



NATIONAL DEFENSE RESEARCH INSTITUTE

## NDRI Research Clients—2002

CLIENT	POLICY CENTER			
	Acquisition and Technology	Forces and Resources	International Security and Defense	Intelligence
<b>Assistant Secretary of Defense</b> (Command, Control, Communications, and Intelligence)	▲		●	◆
<b>Defense Information Systems Agency</b>	▲			
<b>Defense Intelligence Agency</b>			●	◆
<b>Department of Veterans Affairs</b>		■		
<b>Deputy Secretary of Defense</b> Office of the Special Assistant for Gulf War Illnesses		■		
<b>Director of Net Assessment</b>			●	
<b>Joint Staff</b>			●	
<b>National Security Agency</b>				◆
<b>National Imagery and Mapping Agency</b>				◆
<b>Under Secretary of Defense for Acquisition, Technology, and Logistics</b>				
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 (Industrial Policy)	▲			
Deputy Under Secretary of Defense (Installations and Environment)		■		
Deputy Under Secretary of Defense (International Technology Security)		■		
Missile Defense Agency	▲			
<b>Under Secretary of Defense (Comptroller)</b>				
Director, Program Analysis and Evaluation	▲		●	
Defense Finance and Accounting Service		■		
<b>Under Secretary of Defense for Personnel and Readiness</b>		■		
Principal Deputy Under Secretary of Defense (Personnel and Readiness)		■		
Deputy Under Secretary of Defense for Civilian Personnel Policy		■		
Deputy Under Secretary of Defense for Military Community and Family Policy		■		
Deputy Under Secretary of Defense for Military Personnel Policy		■		
Deputy Under Secretary of Defense for Program Integration		■		
Assistant Secretary of Defense for Health Affairs		■		
Assistant Secretary of Defense for Reserve Affairs		■	●	
TRICARE Management Activity		■		
<b>Under Secretary of Defense for Policy</b>				
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			●	
<b>Unified Commands</b>				
U.S. Joint Forces Command			●	
U.S. Pacific Command	▲		●	
U.S. Transportation Command		■		
U.S. Southern Command			●	
U.S. Space Command	▲			
<b>U.S. Marine Corps</b>			●	
<b>U.S. Navy</b>	▲	■	●	

**M**anaging risk is an essential part of strategic planning, but as any planner will tell you, it is hardly easy to manage it well. Risks come in a variety of forms, and each must be identified properly in the right strategic context. Risks must be analyzed in detail to understand their immediate and long-term effects. And actions to mitigate—if not eliminate—risks must be devised, in a way that doesn't engender new, unforeseen ones.

In his 2002 Annual Report to the President and Congress, the Secretary of Defense presented the DoD program in terms of a new risk framework with four key elements:

- **Force management risk** associated with personnel quality, quantity, and readiness;
- **Operational risk** associated with near-term military capabilities and contingencies;
- **Future challenges risk** associated with investment in mid- to long-term capabilities and the development of new operational concepts; and
- **Institutional risk** associated with efficient and effective resource management.

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RAND IS A NONPROFIT  
INSTITUTION THAT  
HELPS IMPROVE  
POLICY AND  
DECISIONMAKING  
THROUGH RESEARCH  
AND ANALYSIS.

As the department implements the new defense strategy, managing risks along these dimensions becomes central.

Throughout 2002, the National Defense Research Institute (NDRI) devoted much of its analytical strength to identifying, analyzing, and recommending policies to mitigate various risks to the Department of Defense. We continued our long-standing stream of analysis on personnel issues, including research on compensation for active duty forces, how the quality of military personnel may be revealed over time, and how deployments influence reenlistment. NDRI examined deterrence and influence in the global war on terrorism, urban ground combat reconnaissance, and options for funding aircraft carriers. We recommended an analytical architecture for capability-based planning and transformation, examined effects-based operations, and looked at close-support needs of future ground commanders. Finally, NDRI also analyzed final assembly and checkout alternatives for the Joint Strike Fighter, assessed the use of "other transactions" authority for prototype projects, and helped the National Security Agency improve its acquisition function.

This annual report describes a few of these studies in some detail. It also provides an overview of the 2002 NDRI research agenda, which comprised a broad slate of topics in the areas of international security and defense policy, acquisition and technology policy, forces and resources policy, and intelligence policy. The report is illustrative, but not exhaustive. It does not seek to capture the full breadth and depth of our analytical activities. Nevertheless, it does demonstrate expertise that has been built and sustained over decades, reflecting RAND's enduring commitment to improve decisionmaking through research and analysis, and to thereby improve the security and public welfare of our nation and the world.



**Jeffrey A. Isaacson**  
Director  
National Defense Research Institute



# National Defense Research Institute

The National Defense Research Institute (NDRI)—a federally funded research and development center at RAND—provides studies and analyses to policymakers in the Office of the Secretary of Defense (OSD), the Joint Staff, the Unified Combatant Commands, the U.S. Navy, 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 multidisciplinary capability, objectivity, independence, and an explicit national-interest charter are essential. In 2002, the Institute performed this function by carrying out a well-rounded research agenda that corresponded closely to the responsibilities of three of the undersecretaries in the OSD—Policy; Acquisition, Technology, and Logistics; and Personnel and Readiness—who, along with the military's intelligence agencies, have been the main supporters and consumers of NDRI studies and analysis. This agenda was conducted by NDRI's four well-established research centers—the International Security and Defense Policy Center, the Acquisition and Technology Policy Center, the Forces and Resources Policy Center, and the Intelligence Policy Center.

NDRI's agenda derives from long-standing, mutually reinforcing, dynamic relationships with clients. In 2002, the Institute's four Centers deepened these connections by helping clients identify and evaluate new policies; framing alternate ways to implement current policies; and providing

other analytical and technical assistance, including specific aid to decisionmakers as the United States broadened its war on terrorism and expanded its efforts to defend America's homeland. In so doing, NDRI sustained and invigorated its core investigational, theoretical, and methodological capabilities, thereby strengthening the institutional muscle that it draws from to pursue vital national security research today and in years to come.

## NDRI's Research Centers in 2002

- The **International Security and Defense Policy Center** explored how the world's security landscape has changed as a result of the global war on terrorism that the United States and its allies have pursued since September 11; how evolving 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; assessed ways to identify and thwart technological threats posed by terrorists and other rogue actors; and examined acquisition and production strategies the Department of Defense (DoD) should consider to acquire weapon systems and other capabilities in the future.
- The **Forces and Resources Policy Center** focused on issues affecting the effectiveness and quality of life of



U.S. uniformed personnel, including policy options that help ensure that the United States is able to attract and retain high-quality military personnel; on forces the United States needs to execute military strategies; on ways the DoD can optimally use resources; and on structures and capabilities the United States needs to effectively meet emerging homeland defense responsibilities.

- The **Intelligence Policy Center** examined international security, acquisition, and manpower issues that affect the collection, evaluation, and dissemination of defense intelligence. 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

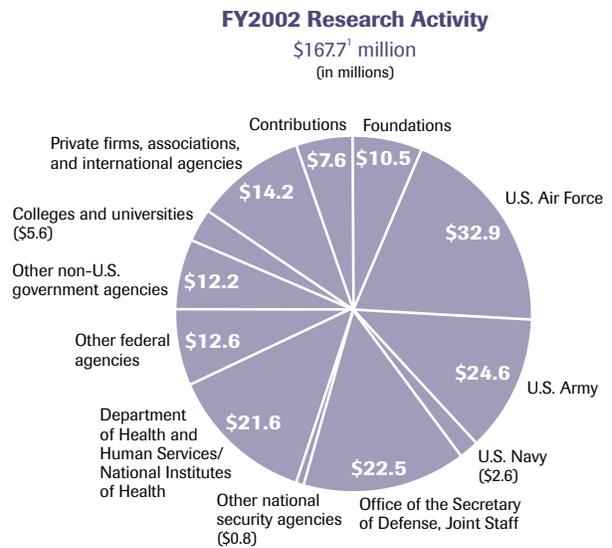
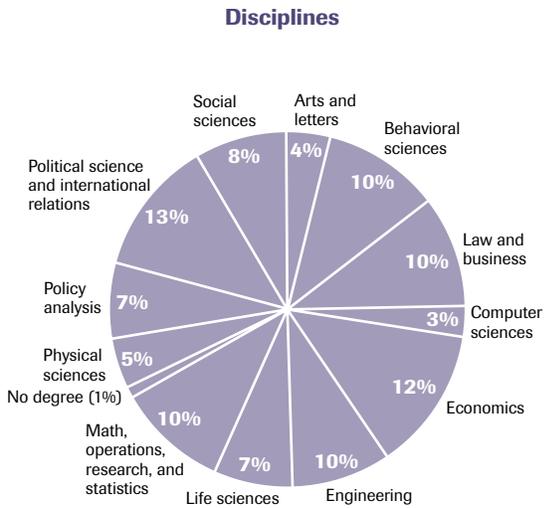
NDRI is part of RAND, a private, nonprofit institution whose mission is to improve policy and decisionmaking through research and analysis. Since its founding in 1948, RAND has studied the most pressing public policy problems of the day, producing in-depth, objective policy analyses; basic and applied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

Today, RAND studies assist 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 offering additional analytical resources are housed at RAND. Project AIR FORCE—RAND's oldest studies and analysis organization—assists U.S. leaders in determining 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. Totalling nearly 1,600 full- and part-time employees, RAND's staff is diverse in work experience; political and ideological outlook; race, gender, and ethnicity; and academic training. Eighty-five percent of the research staff holds advanced degrees, with more than 65 percent having earned Ph.D.'s or M.D.'s. 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 or intelligence issues, for example.

RAND Health and RAND's Center for Military Health Policy Research bring crucial insight into questions connected with the provision and management of military medical services, the possible causes of Gulf War Illness, and the clinical implications of the use of mass destruction weapons by terrorists or rogue states. RAND's Science and Technology Policy Institute—a federally funded research and development center that provides research and analysis for the White House Office of Science and Technology Policy—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



<sup>1</sup>Net of subcontracts and RAND-sponsored research.

### RAND's Multidisciplinary Staff Provide Breadth and Depth to Research Activities

when investigating policy issues. These specialists are in areas such as

- surveys, statistical analysis, and information systems;
- computer modeling and simulations; and
- 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.

A broad range of sources, from individuals and charitable foundations to combinations of private firms, supports RAND research. Agencies of the U.S. government are sources of the largest shares of support. 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.



**T**he International Security and Defense Policy Center (ISDP) explores the implications of change—political, strategic, economic, and technological—on the international scene and assists U.S. national security decisionmakers with developing strategies and policies to manage and adapt to such transformations.

In 2002, terrorism remained the most pressing and immediate challenge to U.S. national security. By helping U.S. policymakers gain an understanding of how terrorism intersects with other emerging challenges, ISDP research assisted the U.S. national security community in devising options to protect American and allied interests at home and abroad. These intersecting challenges—the continuing spread of weapons of mass destruction and other lethal technologies, the ability of adversaries to access other destabilizing technologies, the growing dependence upon information and information dominance in U.S. military strategy and operations, and the increasing U.S. and allied exposure to unexpected threats at home and abroad—are forcing the United States to rethink its near- and long-term strategies. As spelled out below, four themes guided ISDP’s research in 2002.

## **Understanding the New Security Environment**

ISDP continued to explore the implications of the revolutions in warfare, military affairs, and technology that have reconfigured the national security landscape. It investigated the impact of new threats—not just from terrorists, disaffected ethnic groups, and other nonstate actors, but from mass casualty weapons, from technological proliferation, and arising out of increasing U.S. reliance on information systems—on America’s ability to protect and enhance vital interests at home and abroad. ISDP provided analytical support to OSD’s efforts to identify the kinds of insurgency threats in the future that might require significant involvement of U.S. special operations forces. And the Center investigated how threats of renewed oil embargoes or supply disruptions might affect current U.S. interests and economic performance at home and abroad.

## **Perfecting Strategies to Deal with the New Security Environment**

ISDP explored ways that the United States can mold defense strategies to address emerging threats, shape the international environment, and accommodate new technologies and tactics. The new, post-September 11 threat environment places heavy emphasis on homeland defense. In 2002, the Center continued to help DoD evaluate the medical resources, capabilities, and protocols it could employ in the event of a chemical or biological weapon attack on the United States. ISDP, on behalf of the Defense Threat Reduction Agency, supported the White House Office of Homeland Security in identifying elements of America’s critical infrastructure, threats they face, and strategies to help make them more secure. Beyond homeland defense, Center analysts evaluated the Marine Corps’ urban ground reconnaissance capabilities and explored policy options that U.S. forces could employ to avoid contamination and restore operations in the event of chemical, biological, or radiological attack. In addition, the Center continued to directly support the Commander, U.S. Joint Forces Command Combatant in developing joint warfighting studies and experiments. ISDP also evaluated the air campaign in

Operation Enduring Freedom, extended prior reviews and analyses of how U.S. submarine forces and carrier forces have been employed since the end of the Cold War, and looked at lessons learned in the conduct of civil affairs and humanitarian operations in Afghanistan.

### **Dealing with Failed States and Ungoverned Space**

Another ISDP focus in 2002 was ungoverned space, the territory of failed and failing states, and areas within otherwise minimally functioning states where governance is absent. These territories have become terrain from which recent threats have emerged and upon which conflicts have been waged. ISDP reviewed lessons learned from American-led post-conflict interventions, ranging from Germany and Japan in 1945 to Afghanistan in 2002, and investigated how these might be applied in Iraq in 2003. The Korean peninsula also was a significant area of focus in 2002. The Center examined the military and economic implications of the end of the North Korean regime and of Korean unification. On behalf of the Office of the Secretary of Defense (OSD) and U.S. Forces Korea, ISDP evaluated the Republic of Korea's defense preparedness for chemical and biological attacks. And the Center began helping defense planners evaluate ways that the United States and its allies can increase their ability to prevail in future military engagements.

### **Maintaining Coalitions and Sharing Burdens**

As the United States faced growing strains with its defense partners regarding policies in Iraq, the Middle East, and North Korea in 2002, holding together coalitions became a major policy priority. The Center assessed America's current basing policy in Europe and East Asia and helped defense policymakers develop options for possible changes to global basing in coming years. It helped DoD advise the Taiwan Ministry of Defense on ways it can sharpen its capabilities to formulate defense plans, articulate strategies, perform analyses, and assess budgets and force structures. It evaluated the effect that international aid likely will have on Turkey's economic institutions, its role in NATO, and its prospective membership in the European Union. Center analysts also provided analytical support to the Under Secretary of Defense for Policy on key issues in international and defense economics.



## Honing the Keys to the City

### Refining the United States Marine Corps Reconnaissance Force for Urban Ground Combat Operations

Given the world's population growth trends and recent U.S. military commitments, the U.S. military can expect the need for urban reconnaissance to increase in the near future. Conducting reconnaissance in villages, towns, and cities is considerably more difficult than in open terrain, and the penalty for undertaking urban combat operations without first performing reconnaissance can be severe. In light of the substantial challenges involved in urban ground combat reconnaissance, the U.S. Marine Corps (USMC) asked NDRI to identify the shortfalls in urban combat ground reconnaissance to assist in the creation of tactics, techniques, and procedures (TTP) for this mission area. Through literature searches and in-depth interviews with members of the Marine reconnaissance community, NDRI researchers found a number of deficiencies in doctrine, training, organizational structure, and equipment connected with the Corps' ground urban combat reconnaissance efforts. The accompanying table details the major needs within these areas. Based on an analysis of these shortfalls and the role of urban reconnaissance within Marine Corps operations, NDRI also identified top-level considerations that USMC leaders need to pay attention to in order to improve urban ground combat reconnaissance TTP.

#### USMC Ground Urban Combat Reconnaissance Faces Shortcomings

**USMC has no formal urban reconnaissance doctrine.** Doctrine for urban ground combat reconnaissance should provide the foundation for the planning and execution of operations and training, the development of organizational structure, and the basis for equipment procurement. Although the USMC's generic reconnaissance doctrine contains information of use to urban combat situations, there is no formal, written urban combat reconnaissance doctrine in any of the USMC manuals. British and U.S. Army publications similarly fail to address this topic in depth. To derive the needed doctrine, the USMC will have to begin by combining historical study and the results of experiments

conducted at the Marine Corps Warfighting Laboratory. The doctrine resulting from these studies should be combined with information about the physical and social infrastructures of urban areas to which Marines will be deployed.

**USMC needs more comprehensive training for urban reconnaissance.** While selected USMC units receive thorough urban-specific training, reconnaissance units have tended to receive far less. The extent of the reconnaissance training is usually determined by commander priorities, availability of facilities, and a host of other practical limitations. Marines who were interviewed as part of this study widely shared the sentiment that they are not comfortable in urban environments because they are not trained in them. There is an immediate need to develop comprehensive urban reconnaissance training that incorporates classroom instruction, drills, military training facilities, and actual urban areas. The training's curriculum and standards should be consistent in reconnaissance schools and across units, and it should be supplemented with specific training packages tailored to meet local unit mission requirements.

**USMC needs organizational structures and equipment that better suit reconnaissance missions in urban areas.** Without sufficient operational experience, members of the reconnaissance community are uncertain of the organizational structures needed to conduct urban missions effectively. For example, there is no guidance regarding the optimal size of a reconnaissance team operating in an urban area. Urban reconnaissance TTP will have to address such issues to determine the personnel needs for accomplishing missions in built-up areas.

The USMC must be certain that the equipment that has been tested in open terrain will also be reliable when used in a setting with a greater density of buildings and people. For example, sound is a much larger concern in dense urban areas than it is in open terrain. Marines in urban ground reconnaissance need acoustic sensors to detect enemy intrusion, quiet means to monitor radios, and near-silent boots to enable undetected movement through populated areas. They also need communications equipment that does not rely on direct line-of-sight because of the intervening buildings and other structures.

## Improvements in USMC Urban Ground Combat Reconnaissance Should Address Shortfalls in Four Primary Areas

Doctrine	Training	Organizational Structure and Personnel Management	Equipment and Supplies
<ul style="list-style-type: none"> <li>• Standards for reliance on human intelligence and analysis vs. reporting of information by reconnaissance Marines</li> <li>• Adequate weapons for urban missions</li> <li>• Counter-reconnaissance guidance</li> <li>• Procedures for debriefing of civil affairs personnel</li> <li>• Clear descriptions of needs of other Marine units</li> <li>• Sufficient information about civilian infrastructure</li> <li>• Guidance for conducting subterranean reconnaissance</li> <li>• Timing guidelines for urban insertions and extractions</li> <li>• Synchronized urban escape and evasion plans</li> <li>• Guidelines for interacting with nongovernmental organizations and private volunteer organizations</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive training that provides experience in urban areas</li> <li>• Consistent intelligence training across USMC</li> <li>• Thorough understanding of weapons effectiveness in cities</li> <li>• Training and testing involving units of different sizes</li> <li>• First aid and other medical training</li> <li>• Cultural intelligence training</li> <li>• Training in the following skills:                             <ul style="list-style-type: none"> <li>– Inserting and extracting teams</li> <li>– Escape and evasion procedures</li> <li>– Dealing with booby traps</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Standards for size of reconnaissance teams</li> <li>• Procedures for dissemination of information from reconnaissance reports</li> <li>• Systematic use of available information regarding the local urban infrastructure</li> <li>• Standards for use of unmanned aerial vehicles and for personnel needed to operate and process intelligence from them</li> <li>• Means to resupply Marines in hides or observation posts</li> </ul>	<ul style="list-style-type: none"> <li>• Equipment tailored to specific needs of the urban environment</li> <li>• Acoustic and motion sensors to detect targets and potential threats</li> <li>• Wireless listening devices</li> <li>• Training on use of new equipment</li> <li>• Communications equipment that will function reliably in urban areas</li> <li>• Stealthy radio-monitoring equipment</li> <li>• More streamlined, body-hugging equipment</li> <li>• Quieter equipment</li> <li>• Digital terrain and mapping system</li> <li>• Effective night photography capability</li> </ul>

- **Tactical ground reconnaissance is a collection of systems that is itself a component of the larger system of Marine combat forces.**

Urban ground combat reconnaissance is one component of an information collection system that includes infantry patrols, civil affairs units, helicopter personnel, and many others. Improving urban ground reconnaissance requires better coordination between these units, headquarters, and the forward-most units that must act on the information they collect.

- **Urban operations impose extraordinary leadership, training, task organization, and personnel management demands.**

Urban warfare is characterized by decentralized operations. Marines need extensive training in any changes in the rules of engagement to allow for independent decisionmaking and increased initiative. New urban combat TTP must also address optimal

### USMC Should Pay Attention to Top-Level Considerations to Improve Urban Ground Combat Reconnaissance

NDRI recommends that potential solutions to the urban ground reconnaissance shortfalls address the following top-level considerations:

- **The urban environment demands almost constant creative adaptation.** The proximity of structures and combatants requires the ability to adjust rapidly to respond to adversaries or to promote friendly force objectives. Urban reconnaissance procedures must allow for quick decisionmaking and immediate action.

team size and reporting procedures for the specific locations to which Marines will be deployed.

- **The urban environment makes special demands on equipment and technology.** Density of forces and non-combatants, line-of-sight interruption, reflection of sound off hard surfaces, and other characteristics of urban warfare mean that urban reconnaissance units will often require equipment different from that used in rural combat. Until the Marine Corps becomes more familiar with the demands of urban operations, they will need—at least in the near-term—to adapt equipment designed for other environments to make it more suitable for urban ground reconnaissance.

*For more information, see*

*Honing the Keys to the City: Refining the United States Marine Corps Reconnaissance Force for Urban Ground Combat Operations*, Russell Glenn, Jamison Medby, Scott Gerwehr, F. Gellert, A. O'Donnell, MR-1628-USMC, 2003.



The Acquisition and Technology Policy Center (ATP) addresses how constantly accelerating technological change affects transformation within the U.S. military establishment and throughout the world political scene. Its research agenda—which touches upon U.S. technology, force modernization, industrial base, and acquisition policies—emerges from the application of accelerating advances in information and other technologies that lead to dramatic improvements in military capabilities. These advances bring about novel system developments and innovative concepts of operation that allow U.S. forces to assume new roles and accomplish new missions. U.S. forces have been able to exploit America's technological advantage to great effect—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; thwarting potential terrorist actions both in the United States and abroad; and engaging effectively in peacekeeping and humanitarian operations.

ATP's research agenda in 2002 comprised the six interrelated elements discussed below.

## Conflict in the Information Age

ATP explored in 2002 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 assess the course of the information revolution in various parts of the world; supported OSD's effort to gain an overall understanding of key defense-related command, control, and communications issues; assessed how information superiority and digital technologies improve command and control in ground operations; and evaluated the role of deception in active information system network defenses. Center analysts in 2002 also developed tools that defense policymakers can use in making communications and information system investments connected to network-

centric warfare. The Center conducted exercises for U.S. and allied defense policymakers on the role of strategic information operations in Operation Enduring Freedom and the war on terrorism. It continued to develop measures the Navy can use to gauge which information resources most effectively enhance its tactical operations. And Center researchers analyzed legal issues pertaining to information assurance.

## Understanding the Effect of New Technologies on Future Military Operations

ATP continued to investigate ways to exploit technological advances in military operations. For the Navy, the Center evaluated the effect of electric drive technologies on ship operations. On behalf of the Defense Advanced Research Projects Agency (DARPA), the Center identified strategies and other measures that the United States could use to influence terrorists' behaviors and to put at risk belongings, relationships, and beliefs that they hold most dear. The Center supported DARPA in its brain-machine interface studies and continued to help explore ways to identify humans at a distance. It also supported DARPA's efforts to develop trustworthy software-intensive systems and to identify ways to access databases that contain information that can be used to counter terrorists. Other ATP researchers continued to analyze research, development, and technology needs connected with current and future arms control agreements.

## Assessing Force Modernization and Employment Options

ATP in 2002 continued to investigate force modernization priorities. The Center carried on a multiyear effort to evaluate naval force structure options, acquisition and modernization strategies, and budget issues for the Navy and OSD. Center researchers also helped senior Navy decisionmakers identify major decisions they will need to make in the future, so-called forks in the road; began evaluating various platforms that could support sea basing in years to come; continued to compare the costs and benefits of building new aircraft carriers versus refueling carriers currently in service; and examined the implications for shipyard workers of changing the start date or production schedule



of the next generation of carriers, the CVN(X). ATP also provided analytic support to the U.S. Pacific Command and the Australian Defence Headquarters on interoperability issues.

### **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 and to identify where its unique needs might require different solutions. In a major effort, the Center in 2002 performed a congressionally mandated analysis that looked into the risks—measured by higher costs or reduced innovation—that further consolidation in the U.S. military aircraft industry might engender. ATP also continued to support a congressionally mandated commission charged with evaluating the health of the entire U.S. aerospace industry. And the Center, in conjunction with NDRI's Forces and Resources Policy Center, provided ongoing support to Navy efforts to formulate study plans.

### **Assessing New Acquisition and Management Strategies, Processes, and Organizational Structures**

ATP researchers in 2002 helped defense policymakers identify ways to improve acquisition processes and implement meaningful management reforms. The Center investigated options for the DoD to tap into the private venture capital community to access new technology, evaluated the DoD's expanding reliance

on service contracts, and reviewed the policies and procedures that defense officials use to manage major ship procurements. In an effort done at the request of Congress for OSD, the Center compared the implications of assembling and readying the Joint Strike Fighter (JSF) at a single site versus doing so at multiple locations. It continued to develop 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. In another congressionally requested effort, the Center in 2002 evaluated on behalf of the Director, Defense Research and Engineering and the National Aeronautics and Space Administration ways that NASA could more effectively manage its wind tunnels and other test facilities. The Center also reviewed processes the Missile Defense Agency uses to develop programs and allocate resources.

### **Application of New Modeling and Simulation Approaches**

ATP helped the DoD fashion a more flexible, robust simulation and modeling environment in 2002. The Center continued a multiyear effort to help the Defense Information Systems Agency measure the degree to which command, control, and communications capabilities influence joint military operations. Center analysts also began to evaluate concepts and tools that senior DARPA staff can use to develop counterterrorism strategies.



## Transitioning NAVSEA to the Future Strategy, Business, and Organization

The Naval Sea Systems Command (NAVSEA) is the largest of the Navy Systems Commands. Its responsibilities involve all aspects of the life cycle of ships, submarines, and their components—spanning acquisition support to the Navy Program Executive Officers, technical research on weapons and other components, in-service engineering and maintenance, and ship disposal.

How NAVSEA can continue to provide this full spectrum of services in the 21st century is an open question. In an environment of continued downsizing; declining infrastructure and resources; and strong competition from the private sector for scientific, engineering, and management expertise, what should NAVSEA's proper role be? To answer this question, NAVSEA asked NDRI to provide an objective outside perspective of the strategic environment in which it will operate during the next 10 years, identify markets and products that will best support the Navy's missions during that period, and propose alternative ways the Command could align its organization to adapt to those emerging conditions.

NDRI's effort provided NAVSEA with a top-down analytic approach that will help the Command prepare for and adapt to change. Combining several methodologies, NDRI's study drew from Assumption-Based Planning and a strategy-to-tasks framework to assess NAVSEA's strategic environment; from market and portfolio analyses to examine the command's business opportunities; and from organiza-

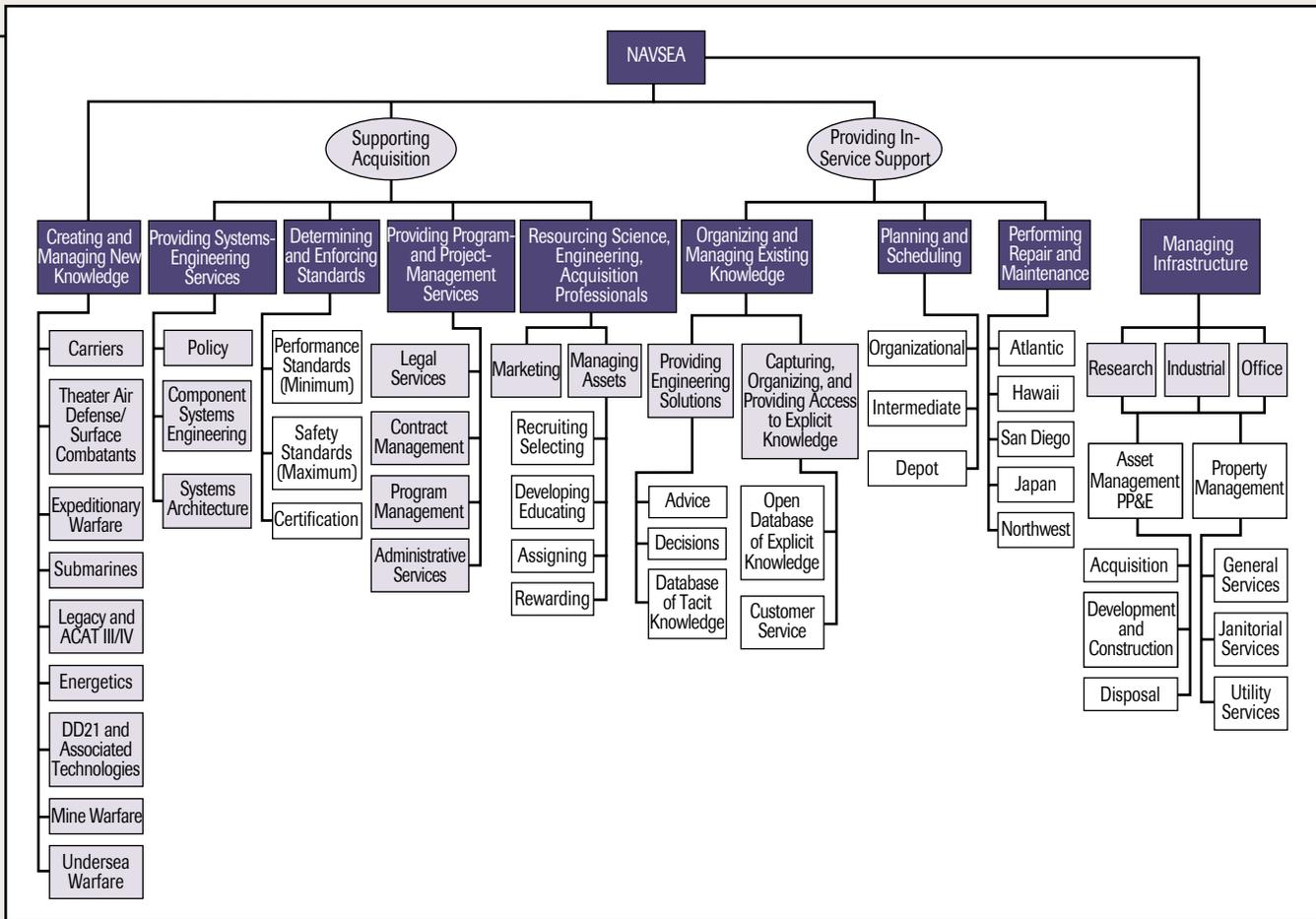
tional analyses to identify ways that NAVSEA can restructure its focus, shape, and size.

Applying these methodologies to NAVSEA involved exhaustive effort. In examining the Command's markets and in analyzing products, for example, NDRI performed an analysis that linked together much of NAVSEA's business in 15 markets, 108 products, 49 processes, 1,200 activities, 195 facilities, and seven major business units. The end result was a planning methodology that should be of use to many other government or commercial organizations engaged in business planning decisions involving activities, products, markets, technologies, people, facilities, and organizational realignment.

In evaluating NAVSEA's future strategic environment and markets, NDRI found that defensive systems are likely to be a high-growth market area, because of the anticipated prominence of littoral warfare. At the same time, other traditional NAVSEA markets are likely to be low-growth; anti-air warfare, for example, will be a slow market because no strategically competitive air forces likely will emerge during the next decade. NAVSEA's remaining markets likely will grow at intermediate rates.

These market trends have implications for NAVSEA products, NDRI concluded. Products that significantly contribute across a spectrum of markets and are simultaneously of high importance—surface communications and submarine periscopes and masts, for example—could be candidates for

<b>Alternative Organizational Orientations and Business Lines</b>		
<b>Orientation</b>	<b>Business Unit Focus</b>	<b>Business Lines</b>
<b>Industry</b>	Industry functions	Readiness enhancement Naval knowledge management Critical resource management
<b>Market/Customer</b>	Customer needs	Readiness enhancement Future capability development
<b>Competency</b>	Core competencies	Engineering services Managing ships
<b>Product life cycle</b>	Providing a full spectrum of support throughout the life cycle of products	Creating and managing new knowledge Acquisition support In-service support



**Organizational Structure for Product Life Cycle Orientation**

new or continued NAVSEA investment. On the other hand, low-importance NAVSEA products that are restricted to few markets are candidates for niche analysis or repositioning. Because such evaluations constantly change as customer needs and technologies evolve, NDRI designed its methodology to allow NAVSEA to iterate its market/product mix in response to new conditions and demands.

NAVSEA's changing strategic environment, markets, and products have implications for the command's organizational structure. NDRI identified four ways that NAVSEA could reorganize—along industry, market/customer, competency, or product life cycle lines. Each alternative orientation

would involve NAVSEA organizing around distinct business lines as outlined in the table on page 12 (opposite).

The graphic above shows how NAVSEA's organizational structure might look if the command were structured along the lines of providing product life cycle support.

NAVSEA has drawn on some of NDRI's analytical approach to build its own business plans and assess its core equities. Follow-on NDRI research could help identify alternative sizes for the command.

**For more information, see**

*Transitioning NAVSEA to the Future: Strategy, Business, and Organization*, Michael V. Hynes, Harry J. Thie, John E. Peters, Elwyn D. Harris, Robert M. Emmerichs, Brian Nichiporuk, Malcolm MacKinnon, Denis Rushworth, Maurice Eisenstein, Jennifer Sloan, Charles Lindenblatt, Charles Cannon, MR-1303-NAVY, 2002.

## Final Assembly and Checkout Alternatives for the Joint Strike Fighter

The DoD's choice in October 2001 of the Lockheed Martin Corporation to be the prime contractor to develop and produce the Joint Strike Fighter (JSF)—the only new manned fighter aircraft currently planned for the next 30 years—left several open questions. What exact production locations might the company use to produce the fighter? What production strategies might it employ? In hopes of finding answers, Congress directed that the DoD examine alternatives to Lockheed Martin's plan to assemble the major components of the JSF and test the aircraft at its Fort Worth, Texas, plant, in a process called final assembly and checkout, or FACO. The DoD turned to NDRI to consider single- and multiple-site options for carrying out FACO there or at three other U.S. plants controlled by Lockheed Martin or its JSF teammate Northrop Grumman.

### No Efficiency, Effectiveness, or Cost Reasons to Split FACO

The JSF program, which is expected to run for more than two decades and cost \$300 billion (in then-year dollars), will deliver some 3,000 fighter/attack aircraft to the U.S. Air Force (USAF), Navy, and Marine Corps (USMC), as well as to the UK Ministry of Defence. These aircraft will replace all F-16s, A-10s, and AV-8Bs in the USAF's inventory, and augment the USAF's F-22s; replace USMC AV-8Bs and F/A-18C/Ds; and replace Harriers in the UK inventory. The JSF also will augment the Navy's inventory of F/A-18E/Fs. It will be produced in three variants: conventional takeoff and landing (CTOL), carrier variant (CV), and short takeoff/vertical landing (STOVL).

Many options exist to spread the JSF's FACO work across multiple sites. NDRI considered the nine shown in the table below, comparing the cost of each against the baseline of having Fort Worth conduct FACO for all JSF aircraft. These do not represent all possible options, but they represent a reasonable sample of the potential alternatives.

NDRI found no efficiency, effectiveness, or cost reasons to split FACO operations between two sites or across multiple sites. Moving some or all of the JSF's FACO from Fort Worth to another location would increase costs to DoD. These cost increases are depicted in the table on page 15, which compares the costs of the alternatives listed in the table below. The numbers represent the differences in cost (in 2002 dollars) from the baseline case of doing all the work in Fort Worth. It shows two sets of comparative costs: one that includes only the effects on JSF FACO, and a second that includes the effects on all DoD programs at all affected sites. The second column represents the costs to DoD as a whole and better portrays overall budget implications of various FACO strategies.

All alternatives that divide the work across one or more additional sites increase costs, because of loss of learning and duplicate facilities and tooling. Furthermore, moving FACO activity from Fort Worth changes the overall DoD costs because of the effect on indirect costs for other

FACO Strategies Considered	
Alternative	Description
1	100% of FACO at Lockheed Martin-Fort Worth, TX (Baseline)
2	100% of FACO at Lockheed Martin-Palmdale, CA
3	100% of FACO at Lockheed Martin-Marietta, GA
4	100% of FACO at Northrop Grumman-Palmdale, CA
5	50% of FACO at Lockheed Martin-Fort Worth, TX 50% at Lockheed Martin-Palmdale, CA
6	50% of FACO at Lockheed Martin-Fort Worth, TX 50% at Northrop Grumman-Palmdale, CA
7	50% FACO at Lockheed Martin-Fort Worth, TX 50% at Lockheed Martin-Marietta, GA
8	All CTOL at Lockheed Martin-Fort Worth, TX All CV and STOVL at Lockheed Martin-Marietta, GA
9	One-third of all production at each of the Lockheed Martin sites

DoD work. The costs of the rest of the JSF work under way at that plant, as well as of the other programs there, will increase because these programs will have to bear a greater fraction of the Fort Worth overhead costs. These increased costs are not fully offset by a concomitant reduction in costs at the other facilities, because of their unique overhead structures.

### No Other Compelling Benefits from Splitting FACO

The study also examined other potential benefits from splitting FACO—distributing economic benefits to more than one region or generating competition among alternative sites, for example. NDRI found that none of these potential benefits was compelling; split production would generate

- **No competition advantages:** Because DoD has reaffirmed that JSF will be a “winner take all” program, it has already decided not to induce competition among different potential manufacturers in the production phase.
- **No capacity advantages:** Lockheed Martin’s analysis indicates that Fort Worth can deliver the required number of aircraft on schedule and, therefore, there appears to be no capacity argument for opening another FACO site.
- **No industrial base benefits:** NDRI’s analysis indicates that multiple FACO sites do not appear to be critical to the industrial base. The work involved in FACO is somewhat limited, and furthermore manufacturers maintain much of the capability to do the tasks involved in final assembly and checkout with other aircraft in production and normal maintenance activities.
- **No widespread additional economic benefits:** NDRI’s findings question the degree to which splitting FACO operations would generate significant additional economic activity over the life of the \$300 billion. The

FACO Option Cost Comparisons Difference in Cost from Alternative 1 (Millions FY2002 Dollars)		
Alternative	JSF FACO Costs	DoD Costs (Including JSF FACO Costs)
1	0	0
2	4.0	256.9
3	132.1	74.1
4	199.0	656.7
5	310.3	221.5
6	328.4	386.4
7	331.8	117.1
8	419.1	134.7
9	501.7	277.6

unemployment rates at the alternative sites are either less than the national average or about the same. The study also notes that the number of new jobs created by FACO operations—1,200—is not large in terms of a regional workforce. Moreover, the rationale underpinning the JSF contract—a single development and production program producing three variants with many common characteristics—was to allow DoD to procure the aircraft at the lowest possible cost. Splitting FACO may provide economic benefit to some limited locality, but the costs must be borne by all taxpayers, and these additional costs do not result in any increase in military capability. Splitting FACO operations seems to be at odds with this rationale, as well as with the spirit of acquisition reform, which calls for a reduction in the amount of unnecessary government oversight and control of the specifics of military procurements.

**For more information, see**

*Final Assembly and Checkout Alternatives for the Joint Strike Fighter*, Cynthia R. Cook, Mark V. Arena, John C. Graser, John A. Ausink, Lloyd S. Dixon, Timothy E. Liston, Sheila E. Murray, Susan A. Resetar, Chad Shirley, Jerry Sollinger, Obaid Younossi, MR-1559-OSD, 2002.

The Forces and Resources Policy Center (FRP) has been helping defense policymakers address personnel and resource implications of changes in the labor market and structure of the U.S. and global economy, the emergence of new security challenges, and the rapid progress of technology. Its research delves into the array of issues affecting America's military personnel and their families. It also helps determine forces needed to execute U.S. military strategies; optimal use of DoD resources; rational structuring of DoD organizations; and efficient interactions between federal, state, and local authorities across a range of responsibilities, including homeland defense.

FRP analyzed these issues in 2002 along five interconnected themes outlined below.

## Maintaining Adequate Manpower Supply

Attracting steady supplies of skilled, smart personnel continues to be a paramount issue for the military services as they are transformed by the information age. The services—faced with more youth attending colleges and universities—not only must compete with private-sector employers for high-quality enlistees, they also have to develop policies



that will enhance their ability to recruit youth with education beyond high school. FRP researchers in 2002 helped OSD policymakers by exploring ways the services can bring experienced civilians with needed skills into the enlisted ranks beyond entry level, assessing the productivity of a prototype recruiting station located in a large metropolitan shopping mall, and investigating the costs of competition among services for recruits. The Center helped evaluate practices the DoD uses to recruit personnel into its civilian workforce, including its intern programs. And the Center continued to investigate ways the DoD can make the military compensation system more flexible.

## Assessing and Improving Military Quality of Life

FRP has for several years assessed DoD policies and practices designed to directly improve military quality of life. In 2002, Center analysts continued to support the 9th Quadrennial Review of Military Compensation, extending their significant body of work on compensation issues. It also began an investigation into how to make the military retirement system a more attractive benefit for both the active and reserve military members. The Center explored the value of in-kind and deferred benefits for active-duty personnel and their families, and analyzed the costs and benefits of sabbatical leaves for uniformed personnel. It continued analysis of issues surrounding military spouse employment, an area of concern that emerged from the 2001 review of military morale and quality of life supported by FRP. And in 2002 the Center continued its work on the DoD child care system, focusing most recently on measuring and understanding demand.

## Improving the Military Health Care System

Myriad medical management issues face the DoD, the overseer of the largest health care operation in the United States. In 2002, FRP continued to evaluate aspects of TRICARE—the system that provides health care to military



members, dependents, and retirees—studying the use of pharmaceuticals by Medicare-eligible military retirees, the impact of uniform formularies, and the effects of changing the system’s co-payments and deductibles. The Center also continued to review how the Department of Veterans Affairs allocates resources to its medical facilities. Center analysts also assessed the health coverage of Reservists and their dependents, and whether DoD-provided coverage is adequate.

### **Shaping the DoD’s Workforces**

The DoD continually reassesses whether it has the human resources it needs to accomplish its mission. A major aspect of this involves making estimates of how manpower requirements will evolve and what the optimal experience profile in the defense workforce might look like. The Center in 2002 supported DoD efforts to develop systems to manage the acquisition workforce. It also provided support to the Department’s comprehensive review of the roles and missions of the Reserve forces, and examined ways the DoD could use the Reserves to attract and develop cutting-edge technological skills that could be tapped in future contingencies. 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. And the Center assessed the use of simulators to train Navy personnel for duty on surface ships.

### **Managing Other Resources**

FRP in 2002 continued to help DoD managers adopt best business practices, identify new ways to organize and budget for their operations, and embrace new approaches to strategic planning. The Center evaluated the potential effect of changes in the structure of the education and professional development programs provided to DoD civilian employees. Working in consort with NDRI’s Acquisition and Technology Policy Center, FRP supported Navy efforts to formulate study plans. Center analysts helped the Navy explore ways to improve aircraft and ship maintenance. In the logistics area, FRP analysts continued to investigate 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 options to more quickly and reliably provision and service Trident submarines. The Center also delved into how the DoD can more effectively budget for medical readiness in light of its mission to provide medical services and support during military operations. And the Center provided continuing 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.



## What Are the Costs of Operating the Military's Child Care System?

DoD provides child care through a system known as the Child Development Program (CDP). The CDP is large, currently serving about 176,000 children six weeks to 12 years old in 900 child development centers (CDCs) and in 9,200 family child care (FCC) homes nationwide. Despite its large size, the CDP is also a high-quality system. The Military Child Care Act of 1989 was designed to promote quality in CDCs, and it has helped to do so through no-notice inspections, salaries tied to training milestones, and the provision of training and curriculum specialists. Today, virtually all CDCs are accredited. Moreover, the DoD has applied some of the same regulations designed to improve quality to FCC homes. CDC care is also affordable—the DoD bases parent fees on total family income rather than on child age, as is common practice in the civilian sector. Finally, care is widely available.

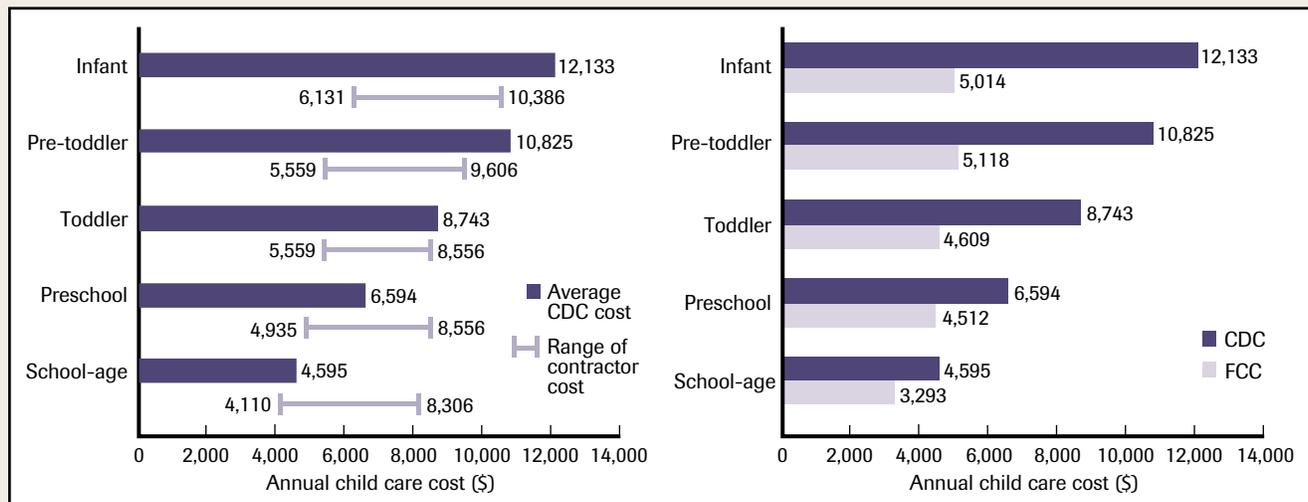
How much does this impressive system cost and how do costs vary by child care setting and by child age? This NDRI study addressed these questions, using data collected by surveys of CDP directors at 60 installations and at five of seven centers operated for the DoD by contractors, and by interviewing administrative and human resources staff at civilian employer-sponsored child care centers.

### How Do CDC, FCC, and Contractor-Provided Costs Compare?

The average annual cost of CDC care varies by child age and ranges from \$12,133 for infant care to \$4,595 for school-age care. These costs varied substantially by installation. The analysis considered reasons for the variation and found that total per-child cost is significantly lower in larger centers and significantly higher at installations located in areas with a higher cost of living. The remoteness of installations and the percentage of infants and toddlers served at their CDCs were not significant cost drivers.

Child care is not a core DoD competency, and some would argue that an outside contractor might be able to deliver care more efficiently. However, as the left-hand chart below shows, outsourcing does not seem to be a major source of potential savings. Compared with the cost of CDC care, the cost of contractor-provided care tends to be lower for the youngest children but higher for the older children. This suggests that DoD contractors may be cross-subsidizing the high cost of infant care, a common practice in private centers.

When the researchers compared the cost of CDC care with that of FCC care, they found, as shown in the right-hand chart below, that FCC care is substantially less



**Annual Child Care Costs at Child Development Centers (CDCs) and Family Child Care (FCC) Homes**

FY1998 Data

## Portion of Annual DoD-Run Child Development Center Costs Charged to Users

FY1998 Dollars

Child Age	Average Annual Cost/Child	Parent Fees by Income Category				
		I: <\$23K	II: \$23K-34K	III: \$34K-44K	IV: \$44K-55K	V: >\$55K
Infant	\$ 12,133	20%	24%	29%	33%	38%
Pre-toddler	\$ 10,825	23%	27%	32%	37%	43%
Toddler	\$ 8,743	28%	34%	40%	46%	53%
Preschool	\$ 6,594	37%	45%	53%	61%	71%
School-age	\$ 4,595	53%	64%	76%	88%	101%

expensive. For the two youngest age groups, the costs for FCC care are less than half of what they are for CDC care. Although the differential decreases in the older age groups, FCC care is always less expensive.

However, parents who use FCC care do not necessarily benefit from the lower FCC costs. Mostly, fees are negotiated between parents and providers and are unregulated by the DoD. As a result, the average parent fee may be more than the fee for CDC care, especially for low-earning families, who are heavily subsidized in CDCs. Subsidies could increase FCC use, but they are not widely or consistently used. Only 14 installations reported providing a subsidy for infants (and even fewer provide subsidies for older age groups), and that subsidy varied tremendously, ranging from \$6 to \$90 weekly.

The DoD bases parent fees on total family income rather than on child age. As shown in the table above, in fiscal year 1998 the DoD had five family income categories. The DoD heavily subsidizes CDC care, especially for the youngest children (infants and pre-toddlers). Even the highest income group pays less than 50 percent of the cost of infant and pre-toddler care, and the lowest income group pays less than 25 percent.

### How Does DoD Care Compare with Employer-Provided Care in Cost and Fees?

To provide context, the researchers also looked at civilian employer-provided care in seven facilities: four in the private sector selected from *Working Mother* magazine's annual list of the "100 best companies for families" and three from the public sector.

All seven had either achieved or were pursuing accreditation. The private-sector centers had subsidy levels similar to the DoD's—around 50–70 percent. Although they subsidize at about the same level as the DoD, parent fees are still substantial, topping \$700 per month for infants. These fees allow employers to put money into quality improvement and to send parents a message about relative cost; it also reflects the fact that quality improvement goals sometimes supersede affordability concerns. Private-sector firms are less focused on meeting a large share of the need and less concerned than the DoD about affordability for low-earning employees.

### Implications

Since FCC costs are considerably lower than CDC costs, especially for infants, moving infants from CDCs to FCCs would save the DoD money, even if it had to offer higher FCC subsidies to attract parents and providers to the FCC system. Also, larger centers tend to be more efficient, so the DoD should consider size in any plans for building new centers. Finally, since per-child costs varied substantially across installations, identifying and disseminating efficient practices could promote savings.

However, whatever cost-saving actions the DoD takes must be consistent with DoD values, particularly providing options for families (e.g., some families prefer CDC care for infants). The DoD might be able to justify some cost-saving actions if it could show, for example, that the FCC outcomes are good. No data on military child care outcomes currently exist; such data should be collected.

**For more information, see**

*Examining the Cost of Military Child Care*, Gail L. Zellman, Susan M. Gates, MR-1415-OSD, 2002.

## Learning About Quality

### How the Quality of Military Personnel Is Revealed Over Time

To gauge its success at retaining capable service members, the military needs to measure the quality of its enlisted personnel. Traditional estimates rely on data gathered when members join, such as education levels and Armed Forces Qualification Test (AFQT) scores. While these data are useful in recruitment, they tell only part of the story about a member's value to the military. Individuals reveal much of their quality "on the job" over time, in ways that are less easy to quantify.

The Office of the Secretary of Defense asked NDRI to develop a more comprehensive method of measuring personnel quality that takes into account the attributes that are revealed throughout the first term of a member's service. In addition, NDRI was asked to use the new method to evaluate the military's success at retaining high-quality personnel in recent years.

#### Promotion History Can Be Used to Measure Quality

Drawing on previous RAND studies, researchers posited that enlisted members' success is determined by more than time-of-entry indicators such as AFQT, but also by the quality of the job match between a member and the military. Factors such as an individual's abilities not measured by the AFQT, taste for military service, and how much effort he or she is willing to put into the job have an important effect on whether a person will advance and, ultimately, whether he or she will reenlist.

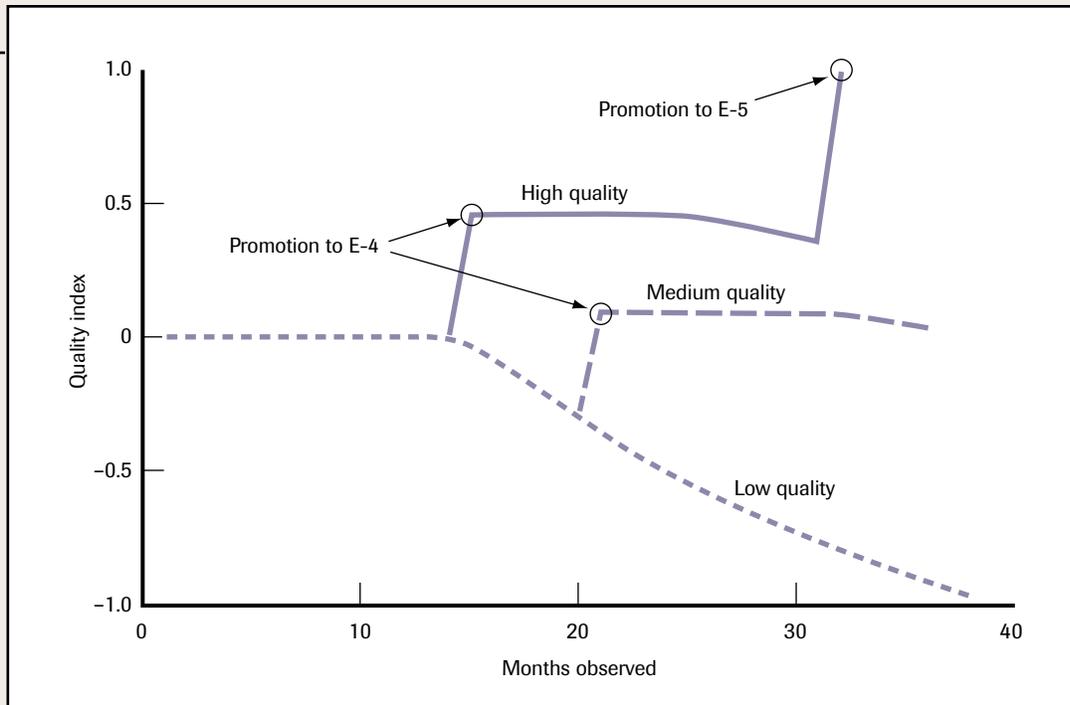
Although these factors cannot be measured directly, their relative strength can be determined from a person's promotion history. The promotion system bases advancement on criteria that reflect acquired skills and knowledge, physical fitness, duty performance, awards and decorations, and education and training. Members who attain and surpass the criteria more rapidly are promoted faster than their peers. Thus, the relative speed of promotion can be used as a yardstick for measuring a member's quality.

Researchers developed a statistical model to estimate an individual's "quality factor," or the portion of his or her quality revealed on the job and not accounted for by AFQT score. The model calculated this factor based on how quickly a member was promoted to ranks E-4 and E-5, two important milestones reachable in the first term of a member's service. The team used the model to analyze data on all enlisted personnel who joined the military between fiscal years 1979 and 1992. They asked three questions: (1) Is AFQT score positively related to a member's overall quality? (2) What is more important with respect to overall quality: the contribution of AFQT or the contribution of the "quality factor"? (3) Based on the new method, are higher-quality members more likely to reenlist?

#### Promotion History Coupled with AFQT Score Gives a More Accurate Picture of Personnel Quality

Analysis of personnel data using the new method yielded several important conclusions:

- **AFQT Score Is Related to Quality, But Its Importance Diminishes Over Time.** As a representative example, the figure portrays three individuals with identical AFQT scores but different promotion histories. An individual's "quality index" was raised or lowered depending on whether the individual was promoted earlier or later than others in the same group. While entry characteristics alone would judge these individuals to be of equal quality, their different rates of promotion indicate that they exhibited very different levels of quality on the job.
- **On-the-Job Qualities Are More Important Than AFQT Scores in Explaining the Differences Between Personnel.** Individual qualities such as ability, effort, and taste for the military accounted for 92 percent of the variation in overall personnel quality in the Army, 54 percent in the Air Force, and 87 percent in the Marine Corps (AFQT scores accounting for the remainder). The percentage is lower for the Air Force because this service relies more heavily on the AFQT to measure the skills and knowledge required for promotion. (The Navy was not



### Quality Index Is Updated As New Information Is Revealed Over Time

included in this assessment because its unique policy of promoting personnel in six-month groupings makes it harder to estimate the quality of individual members.)

- High-Quality Members Are More Likely to Remain in the Military.** This finding contradicts the traditional hypothesis that services tend to lose higher-quality personnel. It is true that, all other factors being equal, personnel with higher AFQT scores are slightly more likely to seek civilian careers when their military terms are up. The reason is that AFQT scores also reflect aptitude in many nonmilitary arenas, making high-scoring personnel equally well-suited to civilian careers. However, this study shows that personnel with a higher *overall* quality index tend to remain in the military. One factor is that higher-quality personnel succeed because they are a good match with the military and their specialties in the military. Furthermore, the prospect of continued higher rates of promotion and pay offer incentives for such individuals to remain in a career that promises further advancement and rewards.

### New Method Has Numerous Applications

The military can improve personnel planning by using the method presented in this study to

- gauge success at retaining high-quality personnel in the future, as was done here with respect to past data;
- determine whether high-quality members are more likely to reach positions of higher rank and greater responsibility;
- study personnel quality in particular occupations;
- determine whether policy changes have greater or lesser effect on low- or high-quality service members. Possible policy actions might include changes in pay, reenlistment bonuses, education and training opportunities, promotion speed, and work intensity.

**For more information, see**

*Learning About Quality: How the Quality of Military Personnel Is Revealed Over Time*, James R. Hosek, Michael G. Mattock, MR-1593-OSD, 2003.

The Intelligence Policy Center (IPC) helps clients confront today's rapidly evolving intelligence environment. It helps decisionmakers understand the nature of emerging threats, such as terrorism and the proliferation of weapons of mass destruction, which are more fragmented than the threats of the past but still hold potentially large consequences for U.S. national security. The Center also helps defense policymakers understand the changing role of intelligence in warfighting. In addition to its traditional role supporting other instruments of American power, intelligence today has an ability to create conditions to prevent, preempt, and deter adversaries. A whole new slate of intelligence tools—including sensors, analysis tools, and fusion tools—will have the potential to transform warfighting, but only if they are considered as an integral part of U.S. warfighting strategy and tactics and tailored carefully to operational needs and conditions.

Pressured by the needs to balance modernization and operations, adjust to increased oversight, and pursue transformation, intelligence agencies' management processes are changing in significant ways. Effective management of these agencies requires not only a complex set of tradeoffs and links between requirements, resources, and capabilities, but also a willingness to accept risk and pursue technological innovation.



With a focus that cuts across international security, acquisition, technology, and manpower issues, the Center in 2002 conducted studies and analyses along the four themes outlined below.

## Identifying New Security Threats and Risks

In 2002, the IPC helped the DoD define early indications and warnings of future threats and modeled the behavior of potential adversaries, both state and nonstate. For the Defense Intelligence Agency (DIA), the Center examined the structure of China's theater-level command and control operations and their implications for allied operations. Another IPC effort on behalf of DIA evaluated China's emerging nuclear doctrine and evolving notions of deterrence.

## Identifying New Intelligence Sources and Methods

The Center in 2002 helped develop new approaches to intelligence collection and analysis, especially those that drive an intelligence advantage over U.S. adversaries. This work involved providing assistance to intelligence agencies as they considered how to more effectively obtain unique access to intelligence information, array data in ways that provide more detailed and comprehensive pictures of given situations, and portray data in more understandable formats for decisionmakers. In this vein, IPC provided assistance to the National Imagery and Mapping Agency (NIMA), assessing the goals and strategies it has established to transform its mission, structure, and processes. It provided recommendations on NIMA's emerging geospatial intelligence mission, including the broad policy and security aspects of multi-int operations and analysis. In addition, Center analysts in 2002 continued to help the National Security Agency (NSA) identify ways to improve computer models that it uses for cryptologic analysis, and contributed new understandings of the U.S. SIGINT system, including interactions among various organizations and entities



within it. The Center supported efforts by senior leaders at NSA and the National Cryptologic School to develop an in-house advanced analysis studies group charged with “thinking over the horizon” on contemporary and future intelligence community issues.

### **Improving Intelligence Support to the Warfighter**

As warfighting becomes more complex, so does the volume and diversity of intelligence information that will be required to support it. Among these are new types of intelligence information related to foreign cultural, medical, infrastructure, and other unique contextual information. Along these lines in 2002, the IPC—on behalf of the Armed Forces Medical Intelligence Center in the DIA—investigated the capabilities of Islamic nongovernmental

organizations to deliver combat and public health services to participants in rural and urban insurgencies around the globe.

### **Improving Decision Processes**

DIA, NIMA, and NSA—like other U.S. intelligence agencies that hold both operational and acquisition responsibilities—place a premium on strategic management and decision processes. IPC in 2002 continued to help those agencies’ decisionmakers think through acquisition reform, workforce management, systems engineering, outsourcing, and other strategic management topics. On behalf of the NSA, the Center continued to help identify business practices that, if adopted, would improve the agency’s acquisition processes, including efforts to better improve and align the agency’s corporate requirements, programming, and budgeting systems. IPC also provided analytic assistance to NSA’s Signal Intelligence Directorate to develop a strategic plan. Another Center project team provided analytic support and assistance to NIMA on strategic planning and acquisition reform efforts, contributing to the realignment of NIMA’s strategic organizations and resources.

# Crosscutting Research

Numerous issues that NDRI addresses—many touching on some of today’s most critical and complicated U.S. defense challenges—transcend the particular interests of individual DoD clients or cut across multiple areas of inquiry and expertise within the Institute.

The need for such integrated analyses has, if anything, grown since the September 11 terror attacks and the launch of the global war on terrorism. The new war-fighting, counterterrorist, and homeland defense roles that the DoD is shouldering have raised questions that not only fall well outside of neat organizational and intellectual domains but that require answers that emerge from imaginative, synthesized, and joint lines of inquiry.

NDRI has been involved with integrated approaches and solutions to complex national security problems for 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 through specific strategy, technology, personnel, and bureaucratic jurisdictions.

NDRI’s Advisory Board annually establishes and endorses some crosscutting studies. Other studies that involve research cutting across more than one NDRI research center emerge from requests by specific clients. Past studies that NDRI pursued are outlined below. In 2002, NDRI also examined metrics for force transformation and the changing post-September 11 geopolitical environment. Two studies that the Institute completed in 2002 are described in the pages that follow.

## 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 in 1997.

**Manpower in Strategic Defense Planning** explored whether and to what degree the DoD’s approach toward deployments in the 1990s—in which the Pentagon relied repeatedly on certain units and individuals to handle numerous diverse missions since the 1991 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 per tempo, 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.

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

analytic support has helped a high-level national panel gauge how well prepared the United States is to deal with WMD terrorism. Created by Congress in 1998, the panel has assessed federal efforts to enhance domestic preparedness, spotlighted deficiencies, and recommended strategies to better coordinate federal, state, and local efforts. To date, 81 of the panel’s recommendations have been adopted in whole or in major part by the Executive Branch or Congress.

**Nuclear Weapons and the Future of Strategic Warfare**

research outlined a spectrum of possible long-term nuclear futures for the United States—ranging from maintaining today’s U.S. force totals to cutting them to 300 strategic and tactical warheads—and defined global political and arms control conditions that would be needed to achieve each different end state. It also investigated changes to U.S. targeting strategy that would be needed to adjust to these different end states.

# Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation

This NDRI study built on a decade of work recommending changes in defense planning toward a capabilities-based approach.

To prepare itself for future contingencies, the military needs to identify the range of possible threats, determine capabilities it will need to meet them, and decide what capabilities to invest in given limited resources for defense spending. For the past four decades, the U.S. military has relied on the method of threat-based planning, which seeks to develop capabilities necessary to defeat a specific enemy within a very limited number of very specific scenarios. Even if the method was sufficient during the Cold War (debatable), which featured a very large and capable adversary in reasonably predictable scenarios, the United States today must prepare forces for a wide variety of potential enemies, missions, and circumstances—including those of so-called asymmetric warfare. Defense planning must develop capabilities that are flexible, adaptive, and robust.

This concept is no longer controversial. In its 2001 Quadrennial Defense Review, DoD strongly embraced “capabilities-based planning (CPB)” and provided extensive rationale. It has consistently emphasized the approach since then. However, DoD’s guidance on the matter did not provide much detail. This NDRI study reviewed and extended past work on the matter and recommended a detailed framework for implementing CPB in future defense planning.

## CPB Seeks to Be Operationally Relevant and Financially Responsible

NDRI’s study defines CPB as planning—under uncertainty—to provide capabilities suitable for a wide range of modern-day challenges and circumstances, while working within an economic framework. This seemingly simple definition has three important features that distinguish it from prior methods of analysis:

- **It treats uncertainty as a fundamental consideration in planning.**
- **It considers multiple threats and circumstances.**

President Bush and Secretary of Defense Rumsfeld identified “new challenges” to U.S. security as a motivation for transforming forces. The issue here is not just identifying the adversary, but anticipating possible enemy strategies, tactics, and many other aspects of circumstance.

- **It emphasizes economic constraints.** The military does not have a blank check to prepare for any challenge that might conceivably arise. Instead, the DoD must make choices within the reality of budget limitations (even when budgets are rising). CPB should inform those choices, while emphasizing flexibility, adaptability, and robustness of capability, rather than “optimization” for specific cases.

## NDRI Identified a Five-Step CPB Process

NDRI developed a procedure for capabilities-based planning summarized in the flowchart on page 26, which has the following major steps:

**Step 1) Identify operations required to deal with diverse threats in diverse circumstances.** The first step is to develop a list of not-implausible scenarios requiring U.S. military action. A notional list would include old standbys, such as an Iraqi invasion of Kuwait, but would include many others as well, such as scenarios involving a U.S. attack on rogue states or terrorist facilities. Next, planners identify the operations that military forces might have to conduct and characterize the stressful circumstances that would make doing so difficult in one way or another. Some operations will be “business as usual,” and ensuring capability for them does not require attention from the defense secretary. Others may be called special *operational challenges* for planning. For example, projection-force operations may involve *immediate* countering of enemy maneuver forces, destruction of critical mobile targets, or response to attack, all potentially done under stressful circumstances—such as adversaries employing short-warning tactics, obstructing access to regional bases and waters, and even resorting to mass-casualty weapons. What is needed to be able to conduct such operations? By identifying operational challenges in this way, planning transcends particular enemies, scenarios, platforms, and weapon systems. It concentrates instead on crosscutting output: the real-world military ability to conduct the key operations when necessary, in many contexts and despite adverse circumstance. The operations that can be accomplished become key *building blocks* of capability. ➤

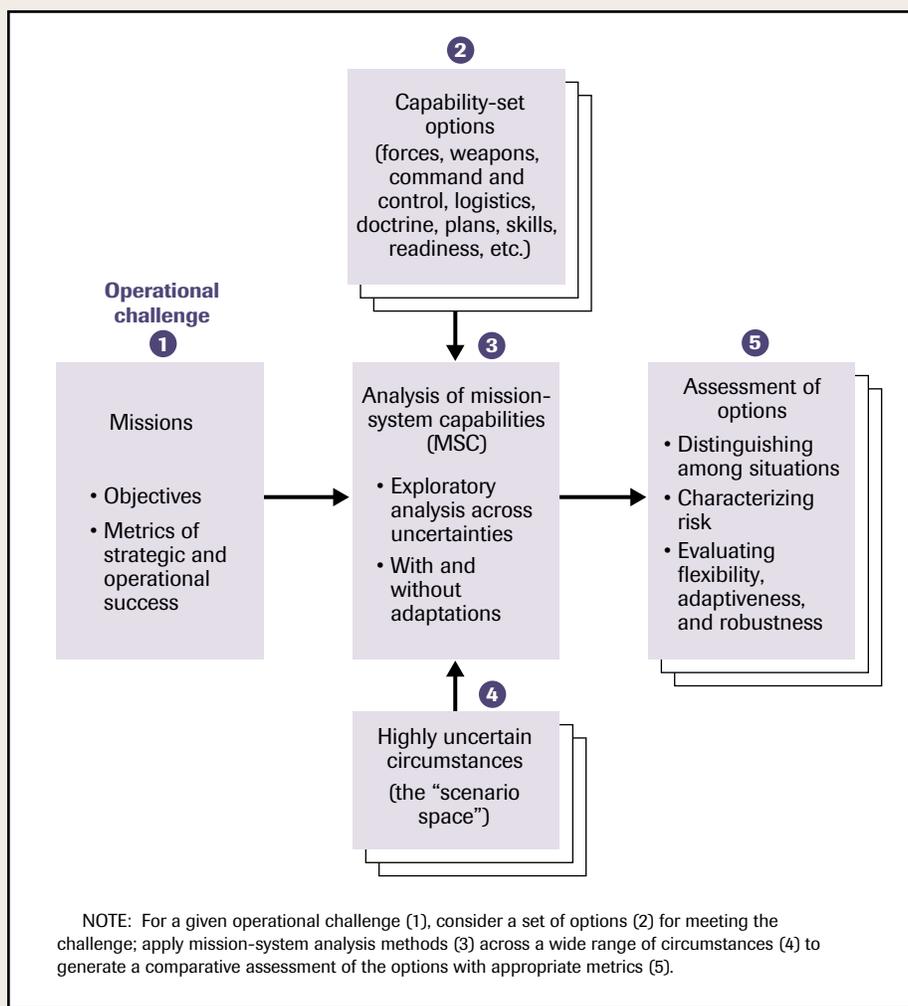
**Step 2) Determine capability options.** Next, planners generate a range of capability options needed to meet the list of operational challenges. Again, the building-block notion is fundamental—as it is in other problems where adaptiveness is important. Here, however, building blocks may be new units (either service units or joint units), platforms, or weapon systems. What future building-block units should look like is far more important than the question of how many divisions, battle groups, or wings the United States should have. “Assembly capability” is also crucial, as in any use of building-block methods. This translates into the need for superb joint command and control, which motivated Secretary Rumsfeld’s initiative to create standing

joint task force command and control elements. These capability options should highlight the critical components of capability, so as to ensure that planning addresses *all* of them: a system that would work except for one component that is not in place is a system that does not work. The same applies for operations. The capability options, however, may provide the critical components of capability in different ways. For example, to interdict enemy maneuver forces early, a commander might first suppress air defenses; or he might instead rely from the outset on stealthy platforms and other long-range fires against which air defenses are ineffective. Any given option might provide requisite capability very well in some circumstances, but not as well in others. Thus, they

need to be compared and assessed.

**Steps 3/4) Analyze capabilities’ effectiveness in a broad “scenario space” (of both name-level scenarios and their detailed circumstances).**

Planners next analyze the performance of each capability option or combination of options within a broad scenario space that, as emphasized throughout CPB, confronts massive uncertainty. In addition to considering different cases of warning, allied support, enemy strategies and tactics, and so on, the analysis also addresses uncertainties in soft factors such as enemy morale and the threshold of effects that will cause an enemy to abandon his own operations. The goal of these steps is to see how such variables affect the likelihood that a mission can be accomplished given certain capabilities.



**The Process of Analyzing Mission-System Capabilities**

## A Notional Scorecard for Assessing Alternatives in a Portfolio Framework

Candidate Option for Funding	Capabilities in Conflict		Force Management	Reassurance, Dissuasion, and Deterrence	Net Effectiveness	Marginal Cost (\$B)	Ratio: Effectiveness over Cost
	Class-A Conflicts	Class-B Conflicts					
Weight	1/3	1/6	1/4	1/4	N.A.	N.A.	N.A.
Baseline	5.0	5.0	5.0	5.0	5.0	0.0	N.A.
Small-bomb package 1	7.0	5.0	5.0	7.0	6.2	0.05	123
Standing JTF headquarters	7.0	7.0	5.0	8.0	6.8	0.25	27
Support for independent brigades	6.0	8.0	8.0	7.0	7.1	0.30	24
Extra F-22 squadron	7.0	5.0	5.0	7.0	6.2	0.60	10
C4ISR package 1	7.0	5.0	5.0	8.0	6.4	1.00	6
C4ISR package 2	8.0	8.0	5.0	7.0	7.0	2.00	4

NOTES: The options, values, and costs shown are purely notional. N.A. = not applicable. The meaning of the effectiveness scores is as follows: 0–2 very bad, 2–4 bad, 4–6 marginal, 6–8 good, and 8–10 very good. These are relative to the baseline force with scores of 5 in all categories. The baseline force is assumed to have no critical omissions. If it did, some of the table's scores might be quite different. Columns for Class-A and Class-B conflicts are intended to summarize much more extensive exploratory analyses. The table implicitly assumes a date for the assessments (e.g., five years from now). A variant table might contrast assessments for the near, mid, and long terms.

### Step 5) Generate a comparative assessment of

**options.** The result is a comparative assessment of options that addresses explicitly the broad range of considerations. Choice, at budget time, should be made so as to achieve flexibility, adaptability, and robustness. To a large degree, this means expanding the set of conflicts and circumstances for which the capabilities will be sufficient. This implies the need for a very different approach to cost-benefit analysis than has often been customary, but NDRI has developed portfolio-management tools to assist in such choices.

### Investment Analysis in CPB

To implement capabilities-based planning, DoD will need a new analytical architecture that emphasizes modular, building-block capabilities; a mission-system view; exploratory analysis across a broad scenario space of conflicts and circumstances; and a portfolio-management style of choice in an economic framework.

Portfolio spreadsheets may prove to be particularly helpful in implementation. Decisionmakers use a combination of hard analysis and value judgments to decide what capabilities merit investment. While there is no rigorous way

to make such decisions, NDRI provided a portfolio spreadsheet methodology, which could help to clarify the tradeoffs that decisionmakers must make.

The table above lists capabilities that might be recommended as a result of CPB analysis. Decisionmakers assign a notional value to each capability based on its effectiveness in fighting two types of conflict (“Class A Conflicts” and “Class B Conflicts”). They also estimate how each option contributes to broad goals such as managing forces, reassuring allies, and dissuading would-be adversaries. Based on these factors, decisionmakers can compute the value of each capability relative to its cost (although a wise decisionmaker looks for “low-hanging fruit,” rather than agonizing over calculations distinguishing with artifactual precision between two nearly equivalent options). The table's hypothetical spreadsheet shows that the small-bomb package is a highly effective, low-cost capability warranting investment. So also, the standing joint task force headquarters. Both are now part of the DoD program.

**For more information, see**

*Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation*, Paul K. Davis, MR-1513-OSD, 2002.

# Deterrence and Influence in Counterterrorism

## A Component in the War on al Qaeda

This NDRI study laid out a framework that U.S. policy-makers can use to devise strategies to thwart and defeat al Qaeda and other fanatical terrorists bent on targeting the United States and its interests. The study originated out of a request from the director of the Defense Advanced Research Projects Agency (DARPA), who asked that NDRI and the Institute for Defense Analysis collaborate in developing a framework for deterring terrorism. The two institutions formed separate teams, who worked closely together through most of the project but produced different reports in order to provide the client with different “takes” on the subject.

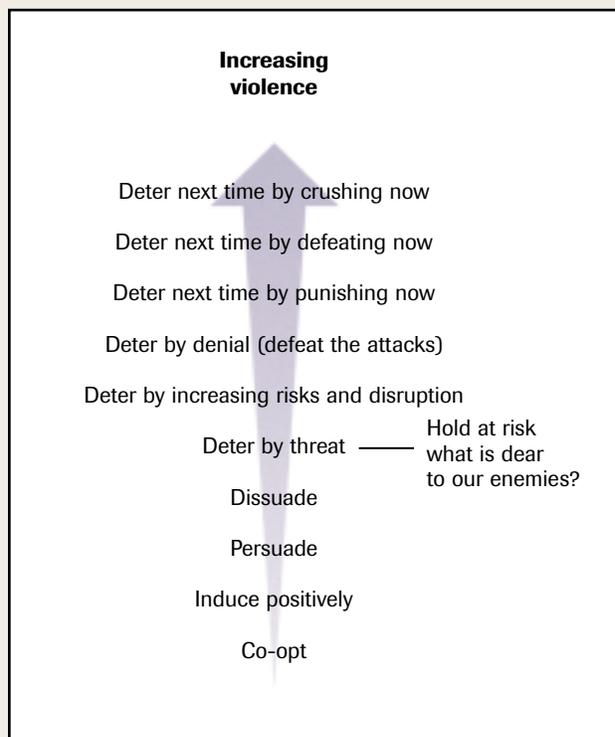
### Three Principles of U.S. Counterterrorism

The NDRI team approached the issue by developing *principles* for strategy and then discussing, one by one, a set of particularly troublesome issues. NDRI’s primary strategic principle was that *influence*, rather than deterrence, is the appropriate complement to direct action against terrorists and defense from terrorist attacks. Deterrence—causing an adversary not to take an action by threatening some counteraction—is simply too narrow. In practice, there are many ways to influence an adversary, only one of which is deterrence. Other ways include co-optation and inducement on one end, and crushing defeats on the other—with such defeats serving to help deter future actions. The figure at right depicts this range as an escalation ladder of influence.

This emphasis on influence, broadly construed, led to a second guiding principle: terrorist groups are not simply single entities; rather, they are *systems*, with diverse elements, many of which may be amenable to influences of one type or another. Zealous leaders may not be deterrable, but those who support a terrorist organization with money, logistics, and sanctuary may very well be. Some of those participating in terrorism may abandon terrorism if they can be brought into the process of reaching political solutions to problems. Some who may not be deterrable today may be deterred from future efforts if their efforts today are decisively defeated.

NDRI’s third principle is that because al Qaeda has no well-defined “center of gravity” and information is so poor, the United States should devise and implement a broad-front, sustainable, high-minded strategy. This strategy cannot be narrow, clever, and “optimized.” Instead, with no way of knowing in advance which effort may prove successful, the United States needs to wage a simultaneous campaign along many fronts. Moreover, if such an effort is to be sustained over many years, it must be persuasive and high-minded. Specifically, it must be

- characterized by manifest strength and manifest purpose and determination;
- consistent with American values in war and a carrying a moral validity apparent to America’s counterterrorism partners; and
- balanced between short-term efforts to destroy terrorists and longer-term efforts to mitigate their organizations’ public appeal and power.



Escalation Ladder of Coerciveness

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## Overcoming Troublesome Counterterrorism Issues

Developing and executing such a strategy will not be easy. To succeed, the United States will need to overcome at least three vexing issues:

- **Deterring Use of Weapons of Mass Destruction.** America's most profound post-September 11 national security concern is the specter of truly catastrophic terrorism involving weapons of mass destruction (WMD). NDRI suggested two approaches beyond those already being taken. The first is to credibly announce that any state or nonstate organization that even *tolerates* the acquisition of WMD by terrorists within its borders will be subject to the full wrath of the United States. The second approach is quite different and controversial: Deterrence of the use of biological weapons—a special and frightening case—could be greatly enhanced if everyone in the Middle East discussed issues sufficiently so as to conclude, from their own common sense, that biological warfare—once begun—could not be contained. Potential advocates of such warfare should instead conclude that, in part because of their own vulnerabilities and lack of public health systems, it is a “game that we should not try to play.”
- **Getting Regional Allies to Act.** One lesson NDRI learned from reviewing the ways various influences could be used against the al Qaeda system was that identifying instruments and targets is the easy part. The hard part is making something happen, especially when many measures would need to be taken by states from which terrorists come or in which they reside. America's European allies began crackdowns and extensive cooperation with U.S. authorities soon after September 11. Egypt and Pakistan are now doing the same. Saudi Arabia, however, is a special case. On the one hand, the United States and Saudi Arabia have had a long and mutually beneficial strategic relationship. On the other hand, the spread of “Wahhabiism,” long promoted by Saudi Arabia, has helped encourage intolerance that transmutes into

religious extremism. The NDRI study suggested that the Saudi government (and governments throughout the Middle East and elsewhere) need to strongly discourage extremist teachings and impede organizations that support terrorism.

- **Maintaining American Values in War Against Terrorism.** Although national standards in war are different from standards in a lengthy peace, the NDRI team argued that core American values can be preserved in the war on terrorism. On the foreign front, the United States should continue to emphasize being discriminate when using force. It should also demonstrate continued support for democracy even when working with nations lacking related qualities that Americans value. Many of America's Western European allies, democracies all, have been forced to change laws and processes to combat terrorism in recent decades. All of them, however, have found it possible to do so without sacrificing their values.

## Concluding Remarks/Afterward

The NDRI study concluded that the concept of deterrence is both too limiting and too naive to be applicable to the war on terrorism. It is important to conceive an *influence* component of strategy that has both a broader range of coercive elements and a range of plausible positives, some of which we know from history are essential for long-term success.

It is interesting to note that key features of NDRI's framework appear to have held up well in the months since the project's completion in the summer of 2002. The U.S. government, for example, has found it necessary to use a broad range of instruments, ranging from persuasion to severe punishment; it is distinguishing among different elements of the al Qaeda system and tailoring instruments accordingly; it is proceeding on a broad track, rather than counting on finding a vulnerable core; it has worked closely with allies worldwide, who have mostly been cooperating well; and it has sought—but with much less success so far—to engage in the war of ideas.

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**For more information, see**

*Deterrence and Influence in Counterterrorism: A Component in the War on al Qaeda*, Paul K. Davis, Brian Michael Jenkins, MR-1619-DARPA, 2002.

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