capabilities are those that all three portfolios will either invest in or maintain. They form a nucleus of key attributes that are important to decision-makers, regardless of the chosen defense strategy. There is significant room for differentiation even within this core, however. The difference between "invest" versus "maintain," for example, could be significant. Other key decisions and trade-offs are those that entail expanding from the core to encompass one or another illustrative portfolio. Moving toward the Protecting an Essential Core portfolio, for example, makes the forces-after-next posture the top priority and suggests divesting capacity for traditionally configured forces and nontraditional missions. Moving toward the U.S. Multilateral Leadership portfolio reverses those priorities.

This framework is adaptable. By combining themes in different ways, defense planners can create different con-structs that will employ different portfolios. This will allow for different strategic choices to flow from changing assess-ments of the future security environment.

Acquisition and Technology Policy Center

T he Acquisition and Technology Policy Center (ATP) addresses issues of accelerating technological change in the context of transformations on the world political scene and within the U.S. military establishment. Its research agenda reflects a fundamental paradox: technological advances simultaneously hinder and help U.S. defense policy. While new technologies expose U.S. forces and interests to new challenges, threats, and dangers, they also bring about developments and innovative concepts of operation that allow U.S. forces to accomplish new roles and missions. As Operation Enduring Freedom demonstrates, the United States has been able to exploit its technological advantage to great effect in a far-flung region of the world—projecting power rapidly from the air, from the sea, and on the ground; waging war from afar and in close quarters with minimal U.S. casualties and collateral damage; countering potential terrorist actions both in the United States and abroad; and engaging effectively in peacekeeping and humanitarian operations.

ATP's research agenda in 2001 was comprised of six interrelated elements discussed below.

Conflict in the Information Age

ATP explored in 2001 how conflict in the information age will affect traditional military engagements and how it could lead to new forms of hostilities. ATP analysts continued to support OSD's effort to craft an Information Superiority Investment Strategy and measure how information contributes to operational outcomes, assessed how digital communications improve command and control in ground operations, and evaluated the role of deception in active network defenses. The Center continued to conduct exercises for U.S. and allied defense policymakers on ways to protect critical information systems and infrastructures from hostile attacks and develop appropriate contingency plans. It applied a RAND-developed methodology to locate vulnerabilities in critical defense information systems. And the Center helped develop measures the Navy can use to gauge which information resources most effectively enhance its tactical operations.

Understanding the Effect of New Technologies on Future Military Operations

ATP continued to investigate military operations in light of advances in technology. The Center helped the Defense Advanced Research Projects Agency (DARPA) assess technologies to locate, identify, and engage fleeting targets and to identify humans at a distance. Center analysts also helped assess and simulate future combat systems in the context of joint warfare. Other ATP researchers analyzed research and development needs connected with new arms control technologies.

Assessing Force Modernization Options

ATP in 2001 continued to identify the priorities of force modernization. For the Navy and OSD, it carried on a multiyear effort to evaluate naval force structure options, acquisition and modernization strategies, and budget issues. Also for the Navy, Center researchers continued to develop a concept of operations and evaluate missions for the NR-2 submarine, a nuclear-powered, deep submergence, research and engineering

vessel that is under consideration. Another ATP research team explored the financial implications of buying new E-2C Hawkeye aircraft versus repairing existing ones in the fleet. The Center also investigated the implications of funding Navy ship construction using advance appropriations.

Maintaining Core Defense Technology and Production Bases

With many crucial defense technology industries having merged, restructured, or reduced their operations, the Center for several years has helped the DoD explore how to preserve vital development and production capabilities. In 2001, this work included assessments of various aircraft carrier refueling, overhaul, and construction alternatives.

ATP researchers continued to help identify future core equities, alternative organizations, and transition plans for the Naval Sea Systems Command (NAVSEA). The Center assisted the Navy in evaluating program management options for the Advanced SEAL Delivery System, a new subsurface craft designed for special warfare operations. And it explored ways the DoD can better interact with the Food and Drug Administration and the pharmaceutical industry on chemical and biological warfare defense issues.

Assessing New Acquisition Strategies

ATP researchers in 2001 helped defense policymakers identify ways to improve the acquisition process and implement meaningful acquisition reform. In a major effort for the new administration, the Center helped an Acquisition Reform Task Force, which was established

in early 2001 by the Secretary of Defense, produce studies, analyses, and recommendations. In another effort for OSD, Center analysts developed a management and business process to improve the Department's ability to assimilate rapidly changing information technology. At the request of Congress, the Center compared the implications of assembling and readying the Joint Strike Fighter at a single site versus doing so at multiple locations. It also developed metrics the Chief of Naval Operations will use to track the performance of key Navy functions and defined policies that would allow the Navy to sink unneeded ships in U.S. waters for use as artificial reefs.

Application of New Modeling and Simulation Approaches

ATP helped the DoD fashion a more flexible, robust simulation and modeling environment in 2001. The Center continued a multiyear effort to help the Defense Information Systems Agency measure the degree to which command, control, communications, computers, surveillance, and reconnaissance capabilities influence joint military operations. Center analysts also provided technical assistance to a DoD effort to develop better counterdrug information technologies and helped defense policymakers obtain data about the use of aircraft by Colombian drug smugglers.

Measures of Effectiveness for the Information-Age Navy

The Effects of Network-Centric Operations on Combat Outcomes

This project created a framework that policymakers can use to assess how and to what degree "network-centric" operations might improve the U.S. Navy's effectiveness in combat. NDRI's effort involved looking at how changes in command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems and procedures could affect a variety of naval combat outcomes.

The Need For New Measures of Effectiveness

Traditional measures of effectiveness usually ignore the effects of information and decisionmaking on combat outcomes. In the past, C4ISR operations have been analyzed separately using measures of performance. Assessing the effects of improvements in C4ISR operations on combat outcomes has been inferred rather than directly assessed. Physical improvements such as greater bandwidth, for example, have generally been thought to benefit combat operations. Improved sensors and fusion algorithms have been thought to have a similar salutary effect on the common operating picture. Even more recent discussions of network-centric warfare (NCW) or network-centric operations and information superiority imply that they will make combat operations more effective by improving decision-making. However, these assertions have not been able to point to a strong, quantifiable link between C4ISR and better combat outcomes.

Network-Centric Warfare

Network-centric warfare is generally thought to be *the linking of platforms into one, shared awareness network in order to obtain information superiority, get inside the opponent's decision cycle, and end conflict quickly*. Traditional warfare, by way of contrast, is considered to be *platform-centric*. In platform-centric warfare, weapons systems act independently and one must mass force to mass combat effectiveness; in network-centric warfare, effects are massed rather than force. Network-centric warfare optimizes the use of weapon systems so that a target is serviced by the most effective system in the network. Thus, it is hypothesized, the effects of massing force can be obtained with a much smaller force. The Navy and the C4ISR community are pursuing the application of this concept to warfare.

NCW is conceptually based on three grids:

- **An information network grid** that provides infrastructure to receive, process, transport, store, and protect information
- **A sensor network grid** that is unique to each task and made up not only of typical warfare sensors such as radar, but also of imbedded logistics sensors to track supply
- **An engagement-decision-shooter grid** that uses a unique blend of warfighters and sensors for each new task

NCW flattens the command and control pyramid, with commanders communicating both directly and automatically, using computer algorithms. With respect to Navy operations, NCW moves toward automated optimization of the positions of units in a group and engagement of enemy forces using new initiatives such as Cooperative Engagement Capability and Ring of Fire.

Gauging the Effectiveness of NCW: Two Vignettes

Using graph and information theory, NDRI analysts assessed both the value and cost of connectivity and of collaboration in two hypothetical naval combat settings—one dealing with defending against a combined ballistic missile/cruise missile threat, the other with detecting and destroying time-critical targets. Both vignettes were hypothesized to take place in 2010.

- **Cruise and Ballistic Missile Attack.** A coordinated Anti-Ship Cruise Missile (ASCM) saturation strike against U.S. surface combatants and a ballistic missile attack against targets being defended by those surface combatants. An ASCM attack might prevent those ships from protecting against ballistic missiles by disabling a ship or saturate their command and control systems so that ballistic missiles can "leak" through.
- **Time-Critical Targets (TCT).** The search for and destruction of an enemy submarine—bound on a mission to interdict allied port operations—that is on its way out of port and has not yet submerged.

The study developed a spreadsheet model to link each vignette's network-centric operations, C4ISR, combat operations, and combat outcomes in a common framework. Because this model generated several hundred alternative combinations of operating procedures, network connectivity, and C4ISR systems for each vignette, the analysis employed exploratory analysis as an evaluation tool. Exploratory analysis refers to the use of many computational experiments to reason about complex and uncertain problems.
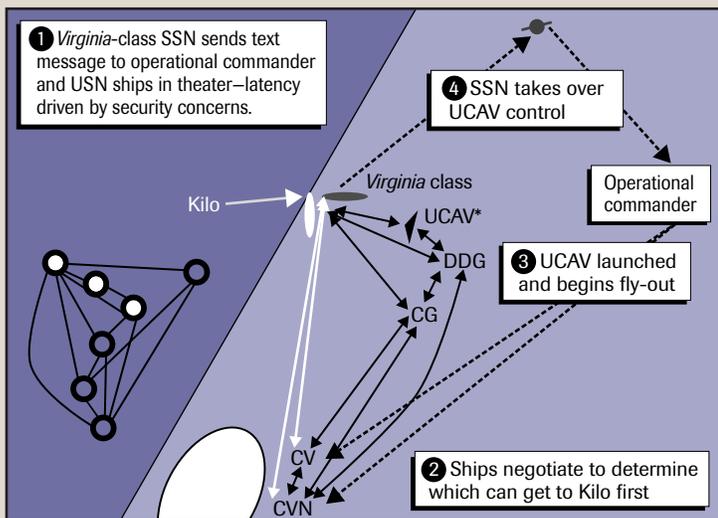
The study suggested that the Navy could measure its ability to blunt a cruise and ballistic missile attack by looking at whether it accomplishes two missions: (1) defending warships against cruise missile attacks, and (2) preventing enemy ballistic missiles from destroying key allied infrastructure. For both missions, the measure of effectiveness is survivability—i.e., the fraction of the fleet or of the critical infrastructure targets that survive the attacks.

NDRI's analysis found that in most of this vignette's scenarios the defending ships were able to detect, identify, and track attacking enemy missiles. They were less able to predict how the enemy would distribute these missiles over time. Knowing the attack distribution contributes directly to the allocation of missile interceptors and therefore to the survivability of both the ships and the friendly infrastructure. The analysis proposed that the Navy could measure how well its alternative command and control procedures and networks would perform by examining the degree to which U.S. commanders know the enemy's attack distribution.

The Navy's ability to hunt and destroy an enemy submarine leaving port, which was the focus of the second vignette, can be gauged by looking at how quickly the United States could bring one or more attack aircraft onto the scene, NDRI suggested. The quicker the Navy's information grid can vector aircraft to the target, the more time the aircraft have to hunt, which translates into a higher probability that they will sink the submarine. As the accompanying figure suggests, network-centric operations in the future may allow unmanned combat air vehicles (UCAV) to assume the attack role.

In both vignettes, NDRI found that network complexity and collaboration combined to affect combat operations. Collaboration is important because it can enhance the degree of shared awareness. But although there are several reasons why collaboration might be expected to improve the degree of shared awareness, NDRI found that there may be ways in which it can degrade team performance. Capturing both effects in a measure of performance is problematic and should be the subject of further research.

① *Virginia*-class SSN sends text message to operational commander and USN ships in theater—latency driven by security concerns.

④ SSN takes over UCAV control

Kilo

Virginia class
UCAV*
DDG
CG
CV
CVN

Operational commander

③ UCAV launched and begins fly-out

② Ships negotiate to determine which can get to Kilo first

Environmental Management in Proactive Commercial Firms

Lessons Learned for Central Logistics Activities in the DoD

Like many innovative commercial firms, DoD has sought to take a proactive approach to environmental issues. However, the Department has found it difficult to implement proactive policies in ways that affect decisions made throughout the DoD.

This study—done for the Office of the Deputy Under Secretary of Defense for Environmental Security—focused on how commercial firms recognized as having the best environmental management practices in the country have implemented those practices throughout their organizations. The study's objective was to identify lessons from these firms' experience that could help the DoD implement similar proactive approaches in its central logistics activities.

The accompanying table outlines some of the major concerns that any proactive DoD environmental management program dealing with central logistics functions would need to address. These issues range from energy consumption and waste disposal to budgets and contracts.

NDRI examined corporate documents and reviewed the secondary trade and academic literature to investigate the methods that successful proactive firms—including AT&T, Caterpillar, Ford, DuPont, IBM, and John Deere—have used to implement environmental management policies. The study found that the DoD can learn a great deal from commercial firms—depot-level maintenance of defense systems, for example, raises the same variety of environmental

Central Logistics Functions and Associated Environmental Concerns	
Logistics Function	**Environmental Concerns**
Transportation	Energy consumption Air emissions Noise Waste disposal Spills and accidents Runoff from roads Congestion and road wear
Supply	Energy consumption Air emissions Hazardous-waste disposal Nonhazardous-waste disposal Normal spills and emissions Serious spills, fires
Maintenance	Direct emissions and small spills Hazardous-waste disposal Nonhazardous-waste disposal Serious spills, fires Energy consumption
Control	Compliance Programming and budgeting Information for integration and improvement
Contracting	Environmental effects of producing the products bought How products bought affect the buyers' environmental performance

issues that exists in the manufacture of comparable integrated electronics and aircraft systems, engines, and heavy equipment.

The study identified a broad, emerging consensus among innovative commercial firms that support an increasingly proactive approach to environmental management. As regulations have become more pervasive, firms have recognized more and more cost-effective opportunities to move away from end-of-the pipe pollution controls. Firms have realized that if they engage in planning before regulations are imposed they have better opportunities to develop cost-effective responses. And as they have become global entities, larger firms have found it easier to develop a single, organization-wide policy than to worry, at the corporate level, about specific compliance issues in each locale. The DoD's policies, NDRI found, are broadly compatible with this consensus.

NDRI suggested that the DoD integrate environmental management with its core mission and develop a formal environmental management program to increase the likelihood that its environmental policies will be successfully implemented. This will require that environmental specialists advocate environmental positions in language that logisticians can appreciate and that they bring information about the regulatory consequences of logistics practices to the attention of those responsible for changing those practices. Ideally, environmental specialists and logis-ticians—managers, production workers, and analysts—should work face-to-face at multiple levels and develop good working relationships. By setting up a formal program, they will be better able to monitor the development and execution of proactive initiatives, measure progress against milestones, and develop lessons the DoD could use to tackle increasingly difficult environmental challenges.

NDRI also suggested that the DoD consider using Total Quality Management (TQM) to verify its implementation approach, particularly in the area of pollution prevention; if effective in central logistics activities, this could help lead the DoD toward broad acceptance of TQM.

For more information, see

Environmental Management in Proactive Commercial Firms: Lessons for Central Logistics Activities in the Department of Defense, Frank Camm, MR-1308-OSD, 2001.

Forces and Resources Policy Center

The Forces and Resources Policy Center (FRP) has helped the DoD since the late 1980s think through personnel and resource implications of changes in force size and structure, the emergence of new security challenges, and the rapid progress of technology. Its research encompasses issues affecting U.S. military personnel, forces needed to execute U.S. military strategies, and ways the DoD can use resources optimally.

FRP analyzed these issues in 2001 along five interconnected themes outlined below.

Assuring the Supply of High-Quality Personnel

Attracting steady supplies of skilled, smart personnel has become a paramount issue for the military services as they are transformed by the information age. Not only must DoD compete with private-sector employers for high-quality enlistees (because more youths are attending college and universities); services also will have to develop policies that will enhance their ability to recruit youth with education beyond high school. FRP researchers in 2001 helped OSD policymakers explore policy options for attracting college-bound youths to military service, examine competition among the services for recruits, and understand trends that affect recruiting by the National Guard and Reserve.

Bettering the Quality of Life for Uniformed Personnel and Their Families

OSD has for several years turned to FRP to assess policies and practices designed to directly improve military quality of life. Center analysts extended their significant body of work on compensation and

analyzed a range of compensation issues in support of the 9th Quadrennial Review of Military Compensation. The Center assisted a blue-ribbon Quality of Life Task Force established by the Secretary of Defense in 2001. And in 2001, the Center began to extend its work on the DoD child care system by examining child care needs in various military settings.

Determining and Meeting Manpower Requirements

As its civilian workforce ages, the DoD faces a growing challenge to retain experienced employees. To address the civilian employee challenge, the Center in 2001 continued to explore a range of management, compensation, recruiting, training, and retention issues connected with its non-uniformed workforce. The Center assisted in the development of acquisition workforce management systems and helped the Chancellor for Education and Professional Development explore ways to measure and improve the quality of DoD's professional education and development system. There also is mounting evidence that uniformed service members, especially those in high-tech occupations, are increasingly more difficult to retain. FRP continued to help the DoD examine whether its existing officer personnel management practices are appropriate for the defense environment it will face in the 21st century.

Optimizing the Military's Infrastructure

FRP in 2001 continued to help DoD explore new and better ways to support its operations. The Center completed its analysis of whether military installations are structured to support forces in the future. The Center examined how the Defense Finance and Accounting

Service could improve its price structure. Other Center analysts explored the effectiveness of using third parties to administer warranty claims on aircraft engines. In the logistics area, FRP analysts explored how logistics providers could use proven process improvement methods to more effectively supply and support U.S. forces based at home and abroad and explored the feasibility of using modular payloads on attack submarines. And as mentioned above, the Center—working with ISDP—provided support to a congressionally mandated panel assessing the ability of state and local authorities to respond to terrorists wielding devastating weapons on U.S. soil.

Improving the Military Medical System

The DoD, which oversees the largest health care operation in the United States, faces a myriad of medical management issues. FRP in 2001 developed a framework for assessing alternative organizational structures. It continued evaluating demonstration programs conducted by TRICARE (the system that provides health care to military members, dependents, and retirees), and surveyed clinicians about their experiences with a pharmaceutical formulary. Other Center analysts began an assessment of how health coverage is provided to reservists and their dependents. FRP analysts also reviewed how resources are allocated to Department of Veterans Affairs medical facilities.

The Pay, Promotion, and Retention of High-Quality Civil Service Workers in the Department of Defense

Despite their having to use a common pay table, civil service personnel managers in the Department of Defense (DoD) have generally been able to use the compensation and personnel systems in ways that—by and large—have helped attract, retain, and motivate high-quality civilian workers. However, DoD personnel managers might need to adjust the Department's compensation system if they want to continue to promote and retain highly educated civilian personnel—those with postgraduate degrees—in the future.

So concludes a recent RAND study that investigated the relationship between the federal government's pay, compensation, and promotion practices and its ability to manage civilian white-collar employees in the DoD. It found that, despite having to use a one-size-fits-all pay table, managers were able to tailor the compensation and promotion system to obtain desired personnel outcomes and that they likely will need to continue such tailoring in the future.

A Common Pay Table

White-collar General Schedule (GS) workers in federal civil service jobs are covered by a commonly structured pay table that varies to account for differences in federal and non-federal pay growth across geographic areas. Civil service personnel managers can use special pays and other forms of compensation to help attract, retain, and motivate high-quality employees. However, relatively little is known about the career outcomes of higher-quality personnel in the federal civil service or about whether these employees are paid more, are promoted faster, or remain with the civil service longer than lower-quality personnel do. To help fill this research gap, RAND examined the pay, promotion, and retention profiles of civil service workers in the DoD, the largest employer of GS personnel in the federal government.

Using data from Defense Manpower Data Center personnel files, RAND researchers tracked the careers through fiscal year 1996 (FY96) of individuals who entered or reentered the DoD civil service between FY82 and FY96. Out of that pool of data, the researchers focused on two groups: the FY88 cohort, comprising those who entered or reentered in FY88, before the defense drawdown; and the FY92 cohort, defined as those who entered or reentered in FY92, during the drawdown.

Are High-Quality DoD Civilian Workers Paid More and Promoted Faster?

Employing three measures of personnel quality—supervisor rating, education level, or promotion speed—the study found that higher-quality personnel are generally paid more and promoted faster than lower-quality personnel. Specifically, RAND found that those who receive better ratings from their supervisors have higher earnings and faster promotion rates. Moreover, RAND found that individuals who have attended some college are promoted faster and paid more than those who have not attended college. But there was a twist to that latter finding: Although those with the highest degrees (i.e., master's degrees or doctorates) generally were found to be paid more, they are not always promoted faster than those with only a bachelor's degree, when other observable characteristics are held constant. Thus, having advanced degrees does not seem to always translate into faster promotions, although having some college education seems to do so.

The analysis of earnings and promotion speed also indicates that these outcomes vary considerably across occupational areas in the DoD, even when other observable job and individual characteristics are held constant. Thus, pay outcomes vary far more than the common pay table shared by personnel in all occupations would suggest.

Are Faster Promotion Speeds and Higher Pay Sufficient to Induce Higher-Quality Personnel to Stay Longer in the DoD Civil Service?

The study found mixed retention outcomes, depending on the quality measure, the cohort, and the other variables included in the analysis.

Individuals in the FY88 cohort who received better ratings from their supervisors showed better retention patterns, as did those who were promoted faster. Those in the FY92 cohort who were promoted faster also had better retention patterns. However, as depicted in the accompanying figure, in both cohorts individuals with advanced degrees beyond a bachelor's degree had poorer retention. Thus, while some of the evidence suggests that better performers in the DoD civil service have better retention, other evidence, especially that based on education, does not. As
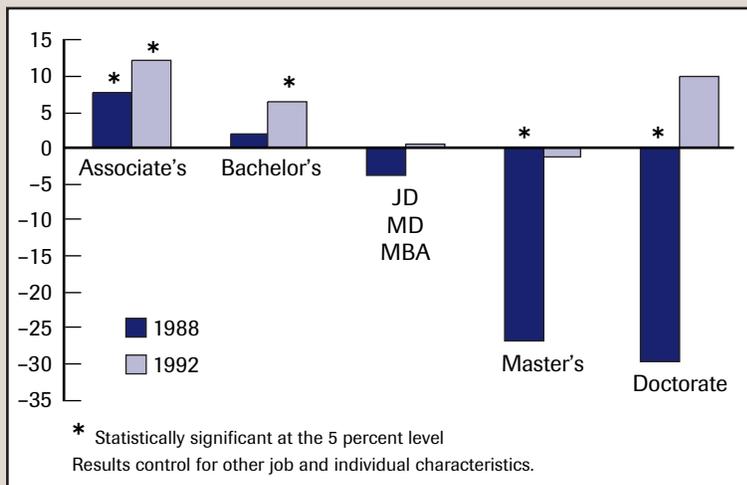
Percent Change in Retention Based on Highest Degree Attained
1988 and 1992 Cohorts

noted earlier, it appears that personnel with advanced degrees are not always promoted faster than those with bachelor's degrees. The evidence on the retention of personnel with advanced degrees indicates either that they did not fit well in the civil service or that their slower promotion speed translated into poorer retention.

RAND also found that retention patterns vary significantly by occupational area, even when other observable characteristics are held constant. Surprisingly, scientists and engineers, a large percentage of whom have advanced degrees, are found to be among the groups with the best retention, when other factors such as education are held constant. However, whether this retention rate is sufficient to meet current and future personnel requirements is another open question.

The evidence presented in the study suggests that higher-quality GS personnel in the DoD civil service generally have been paid more, are promoted faster, and sometimes are retained longer. The evidence also indicates areas where retention and promotion problems may exist, specifically among the most educated personnel, i.e., those with advanced degrees. However, because of measurement error, the results pertaining to education are less than rock solid. The analysis indicates fairly large variations in the careers of personnel in different occupational groups, despite their

common pay table. Given the varying requirements for personnel across occupations and the variety of external market opportunities that exist in different occupations, the differences in the careers of GS personnel are no doubt in part a result of these variations. Finally, whether these differences in the pay, promotion, and retention of higher-quality personnel are sufficient to ensure meeting the DoD's needs for a high-performing workforce is an important area for further research.

For more information, see

The Pay, Promotion, and Retention of High-Quality Civil Service Workers in the Department of Defense, Beth J. Asch, MR-1193-OSD, 2001.

Reorganizing the Military Health System

Should There Be a Joint Command?

Since the end of World War II, the question of whether to create a unified military health system has arisen repeatedly. Some observers have suggested that a joint organization could potentially lead to reduced costs, better-integrated health care delivery, a more efficient administrative process, and improved readiness.

On behalf of the Under Secretary of Defense (Personnel and Readiness), NDRI developed organizational alternatives for the military health system and outlined trade-offs inherent in choosing among them. The analysis concluded that careful consideration should be given to reorganizing the military's new health care program, called TRICARE, but that the additional benefits of a joint command are more difficult to assess.

The DoD's Dual Medical Missions

The DoD operates one of the largest and most complex health care organizations in the nation. Including their overseas facilities, the Army, Navy, and Air Force operated about 450 military treatment facilities (MTFs) in 1999, including 91 hospitals and 374 clinics. They serve just over 8 million active-duty personnel, retirees, and dependents. This care is provided through TRICARE, which offers both managed care and fee-for-service options. TRICARE managed care providers include the MTFs and a network of civilian providers administered through regional contracts with civilian managed care organizations. The fee-for-service

option also covers care provided by civilian providers who have not joined the network.

On the surface, the military health system resembles a fairly typical U.S. managed care organization. However, as a military health system, it has unique responsibilities arising from dual missions:

- **Readiness.** To provide, and to maintain readiness to provide, medical services and support to the armed forces during military operations.
- **Benefits.** To provide medical services and support to members of the armed forces, their dependents, and others entitled to DoD medical care.

The first mission involves deploying medical personnel and equipment as needed to support military forces throughout the world in wartime, peacekeeping and humanitarian operations, and military training. Activities that ensure the readiness of medical and other military personnel to deploy also contribute to the medical readiness mission. The second mission is to provide a health benefit to military personnel and their family members, during active service and after retirement. MTFs supply about two-thirds of the health care used by TRICARE beneficiaries overall and almost all of the health care used by active-duty personnel. Civilian providers supply the rest of the care.

The two missions are linked in two ways. First, the health care provided under TRICARE also contributes to
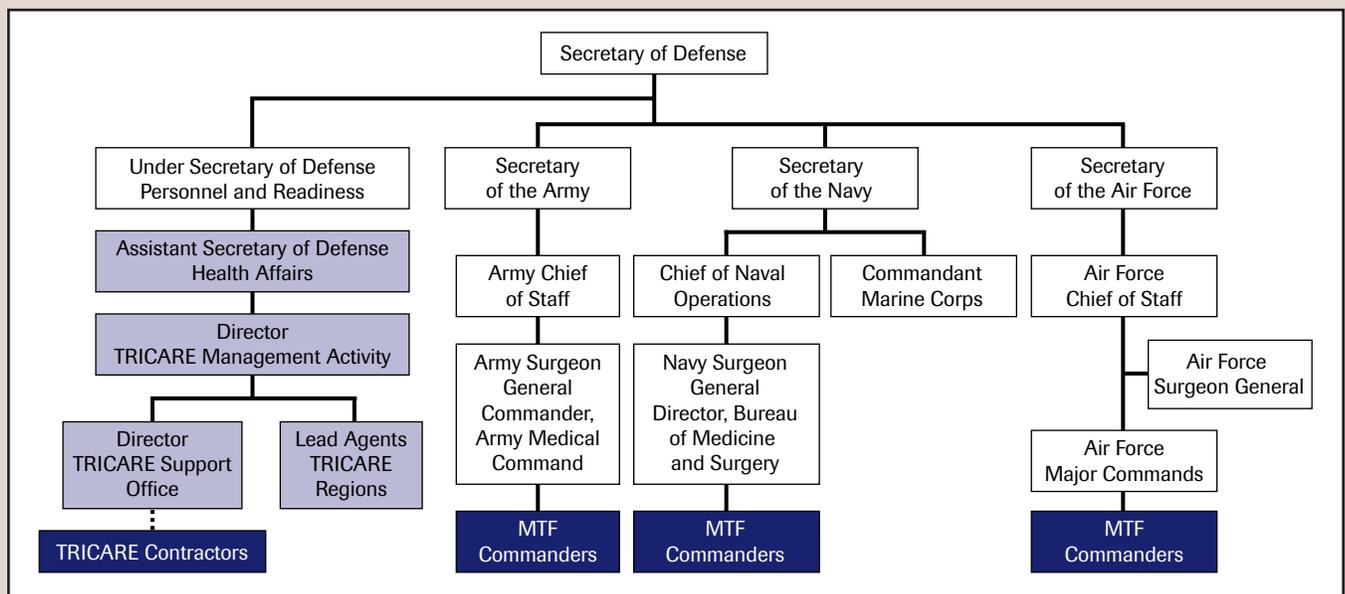
Current TRICARE Organization

Four Alternative Military Health System Organizational Structures

Alternative	Structure	Components
1	Modification of current organization	Same as today TRICARE would administer health plan, supported by local market managers in each region
2	Joint Medical Command	Army Component Command Navy Component Command Air Force Component Command
3	Joint Medical Command	Army Component Command Navy Component Command Air Force Component Command TRICARE Component Command
4	Joint Medical Command	Medical Readiness Component Command TRICARE Component Command

readiness; it keeps active-duty personnel at the peak health needed for military effectiveness and ensures their families are taken care of while they are away from home. Second, the same medical personnel are used for both missions.

Current Organization

The organizational structure that implements TRICARE today is shown in the figure on the previous page. It involves four hierarchies: the Office of the Secretary of Defense (OSD) and the three military services with medical departments. Each oversees a set of providers that delivers health care to TRICARE beneficiaries (the dark-shaded boxes). Health-plan responsibility for TRICARE resides in OSD's Health Affairs office (the lighter-shaded boxes).

The study compared this current structure with organizational approaches used by four large private-sector managed care companies: Kaiser Permanente, UnitedHealthcare, Sutter Health System, and Tenet Healthcare. It also reviewed studies and conducted interviews with key government personnel to better understand the particular needs that derive from the military system's readiness mission.

Four Alternative Organizational Structures

The analysis uncovered four alternative organizational structures, outlined in the table above, for the DoD to consider. One would be a modification of the current structure. Three would rely on a joint command, which, as defined by Title 10, is a unified combatant command having broad, continuing missions and involving forces from two or more military departments. All four management structures consolidate authority over TRICARE resources and establish clear accountability for outcomes.

Alternative 1 would retain much of the current organizational structure but would call for several changes designed to clarify management responsibilities for TRICARE and facilitate resource management and integration of health services. TRICARE would administer the health plan, supported by local market managers.

The three Joint Medical Command alternatives illustrate important organizational differences. Alternative 2 would organize all medical activities in service component commands. MTF commanders would also serve as local TRICARE managers, a dual operational structure that has not worked well in the private sector. Alternative 3, while similar to 2, would follow the more common private-sector practice of separating responsibility for health-plan management from facility management by adding a TRICARE component. The fourth alternative, depicted in the figure below, involves more radical change: It would structure medical activities functionally under a readiness component (organized by service) and a TRICARE component (organized geographically).

TRICARE is testing in its Pacific Northwest facilities whether it can successfully modify the current organization somewhat along the lines of Alternative 1. If it can, the DoD should consider implementing Alternative 1 more broadly. If the test does not substantially improve authority and accountability for TRICARE, the study suggests that DoD should consider a joint command along the lines of Alternatives 3 or 4.
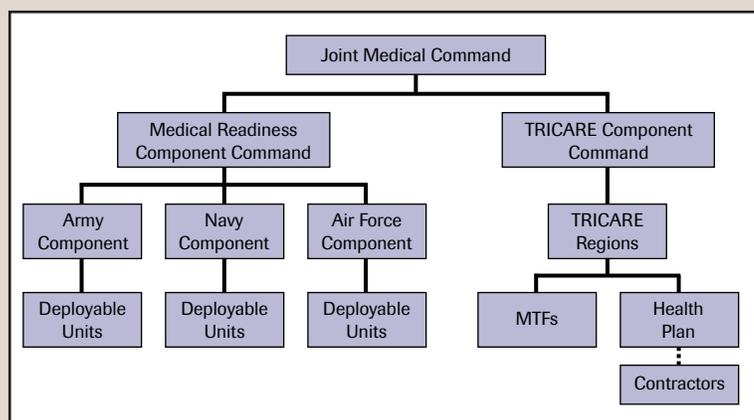
Joint Command with Readiness and TRICARE Components

For more information, see

Reorganizing the Military Health System: Should There Be a Joint Command? Susan D. Hosek, Gary Cecchine, MR-1350-OSD, 2001.

Intelligence Policy Center

Over the years, the volume of RAND work for the defense intelligence community has grown significantly, and today NDRI maintains important client relationships with the Defense Intelligence Agency (DIA), the National Imagery and Mapping Agency (NIMA), and the National Security Agency (NSA), among others. In recognition of this growing body of work and of the DoD's emerging intelligence needs, NDRI in October 2001 established the Intelligence Policy Center (IPC).

The Center works with these clients to provide research and analytical support, linking to other intelligence efforts within RAND's Arroyo Center and Project AIR FORCE as appropriate. With a focus that cuts across international security, acquisition, technology, and manpower issues, the Center in 2001 conducted studies and analyses along the three themes outlined below.

Understanding New Security Threats and Risks

The DoD needs early indications and warning of how future threats will manifest themselves, in part to inform strategy and in part to respond directly. The Center in 2001 assessed the nature of emerging threats to U.S. security, whether of a traditional or asymmetric character. Beyond the strategic context for these threats, the IPC focused on the explicit

implications of these threats for the warfighter. On behalf of the DIA, the Center developed a framework to help intelligence analysts predict the likelihood that a terrorist group will seek to acquire chemical, biological, radiological, or nuclear weapons. Other Center analysts helped policymakers assess information infrastructures in China and Taiwan and potential information warfare operations that each could undertake.

Identifying New Intelligence Sources and Methods

The Center helped develop new approaches to intelligence collection and analysis, especially those that drive an intelligence advantage over U.S. adversaries. The DoD needs assistance in considering new ways of how to obtain unique access to intelligence information, how to array data analytically in order to provide a more comprehensive picture of a given situation, and how to portray data more effectively for the decisionmaker. In this vein, Center analysts in 2001 helped the NSA identify ways to improve certain features of computer models that it uses for cryptologic analysis.

Improving Strategic Decision Processes

Because they hold both operational and acquisition responsibilities, DIA, NIMA, and NSA place a premium on strategic management and decision processes. IPC has helped those agencies' decisionmakers think

through acquisition reform, workforce management, systems engineering, outsourcing, and other strategic topics. For example, in 2001 the Center helped the NSA identify business practices that it could adopt to improve its acquisition processes. Another Center project team provided analytic support and assistance for NIMA on a similar acquisition reform effort.

Crosscutting Research

The National Defense Research Institute also addresses issues that transcend the interests of multiple clients within DoD or cut across multiple centers within the Institute, touching on some of today's most critical and challenging U.S. defense issues.

The need for such integrated analyses has never been more apparent than in the months since the September 11 terrorist attacks and the start of Operation Enduring Freedom. War-fighting, counterterrorist, and homeland security roles taken on by the DoD have required joint, synthesized approaches to questions that fall well outside of neat organizational and intellectual domains.

NDRI's involvement with integrated approaches and solutions to complex national security problems spans several decades. Over the years, the Institute has helped policymakers assess options and put forth policy recommendations on a series of broad, integrated examinations of defense issues—the Bottom-Up Review, the National Defense Panel, and the Quadrennial Defense Review, among others. Each called upon policymakers to anticipate and adjust to uncertain threats in the 21st century by cutting

Past and Ongoing Crosscutting Research

Planning Future Forces focused on new directions in defense planning and helped the DoD conceptualize its "Shape, Respond, Prepare" strategy.

Manpower in Strategic Defense Planning explored whether and to what degree the DoD's new approach toward deployments—in which the Pentagon has relied repeatedly on certain units and individuals to handle numerous diverse missions since the Gulf War—has had an unintended consequence: lower retention rates.

Developing New Concepts for Military Operations looked at ways to help the DoD envision and put in place crucial technologies.

Meeting Future Critical Skill Requirements built on past work relating to databases, estimates of personnel quality, measures of perstempo, models of retention, and projections of alternative compensation policies to create a framework for in-depth studies of skill requirements in particular occupational areas, such as information warfare.

Defense Information Revolution work has focused on information superiority, which has enabled the United States and its allies to employ new operational concepts and thereby gain a distinct advantage over future adversaries. However, such superiority depends on a mix of C4ISR capabilities linked across forces, weapons systems, and networks. NDRI has helped improve DoD policymakers' capabilities to assess how C4ISR contributes to the success of military operations.

Transforming Forces for the New Era analyses have identified concrete near- and far-term steps that DoD policymakers can take to transform U.S. forces to meet emerging military challenges.

through specific strategy, technology, personnel, and bureaucratic jurisdictions.

Some crosscutting studies are established and endorsed annually by the DoD through the NDRI Advisory Board. Others are established by a specific client but cut across more than one NDRI research center. A study from each category that NDRI pursued in 2001 is outlined below.

The Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction

Since 1999, NDRI has been providing analytical support to a high-level national panel charged with gauging how well prepared the United States is to deal with terrorists. Officially known as the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, the body has been asked to assess federal efforts—especially programs for assistance to states and localities—to enhance domestic preparedness and emergency training; to spotlight deficiencies in current programs to counter terrorists; and to recommend strategies to coordinate federal, state, and local emergency preparedness and response more effectively.

Congress mandated the creation of the panel in late 1998. Headed by James S. Gilmore III, Virginia's governor from 1998 through 2001, it is composed of experts representing all levels of government and a variety of relevant disciplines, including counterterrorism, fire and emergency medical services, law enforcement, intelligence, emergency preparedness, the military, and public health. It meets quarterly and is required to submit annual reports to the president and Congress. At the request of the Defense Department, NDRI helped establish the panel, coordinates its sessions, and provides focused analysis and technical assistance to its members. NDRI also helps research, draft, and produce the annual reports and other products published under the panel's name. The panel's first annual report (in 1999) concentrated on defining potential threats from terrorists who may seek to use chemical, biological, radiological, or nuclear weapons inside the borders of the United States. It concluded that the possibility that terrorists may resort to such weapons "presents a genuine threat to the United States." It suggested that the country's "seeming inability to develop and implement a clear, comprehensive, and truly integrated national domestic preparedness strategy" means that the United States may still remain fundamentally in-

capable of responding effectively to a serious terrorist attack. Nevertheless, the panel concluded that some public pronouncements and media depictions about the ease with which terrorists might wreak genuine mass destruction or inflict widespread casualties do not always reflect the significant hurdles they would confront in employing such weapons. NDRI's most significant research and analytical contribution to the first report was the development of a comprehensive assessment of the potential threats of terrorist activity inside the United States, which included detailed analyses of the full spectrum of chemical, biological, radiological, nuclear, and conventional weapons that terrorists might choose to employ.

The panel's second annual report (in 2000) assessed federal, state, and local programs to combat

2000 Report: Recommendations for a "National Office for Combating Terrorism"

Recommendation	Adopted by the White House?
Director appointed by president at Cabinet-level rank	Yes
Director confirmed by the Senate	No
Located in the Executive Office of the President	Yes
Point of contact with Congress	Yes
Office responsible for strategy formulation/plans review	Yes
Office responsible for specified oversight/control of relevant federal programs and budgets	No
Office should contain prominent state and local representation	Yes
Office should have no operational control	Yes

2001 Report: Selected Key Recommendations in Five Functional Areas

Area	Recommendation
State and local response capabilities	Increase and accelerate sharing of terrorism-related intelligence and threat assessments
	Design training and equipment programs for all-hazards preparedness
Health and medical capabilities	Develop government-owned, contractor-operated national vaccine and therapeutics research and production facility
	Develop standard medical response models for federal, state, and local levels
Immigration and border control	Create an intergovernmental border advisory group
	Increase resources for the U.S. Coast Guard for homeland security missions
Cyber security	Establish a government-funded entity for cyber detection, alert, and warning functions
	Create a special "Cyber Court" patterned after the court established in the Federal Intelligence Surveillance Act
Use of the military	Establish a homeland security under secretary position in the DoD
	Develop detailed plans for the use of the military domestically across a spectrum of potential activities
	Direct new mission areas for the National Guard to provide support to civil authorities

terrorism. While the panel found much to commend, it noted that problems exist "at all levels of government and in virtually every functional discipline" and are "particularly acute at high levels of the Federal Executive Branch." The panel recommended that the president submit a national strategy for combating terrorism within one year of assuming office and establish a "National Office for Combating Terrorism" in the Executive Office to coordinate all federal programs in this area. NDRI's research and analytic efforts for the second report included the following:

■ comprehensive case studies on the Los Angeles area multi-jurisdictional effort to combat terrorism and on lessons learned from anthrax hoaxes;

■ detailed research and analyses of programs to combat terrorism in the U.S. Department of Agri-

culture, the U.S. Department of Defense, the U.S. Department of Justice, and the Centers for Disease Control and Prevention of the U.S. Department of Health and Human Services; and

■ a thorough analysis of the legal authorities and restrictions related to using U.S. armed forces to respond to a terrorist incident inside the United States.

The White House relied on the panel's recommendations in creating the Office of Homeland Security in the days following the September 11 attacks. As the table on the previous page shows, most of the panel's major recommendations for creating that office were adopted by the White House.

Among the recommendations in its third annual report, issued in December 2001, the panel urged Congress to increase funding to states and localities for efforts to combat terrorism; recommended that federal preparedness programs be designed to ensure first responder participation, especially volunteers; and called for the creation of a national facility to research, develop, and produce vaccines to combat biological terrorism. In total, the panel made 44 specific policy recommendations in five functional areas, several of which are outlined in the table on the previous page.

NDRI had two main analytical contributions to the third report: It provided assessments of terrorism response capabilities in several federal agencies (including the Centers for Disease Control, the Customs Service, the U.S. Coast Guard, and the Immigration and Naturalization Service), and it designed and fielded a comprehensive national survey of state and local agencies, hospitals, and other health care providers that are responsible for responding to terrorist incidents. The survey, conducted from March through early September 2001, sampled almost 1,100 responders in all U.S. states and territories and 200 counties nationwide to gauge their preparedness for terrorist acts and their opinions of federal readiness. Most state and local organizations think that the number of federal programs for combating terrorism should be better organized, refocused on state and local response capabilities, and more effectively coordinated, the NDRI survey found. Those organizations also would prefer the federal government to take a supporting, rather than a lead, response role.

For more information, see

I. Assessing the Threat, First Annual Report to the President and the Congress of the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, 15 December 1999 (available online at www.rand.org/nsrd/terrpanel/).

II. Toward a National Strategy for Combating Terrorism, Second Annual Report of the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, 15 December 2000 (available online at www.rand.org/nsrd/terrpanel/).

III. For Ray Downey, Third Annual Report to the President and the Congress of the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, 15 December 2001 (available online at www.rand.org/nsrd/terrpanel/).

Measuring and Evaluating Local Preparedness for a Chemical or Biological Terrorist Attack, Ronald D. Fricker, Jr., Jerry O. Jacobson, Lois M. Davis, IP-217-OSD, 2002.

Are Local Health Responders Ready for Biological and Chemical Terrorism? Lois M. Davis, Janice C. Blanchard, IP-221-OSD, 2002.

Nuclear Weapons and the Future of Strategic Warfare

Future U.S. national security strategy is likely to be profoundly affected by the ongoing post–cold war evolution of the nuclear weapons issue. Questions surrounding the role of such weapons in U.S. and other national security strategies, the appropriate size of such arsenals, the possibility of the United States and other nations deploying strategic defenses against nuclear-armed and other ballistic missiles, and other issues all reflect continuing concern about the future of these weapons.

At the request of the NDRI Advisory Board, Institute researchers began studying this issue in 2000. NDRI's preliminary research—part of a larger, ongoing study on the future of nuclear weapons—focused on outlining the range of potentially desirable and achievable *long-term nuclear futures* or *end states* over the next 20–30 years, viewed from both a U.S. and global perspective. By starting from the perspective of a set of desirable long-term end states, the research was intended to help policymakers approach near-term decisions with clear goals in mind.

What Long-Term Nuclear Futures or End States Might the United States Pursue?

As depicted in the table on the next page, NDRI examined six possible long-term end states, or asymptotes, ranging from keeping forces at today's levels to cutting forces to a total of 300 (strategic and tactical) warheads.

Asymptote A would constrain U.S. and Russian forces to 10,000 warheads overall—levels that are consistent with START I and at roughly today's levels—and forgo formal limits on the nuclear arsenals of other countries. It reflects what the world might look like if U.S. missile defenses prompted Russia to jettison the START II treaty and relations between the two countries deteriorate significantly. In this world where large nuclear arsenals are considered important, China is assumed to increase its forces from about 400 total warheads today to between 500 and 1,000 warheads over the next 10 to 20 years. France, the United

Kingdom, and Israel keep their arsenals at today's levels. India and Pakistan are assumed to develop arsenals of up to 50 to 100 warheads each. Iran, Iraq, and North Korea could follow two possible paths: They could remain nonnuclear if diplomatic and other nonproliferation efforts are successful; or they could develop small nuclear arsenals, assumed here to be between 50 and 100 weapons. All other countries that are currently nonnuclear are expected to remain so.

Asymptote B would limit the superpowers to a total of 5,000 warheads each—roughly consistent with START II levels for strategic forces—and permit an additional 1,500 nonstrategic weapons. There would be no formal limits on other nations' nuclear arsenals. All other countries are assumed to have arsenals the same as in Asymptote A within 20 or 30 years, except Iran, Iraq and North Korea, whose arsenals would be smaller in this case, if they decide to go nuclear at all.

At 3,000 warheads, Asymptote C would keep U.S. and Russian strategic forces at roughly START III levels (2,000 to 2,500 warheads as agreed in 1997 in Helsinki) plus another 500 to 1,000 nonstrategic nuclear weapons. If Russia were only able to afford 1,000 to 1,500 strategic weapons, Asymptote C would allow some 1,500 to 2,000 tactical warheads. Again, there would be no formal limits on other countries, though France and the United Kingdom might conceivably reduce their forces a little under this perceived asymptote. And Iran, Iraq, and North Korea might not build as many weapons if they opt to go nuclear. All other countries are assumed to have the same forces in 20 to 30 years as in the first two asymptotes.

Asymptote D would cut U.S. and Russian strategic nuclear forces to 1,500 warheads, the low end of what is currently being considered for START III—some might say a bold START III outcome. Tactical nuclear weapons would be tacitly limited to roughly 500 warheads. This level for U.S. and Russian strategic nuclear forces is clearly close to the low end of nuclear arsenal limits that these two countries might negotiate without including tactical nuclear weapons in formal treaty limitations, bringing China

	A Start I	B Start II Refined	C Start III Refined	D Bold Start II Refined	E Start IV	F Very Deep Cuts

U.S. and Russia
    Total
    Strategic
	10,000	5,000
		3,500
			3,000
			2,500
				2,000
				1,500
					1,000
					–
						300
						–

China	500–1,000	500–1,000	500–1,000	500–1,000	500 or 1,000	200 or 300
France **United Kingdom**	300–500	300–500	200–500	200–500	200–300	100
Israel	100–200	100–200	100–200	100–200	50–100	10s or Virtual arsenals
India **Pakistan**	50–100	50–100	50–100	50–100	20–50	10s or Virtual arsenals
Iran **Iraq** **North Korea**	0–100	0–50	0–50	0–50	0–50	Virtual arsenals
South Korea **Taiwan** **Germany** **Sweden** **Japan, etc.**	Virtual arsenals	Virtual arsenals	Virtual arsenals	Virtual arsenals	Virtual arsenals	Virtual arsenals
Light Blue = Explicitly Constrained			Dark Blue = Implicitly Constrained			

Nuclear Forces Under Six Illustrative Asymptotes

formally into further offensive nuclear arms control negotiations, or bringing France, the United Kingdom, and possibly India (and possibly Pakistan and Israel) at least informally into these negotiations.

Asymptote E would cut deeper than any of the regimes START III goals currently envisioned—to 1,000 total (strategic plus tactical) warheads. That would be barely more than twice the size of China's nuclear arsenal today, making it virtually imperative that China in this context agree to limit its own nuclear arsenal. It also assumes that the United Kingdom and France limit themselves to between 200 and 300 warheads. India, Pakistan, and Israel would presumably have to informally agree to constrain their nuclear ambitions in this context—a commentary on the global political environment that would have to prevail to consider this asymptote.

Asymptote F would limit Russia and the United States to 300 warheads each, a level that is consistent with traditional assessments of a so-called "minimal deterrent" strategy and a radical departure from current status quo thinking on nuclear deterrence in the United States. Such a force level would signifi-cantly de-emphasize the role of nuclear weapons in international security matters. If China does not insist on complete parity in such a context, it might be limited to 200 strategic warheads. The United Kingdom and France might also be allowed 200 warheads.

Each asymptote would require a different global political and arms control environment. In general, the deeper the cuts, the more benign the international political environment and more comprehensive and intrusive the arms control regime would need to be.

How Would Force Cuts Affect U.S. Targeting Strategy?

Fundamental U.S. targeting strategy has not changed for decades. It requires the ability to destroy significant portions of the targets in a large number of military categories (both nuclear and conventional) and key military-related economic targets. The goal of this "comprehensive countermilitary" strategy is clear—deter adversaries by threatening the basic instruments of their military and economic power, while implicitly acknowledging the devastation that such an attack would have on the broader society and population.

Yet as forces are reduced, the ability of the United States to target such a broad range of targets becomes much more difficult. NDRI explored three other possible targeting approaches.

■ **A comprehensive counter-society strategy** would eschew military targets and focus exclusively on a broad range of targets with high value to a society such as leadership, command and control (e.g., media, police, intelligence, etc.), critical national infrastructures (electrical grids, petroleum production and distribution, telecommunications, etc.), and other key industries. The goal of this strategy would be to severely disrupt the functioning of a society without targeting population directly.

■ **A balanced counter-forces and counter-society strategy** would reduce the emphasis somewhat on destroying military targets and increase the number of value targets. The goal would be to deter actions by threatening a significant number of targets across a broad range of sectors in a society.

■ **A critical-node counter-society strategy** would focus only on nodes that are essential for a society to function. The concept here is that destroying a significant, but still limited, set of key nodes will seriously disrupt the functioning of a society

without having to kill large numbers of people. The basic concept behind this strategy is much like the Allied strategic bombing campaigns against Iraq in 1991 and Yugoslavia in 1999. The number of weapons required for this strategy could be quite small, depending on the level of disruption desired and the topology of the critical infrastructures. This strategy would probably also emphasize smaller nuclear weapons yields.

This evaluation of nuclear strategy must be done within the broader context of strategic warfare, writ large. The growing appeal of nuclear, biological, and chemical weapons and ballistic missiles for regional powers who seek to keep the United States out of future regional conflicts makes it imperative for U.S. planners to consider all the means at their disposal for deterring and conducting strategic warfare. As a result, the upcoming nuclear posture review should be part of a larger U.S. review of the means for strategic warfare.

NDRI Recent Publications

The Accrual Method for Funding Military Retirement: Assessment and Recommended Changes, Richard L. Eisenman, David W. Grissmer, James Hosek, William W. Taylor, MR-811-OSD, 2001.

An Analysis of Pay for Enlisted Personnel, Beth J. Asch, James R. Hosek, John T. Warner, DB-344-OSD, 2001.

An Analysis of the Veterans Equitable Resource Allocation (VERA) System, Jeffrey Wasserman, Jeanne Ringel, Barbara Wynn, Jack Zwanziger, Karen Ricci, Sydne Newberry, Barbara Genovese, Michael Schoenbaum, MR-1419-DVA, 2001.

Are Local Health Responders Ready for Biological and Chemical Terrorism? Lois M. Davis, Janice C. Blanchard, IP-221-OSD, 2002.

Army PERSTEMPO in the Post Cold War Era, Claire M. Levy, Harry Thie, Jerry M. Sollinger, Jennifer H. Kawata, MR-1032-OSD, 2001.

Assessing Competitive Strategies for the Joint Strike Fighter: Opportunities and Options, John Birkler, John C. Graser, Mark V. Arena, Cynthia R. Cook, Gordon Lee, Mark Lorell, Giles Smith, Fred Timson, Obaid Younossi, Jon G. Grossman, MR-1362-OSD/JSF, 2001.

Assessing the Value of Information Superiority for Ground Forces—Proof of Concept, Dan Gonzales, Lou Moore, Chris Pernin, David Matonick, Paul Dreyer, DB-339-OSD, 2001.

Characterizing the Future Defense Workforce, Dina G. Levy, Harry J. Thie, Albert A. Robbert, Scott Naftel, Charles Cannon, Rudy Ehrenberg, Matthew Gershwin, MR-1304-OSD, 2001.

The Closing and Reuse of the Philadelphia Naval Shipyard, Ron Hess, Jefferson P. Marquis, John F. Schank, Malcolm MacKinnon, MR-1364-NAVY, 2001.

Department of Defense Political Appointments: Positions and Process, Cheryl Y. Marcum, Lauren R. Sager Weinstein, Susan D. Hosek, Harry J. Thie, MR-1253-OSD, 2001.

Disposal Options for Ships, Ronald W. Hess, Denis Rushworth, Michael V. Hynes, John E. Peters, MR-1377-NAVY, 2001.

The E-2C Industrial Base: Implications of a Production Hiatus, Obaid Younossi, Mark V. Arena, Cynthia R. Cook, John C. Graser, Jon Grossman, Mark Lorell, DB-328-NAVY, 2001.

Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Servicemembers, Michael R. Thirtle, MR-981-OSD, 2001.

Enlisted Management Policies and Practices: A Review of the Literature, Sheila Nataraj Kirby, Scott Naftel, MR-913-OSD, 2001.

Ensuring the Quality and Productivity of Education and Professional Development Activities: A Review of Approaches and Lessons for DoD, Susan M. Gates, Catherine H. Augustine, Roger Benjamin, Tora K. Bikson, Eric Derghazarian, Tessa Kaganoff, Dina G. Levy, Joy S. Moini, Ron W. Zimmer, MR-1257-OSD, 2001.

Environmental Management in Proactive Commercial Firms: Lessons for Central Logistics Activities in the Department of Defense, Frank Camm, MR-1308-OSD, 2001.

European Military Prospects, Economic Constraints, and the Rapid Reaction Force, Charles Wolf, Jr., Benjamin Zycher, MR-1416-OSD/SRF, 2001.

An Examination of the Effects of Voluntary Separation Incentives, Beth J. Asch, John T. Warner, MR-859-OSD, 2001.

Final Evaluation Report for Uniformed Services Family Health Plan Continuous Open Enrollment Demonstration, Michael Schoenbaum, Katherine Harris, Gary Cecchine, Melissa Bradley, Ana Suarez, Terri Tanielian, C. Ross Anthony, MR-1352-OSD, 2001.

A Framework for Strategy Development, John G. McGinn, Gregory F. Treverton, Jeffrey A. Isaacson, David C. Gompert, M. Elaine Bunn, MR-1392-OSD, 2002.

A Future Officer Career Management System: An Objectives-Based Design, Harry J. Thie, Margaret C. Harrell, Roger A. Brown, Clifford M. Graf II, Mark Berends, Claire M. Levy, Jerry M. Sollinger, MR-788-OSD, 2001.

General and Flag Officer Careers: Consequences of Increased Tenure, Harry J. Thie, Margaret C. Harrell, Clifford M. Graf II, Jerry M. Sollinger, MR-868-OSD, 2001.

The Global Technology Revolution: Bio/Nano/Materials Trends and Their Synergies with Information Technology by 2015, Philip S. Antón, Richard Silberglitt, James Schneider, MR-1307-NIC, 2001.

Identifying the DoD's Needs for Research and Development on Nuclear Test Detection Systems, Ralph Earle, Roger Hagengruber, John Orcutt, John T. Parker, Richard Wagner, Charles Meade, MR-1331.0-OSD, 2000.

Impact Aid and the Education of Military Children, Richard Buddin, Brian P. Gill, Ron W. Zimmer, MR-1272-OSD, 2001.

Implementing Proactive Environmental Management: Lessons Learned from Best Commercial Practice, Frank Camm, Jeffrey A. Drezner, Beth E. Lachman, Susan A. Resetar, MR-1371-OSD, 2001.

Improving the Defense Finance and Accounting Service's Interactions With Its Customers, Edward G. Keating, Susan M. Gates, Jennifer E. Pace, Christopher Paul, Michael G. Alles, MR-1261-DFAS, 2001.

Improving Support to CINC Theater Engagement Plans: Phase I, Roger A. Brown, Leslie Lewis, John Y. Schrader, DB-323-JS, 2001.

Integrated Facility Environmental Management Approaches: Lessons from Industry for Department of Defense Facilities, Beth E. Lachman, Frank Camm, Susan A. Resetar, MR-1343-OSD, 2001.

Invisible Women: Junior Enlisted Army Wives, Margaret C. Harrell, MR-1223, 2000.

Iran's Security Policy in the Post-Revolutionary Era, Daniel L. Byman, Shahram Chubin, Anoushiravan Ehteshami, Jerrold Green, MR-1320-OSD, 2001.

Lightning Over Water: Sharpening America's Light Forces for Rapid Reaction Missions—Executive Summary, John Matsumura, Randall Steeb, John Gordon, Russell Glenn, Tom Herbert, Paul Steinberg, MR-1196/1-A/OSD, 2001.

Managing Quadrennial Defense Review Integration: An Overview, John Schrader, Roger Allen Brown, Leslie Lewis, DB-317-JS, 2001.

Measures of Effectiveness for the Information-Age Navy: The Effects of Network-Centric Operations on Combat Outcomes, Walter Perry, Robert W. Button, Jerome Bracken, Thomas Sullivan, Jonathan Mitchell, MR-1449-NAVY, 2002.

Measuring and Evaluating Local Preparedness for a Chemical or Biological Terrorist Attack, Ronald D. Fricker, Jr., Jerry O. Jacobson, Lois M. Davis, IP-217-OSD, 2002.

Military Occupational Specialties: Change and Consolidation, Mary E. Layne, Scott Naftel, Harry J. Thie, Jennifer H. Kawata, MR-977-OSD, 2001.

Military Recruiting: Trends, Outlook, and Implications, Bruce R. Orvis, Beth J. Asch, MR-902-A/OSD, 2001.

Minority and Gender Differences in Officer Career Progression, Susan D. Hosek, Peter Tiemeyer, Rebecca Kilburn, Debra A. Strong, Selika Ducksworth, Reginald Ray, MR-1184-OSD, 2001.

Networks and Netwars: The Future of Terror, Crime, and Militancy, John Arquilla, David Ronfeldt, MR-1382-OSD, 2001.

Nonproliferation Sanctions, Richard H. Speier, Brian G. Chow, S. Rae Starr, MR-1285-OSD, 2001.

Patterns of Enlisted Compensation, M. Rebecca Kilburn, Rachel Louie, Dana P. Goldman, MR-807-OSD, 2001.

Pay Competitiveness and Quality of Department of Defense Scientists and Engineers, Michael Gibbs, MR-1312-OSD, 2001.

The Pay, Promotion, and Retention of High-Quality Civil Service Workers in the Department of Defense, Beth J. Asch, MR-1193-OSD, 2001.

Pesticide Use During the Gulf War: A Survey of Gulf War Veterans, Ronald D. Fricker, Jr., Elaine Reardon, Dalia M. Spektor, Sarah K. Cotton, Jennifer Hawes-Dawson, Jennifer E. Pace, Susan D. Hosek, MR-1018/12-OSD, 2000.

Psychological and Psychosocial Consequences of Combat and Deployment with Special Emphasis on the Gulf War, David H. Marlowe, MR-1018/11-OSD, 2001.

RAND Research Suggests Changes in Department of Defense Internal Pricing, Edward Keating, IP-216-DFAS, 2001.

Reforming Mil-Specs: The Navy Experience with Military Specifications and Standards Reform, Mark Lorell, Jeffrey Drezner, Julia Lowell, DB-312-NAVY, 2001.

Reorganizing the Military Health System: Should There Be a Joint Command? Susan D. Hosek, Gary Cecchine, MR-1350-OSD, 2001.

A Review of the Scientific Literature As It Pertains to Gulf War Illnesses—Volume 1: Infectious Diseases, Lee H. Hilborne, Beatrice Alexandra Golomb, MR-1018/1-OSD, 2001.

Strategic and Performance Planning for the Office of the Chancellor for Education and Professional Development in the Department of Defense, Dina G. Levy, Roger Benjamin, Tora Kay Bikson, Eric Derghazarian, James A. Dewar, Susan M. Gates, Tessa Kaganoff, Joy S. Moini, Thomas S. Szayna, Ron W. Zimmer, MR-1234-OSD, 2001.

To order publications cited in this document

Call	(310) 451-7002
Fax	(310) 451-6915
E-mail	order@rand.org
Web	www.rand.org

Or send order to Distribution Services,
RAND, P.O. Box 2138, Santa Monica, CA 90407-2138

AR-7067-OSD