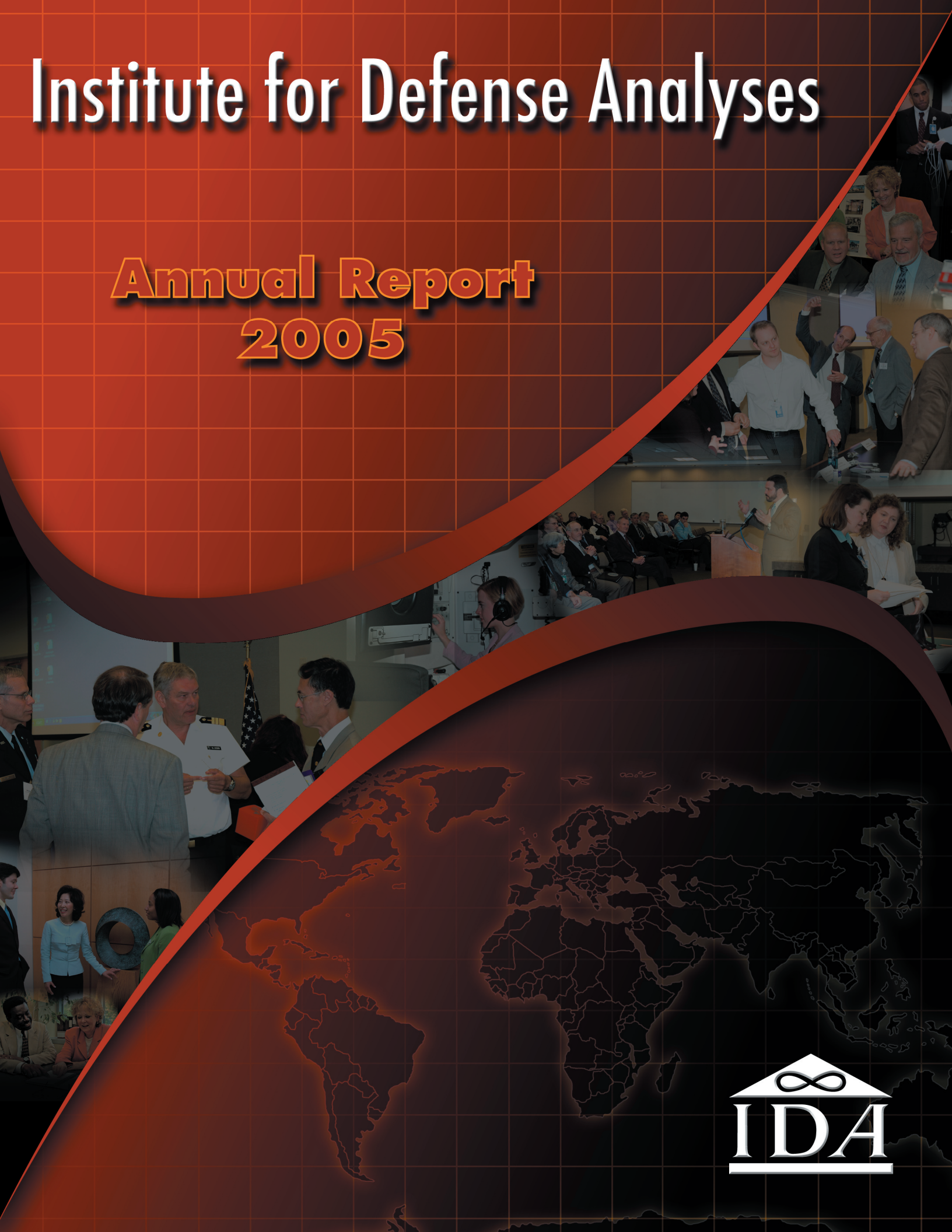
Institute for Defense Analyses

Annual Report 2005



IDA

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Message from the President

2005 has been another busy and productive year for IDA. Our analysts have made contributions to many of the most important issues facing the Department of Defense and other sponsors.

As we look to the future, we plan to sustain and improve IDA's strengths in systems and capabilities assessments, test and evaluation support, cost and resource analyses, force and strategy assessments, organization and process studies, technology assessments, training, manpower and other support analyses, high performance communications and computing, and science and technology policy. Examples of past studies in these areas can be found throughout this report.

At the same time, we seek to broaden and expand IDA's research contributions in several areas of increasing importance to national security. In all of them, we are building on our core competencies and successful problem-solving approaches – strong technical knowledge, rigorous analytical methods and a commitment to making useful recommendations. These areas are:

Intelligence. Since 9/11 there have been dramatic changes in the organization and priorities of the intelligence agencies, both within the Department of Defense and in other departments and agencies. New leaders are asking basic questions about priorities, organizational relationships, collection systems, analytical approaches and assessment of results. Meanwhile, intelligence is crucial for success in Iraq, Afghanistan, and other areas where U.S. forces are operating.

IDA can help with these questions. We are teaming researchers with experience in intelligence agencies with analysts from throughout IDA with relevant technical and analytic skills. Some of the areas in intelligence in which we are now working are information systems, analyses of major new collection systems, counterintelligence damage assessments, vulnerability analyses, and exploitation of captured Iraqi documents. We are building relationships with new sponsors in the Department of Defense and the Director of National Intelligence.

Combatant Command Support. Because military operations have become so complex and varied in recent years, the combatant commands are increasingly involved in the decision-making processes for acquiring new systems and for setting budget priorities. There is a welcome recognition in Washington that new systems must be be better tailored to the dynamic needs in the field, and that the perspectives of combatant commands should play a larger role in informing budget choices, particularly in high-priority, joint mission areas. However, the staffing and procedures for facilitating combatant commander participation in Washington-based activities are immature.

To help strengthen linkages between the commands and Washington, IDA established a pilot program at the Pacific Command (PACOM), with two IDA analysts assigned to PACOM headquarters. Initial indications are very positive. Our analysts in Hawaii developed a methodology for deriving PACOM's requirements from its mission responsibilities and provided them in a format and with justification that made them more useful to the Joint Staff and other Washington offices involved in acquisition, programming and budgeting decisions. IDA was asked to assist other combatant commands in using the methodology, and we hope to establish full-time field offices with other commands in future.

Irregular Warfare. Operations in Iraq and Afghanistan dominate the spending and attention of the Department of Defense and the Intelligence Community. Despite urgent needs for new analytic insights, operational assessments and other quantitative analyses are thin for this type of warfare compared to major combat operations. DoD decision-makers have far more robust analytical support in allocating resources for and measuring results of traditional combat against organized armed forces than they do for security operations, counterinsurgency, peacekeeping and stability operations, and operations against international terrorists.

To help meet evolving sponsor needs, IDA is focusing significant research efforts on understanding and explaining the dynamics of these operations, and on making recommendations for improving U.S. capabilities. We are studying operations in Afghanistan and Iraq, including careful reconstruction of individual engagements, to draw lessons for improvement; we are helping Joint Forces Command conduct experiments to understand operations in difficult urban environments; we are researching improved practices in stability operations with other departments of government and international partners; we are analyzing bandwidth requirements for current operations; and we are helping bring operational analyses to bear on U.S. efforts to counter improvised explosive devices. These activities are putting IDA researchers into the field to gather data, interview soldiers and Marines, and draw conclusions about what equipment and tactics are working.

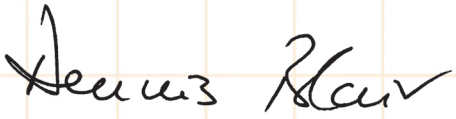
Command and Control Networks. Network-centric warfare is a key to further substantial increases in combat capability for the U.S. armed forces; for several years, IDA has been helping the Department of Defense make decisions on the development and introduction of networks and related systems. It is easy to state the vision: bringing planners, operators and supporters onto high-capacity networks so they can collaborate and operate together. It has proven much more difficult to achieve the vision, requiring careful analysis, difficult engineering and continual reevaluation as requirements and technology change. In addition, extensive networks create the potential for extensive vulnerabilities and greater losses of effectiveness if adversaries penetrate or disrupt our networks. Current operations are increasing the pressure for continual improvements of our networks, and hackers and other adversaries are increasing pressure on the networks themselves.

IDA researchers have been heavily involved in developing improved approaches to developing, purchasing, using and protecting networks. We led key parts of a major study to improve the governance and management of DoD's Global Information Grid; we supported the new office charged to ensure that important information about combating terrorism can be shared throughout federal, state, and local governments; and IDA researchers helped Defense officials as part of the Quadrennial Defense Review design policies for the management of information technology.

Homeland Security and Defense. A fifth area of increased research emphasis is homeland security and defense. Here, IDA is assisting the Department of Homeland Security as well as DoD and other government agencies. Our research teams are helping formulate a plan to deploy sensors to protect cities against terrorist-employed nuclear devices; they are building a methodology to assess risks to individual components of the country's infrastructure; IDA researchers are developing concepts and metrics for the Coast Guard to use in combating terrorists; we are modeling the potential spread of infectious diseases across the country; we are advising the Northern Command on plans and priorities; and we are helping DHS evaluate new commercial products and technologies for countering terrorist attacks.

In these areas of increasing focus, IDA researchers find that they use, refine and hone the skills and approaches they have developed in working on the problems of the past. But they also are developing new approaches, new models and different solutions. It is exciting work, it is important work, and the skilled and dedicated IDA researchers are doing it very well.

Admiral Dennis C. Blair, USN (Ret.)



President, Institute for Defense Analyses

Systems Evaluations

IDA's evaluations of defense systems support decisions on acquisition and program planning, and involve assessments of military utility, system performance, and the risks and costs of technological integration. These efforts cover systems at all stages of development and deployment, including test and evaluation. IDA also conducts broad assessments of new operational concepts, current and future mission needs, system architectures, and system interoperability. To accomplish this, we maintain expertise with the systems of all Services, including tactical systems for land, naval, and air warfare; strategic systems and missile defense; mobility systems; command, control, communications, computers, intelligence, surveillance, and reconnaissance systems; space systems; and information and computing systems. Our research helps DoD set force and inventory levels, identify suitable concepts for system employment in wartime, and choose among alternative weapon systems.

Tactical Systems and Missile Defense

Joint Air Dominance

As part of the recent Quadrennial Defense Review, DoD reviewed its plans for U.S. tactical aircraft forces to see if savings could be achieved without significantly affecting the ability of U.S. forces to prevail in future campaigns. IDA was asked to help by assessing the capabilities of almost 40 different force mixes composed of varying numbers of F-35 Joint Strike Fighters, F-22 Raptors, and other aircraft.

The analyses highlighted the effects of changes in the numbers and types of aircraft, basing access, tanker force levels, air-to-air and air-to-surface weapon performance and inventories, and threat capabilities. In addition, we examined the relationship of aircraft signature, jamming, and air-to-surface weapon range to the vulnerability of strike aircraft to enemy surface-to-air missiles.

Our analyses showed that four of the force structures were far more capable than the others; and of those four, one in particular provided the greatest versatility to the combatant commanders. Our results, which IDA presented to the senior leadership of the Quadrennial Defense Review, were taken into consideration during deliberations about tactical aircraft force structure.

Unmanned Combat Air System

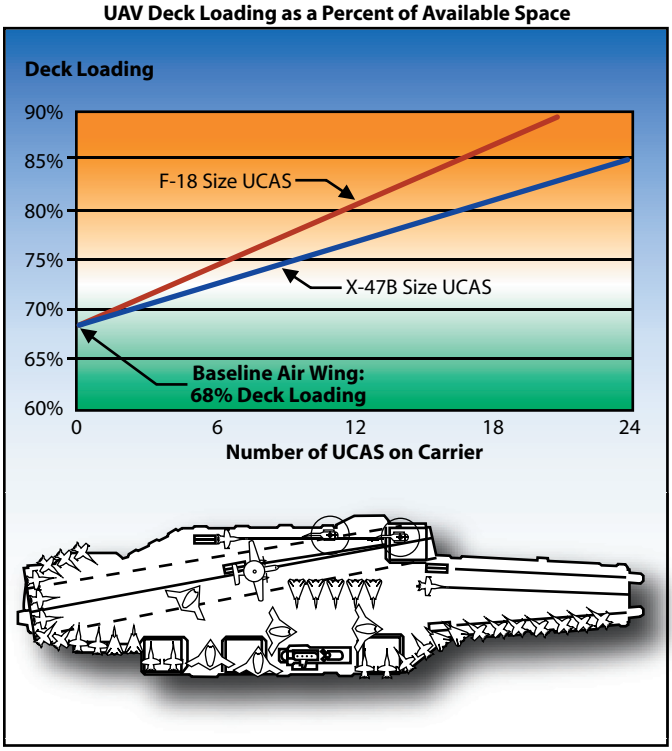
The Unmanned Combat Air System (UCAS) program is developing next-generation air vehicles that could operate effectively in the face of highly sophisticated air defenses.

The UCAS will leverage state-of-the-art stealth and other technologies to enable it to conduct a variety of potential missions: strike; intelligence, surveillance, and reconnaissance; and radar jamming. Two demonstration vehicles are being developed – the Boeing X-45C and the Northrop Grumman X-47B – for field testing in the latter half of this decade.

To help inform DoD investment decisions, we are examining the effectiveness and cost of UCAS concepts, using sophisticated air combat and cost models developed at IDA over the past decade.

Working with OSD, the Services, and the Program Office, our researchers are assessing the feasibility of proposed operating concepts, the costs of procuring sufficient UCAS to meet future needs, the utility of different combinations of mission-specific capabilities, and the overall warfighting contributions of UCAS vehicles. We are also examining the maturity of key technologies and issues surrounding potential development of both land-based and carrier-based variants of the UCAS.

UAV Deck Loading as a Percent of Available Space



One of the UCAS issues analyzed by IDA concerns the ability to base the aircraft on an aircraft carrier without producing congestion on the flight and hanger decks, thus degrading the carrier's capability to rapidly generate sorties. Our analysis indicates that this could be a particular problem if more than 9 X-47B sized or 6 F-18 sized UCAS were added to the planned Carrier Air Wing on a single carrier. Deck loading is the percentage of available space on a carrier occupied by aircraft. Deck congestion becomes a risk at 75% deckloading and unacceptable at 80%.

Rotary Wing Survivability Assessment

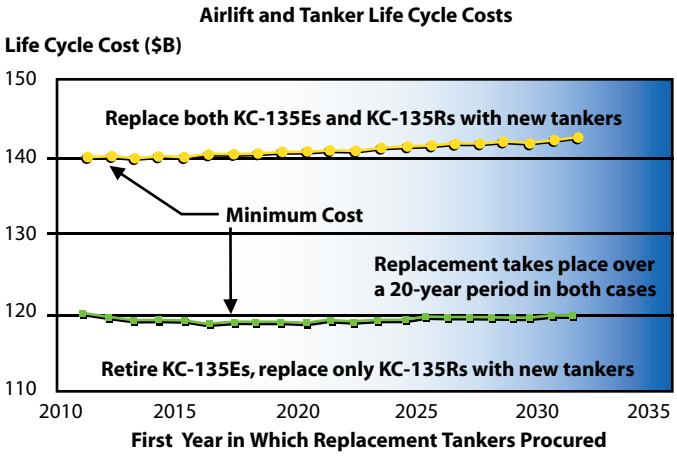
From fall 2001 to spring 2005, the United States lost about 100 helicopters in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). DoD asked IDA to examine available data and records to identify why the helicopters were lost and to develop options for reducing future losses.

Our results showed that about one-third of helicopter losses were due to engagements by enemy forces, which primarily used shoulder-fired missiles, rocket-propelled grenades (RPGs), and small arms. The remaining two-thirds of the losses were due to accidents. While several factors, such as challenging mission demands and mechanical problems, contributed to the losses, accidents were most frequently caused by degraded visibility and

associated aircrew disorientation that were exacerbated by the operating environments in Afghanistan and Iraq.

The study identified several options to improve rotorcraft fleet survivability, including:

- Enhancing the onboard countermeasures suite to counter shoulder-fired missiles.
- Modifying tactics and procedures to minimize exposure to RPGs and small arms.
- Developing a lightweight sensor package integrated with software-based terrain avoidance to improve aircrew performance in degraded environments.



The current KC-135 fleet consists of older KC-135Es, which are costly to maintain, and newer KC-135Rs. IDA compared the life cycle costs for two alternative future tanker force structures. These results show that the start date for procuring the next-generation tankers does not greatly affect the life cycle cost. Consequently, acquisition decisions should be based on other criteria, such as budget-constrained affordability and operational risk of maintaining the aging KC-135s.

Tanker and Airlift Analyses

This past year, IDA continued working on issues related to both aerial tankers and airlift aircraft. We were asked to provide an independent assessment of the objectivity of the Airborne Tanker Analysis of Alternatives (AoA) conducted by another FFRDC under Air Force sponsorship. IDA researchers made numerous analytical contributions to the AoA, and our objectivity assessment was sent to Congress along with the AoA itself.

IDA also contributed to the Mobility Capability Study led by OSD and the Joint Staff that estimated land, sea, and air mobility needs. Its findings were a key input to Quadrennial Defense Review decisions on mobility programs.

Finally, IDA developed a prototype airlift acquisition planning model that will help DoD optimize capability and balance budget-constrained resources among competing airlift programs. Refinements to the model and analyses are currently underway.

Joint Strike Fighter Review Panel

DoD asked IDA to establish an Independent Review Team to examine the F-35 Joint Strike Fighter (JSF) program, which is developing land-based, carrier-based, and short-takeoff aircraft variants. In its initial assessment in 2004, the review team confirmed that without design changes and/or requirements relief, all three variants would be too heavy to meet their stated performance requirements.

A follow-on review in early 2005 assessed the program's progress and responses to our initial recommendations and provided additional recommendations on weight, design solutions, and the systems engineering changes that had been incorporated by the JSF program Office.

In late 2005, IDA reconvened the review team to assess the processes being used to determine the program's readiness to begin long-lead procurement for low-rate initial production aircraft and to update its prior assessments. IDA's recommendations will be incorporated in the JSF Air System Critical Design Review and will be presented at the Defense Acquisition Board review of the JSF program in spring 2006.

Army Mobility

The Stryker and Future Combat System (FCS) programs are part of the Army's efforts to develop a more transportable force. A key design requirement is that most vehicles be compatible with C-130 aircraft, a relatively small intra-theater airlifter. The need to be transportable by C-130s limits the size and weight of the Stryker and FCS ground combat vehicles, thus constraining the vehicles' defensive armoring and offensive firepower.

IDA was asked to examine the tradeoff between what ground forces might gain in transportability by being C-130-capable versus what might be lost in terms of reduced survivability of individual Stryker and FCS vehicles. As part of this analysis, we highlighted the limitations on C-130 load-carrying capacity when the aircraft are operating from airbases above sea level or at high temperature.

In a related effort, we examined future vertical take-off and landing aircraft that could lift 40,000 lbs to a 300 nm

radius at Army standard high/hot conditions. Our researchers assessed the current state of technology developments that would enable such a vertical-lift aircraft to be acquired and assisted in developing and assessing a science and technology program plan for rotorcraft vehicles.

Special Operations Forces Air Operations

DoD efforts to combat terrorism have increased the operating tempo of Special Operations Forces, resulting in increased demands on its aging aircraft. The U.S. Special Operations Command (SOCOM) asked IDA to conduct a broad assessment of its force-application air operations, including the conduct of mobility, air attack and assault, and information operations. This study will assist SOCOM in determining its requirements for future combat aircraft.

This year, IDA identified specific capability needs and assessed the adequacy of the programmed numbers of aircraft to meet those needs. We identified the missions and tasks of the SOCOM component commands, reviewed the joint operations concepts and joint planning scenarios, and assessed the projected capabilities of potential enemies. IDA also developed linkages among the national military strategy, SOCOM core tasks, and the aviation capability needs of SOCOM.

Current SOCOM Combat Aircraft

U.S. Army Special Operations Command Aircraft

MH-47 Chinook

AH/MH 6 Little Bird

MH-60 Black Hawk

Air Force Special Operations Command Aircraft

MH-53 Pave Low

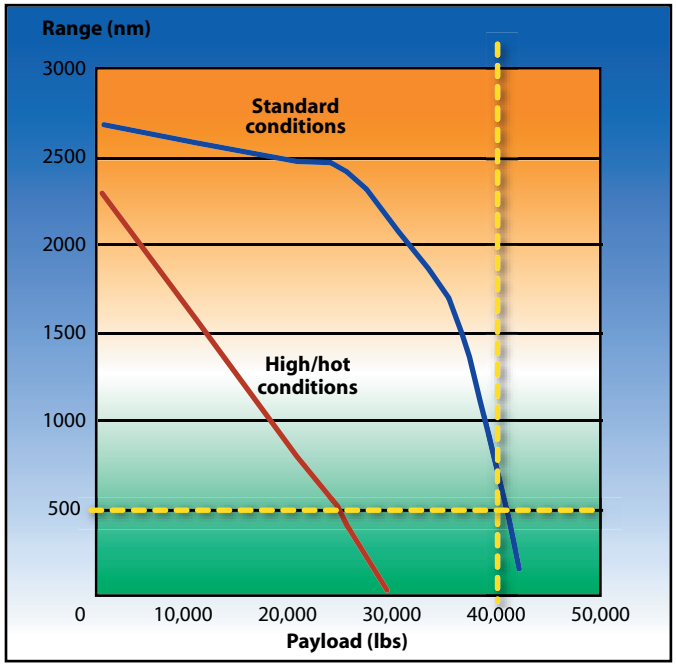
H/E/MC-130 Combat Talon

AC-130 Spectre Gunship

CV-22 Osprey

For IDA's Capabilities-based Assessment of Special Operations Force Application — Air Operations, current SOCOM combat aircraft provide a base case used in developing alternative future roadmaps for Special Operations Forces aviation. Some aircraft may be replaced to address capability needs identified in the study.

C-130 Verticle, Heavy-Lift Capability



The Army desires a vertical, heavy lift capability, in which 40,000 lbs could be transported 500 nm (intersection of yellow lines) at Army high/hot conditions. IDA analysis of vertical, heavy lift capability, however, showed that tactical mobility requires "ideal" or standard conditions (sea level/cool weather) to transport 40,000 lbs this distance.

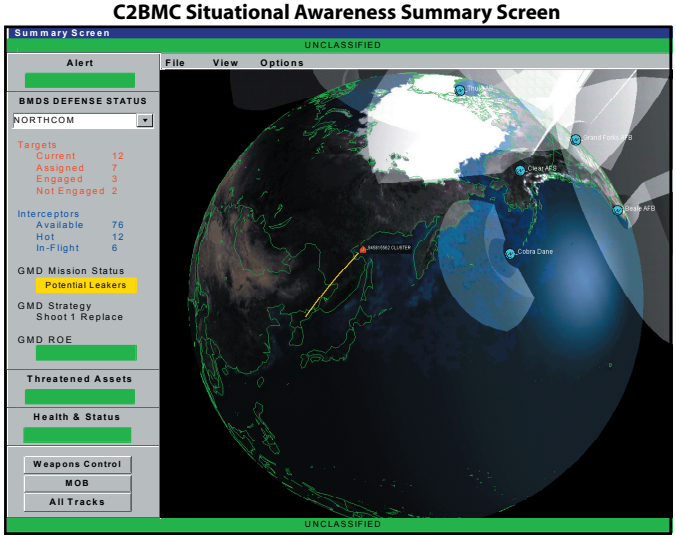
Next year, IDA will develop capability roadmaps that describe potential ways to meet the capability needs that have been identified. These results will support SOCOM as it develops acquisition plans for its future aviation force structure and the corresponding requirements documents.

Missile Defense Agency Support

IDA provides significant technical and analytical support to the Missile Defense Agency (MDA). Currently, this support is focused on command, control, battle management, and communications (C2BMC); advanced technology; and the Black/White Teams.

In the area of C2BMC, IDA is analyzing various tracking and discrimination architectures and algorithms, developing and assessing technical performance measures that will be applied to the overall system and its components, developing models of system performance under a variety of attack scenarios, and assessing weapon/target assign-

C2BMC Situational Awareness Summary Screen



Combatant commanders, warfighters in operations centers, and the National Command Authorities use the Command and Control, Battle Management, Communications (C2BMC) Situational Awareness Summary Screen to view the global missile defense situation. The screen provides a view for U.S. Northern Command (NORTHCOM) along with the threats, defensive asset strengths, and the operational capabilities of the NORTHCOM Ballistic Missle Defense System assets. IDA has supported the integration of the C2BMC Summary Screen into the training architectures, distributed wargames, and distributed ground tests.

ment strategies. Additionally, our researchers are examining the C2BMC architectures for their ability to interoperate with other DoD systems as well as comparable systems of allied countries.

We also are assessing the MDA advanced technology program, making recommendations for specific technology initiatives, and participating in the planning and execution of transition strategies to bring selected technologies from the laboratory into operational use.

Finally, IDA leads a White Team that advises MDA regarding technical means for discriminating enemy missile warheads from decoys and other deceptive measures. Our input has been instrumental in a significant redirection toward the current architectural approach to discrimination.

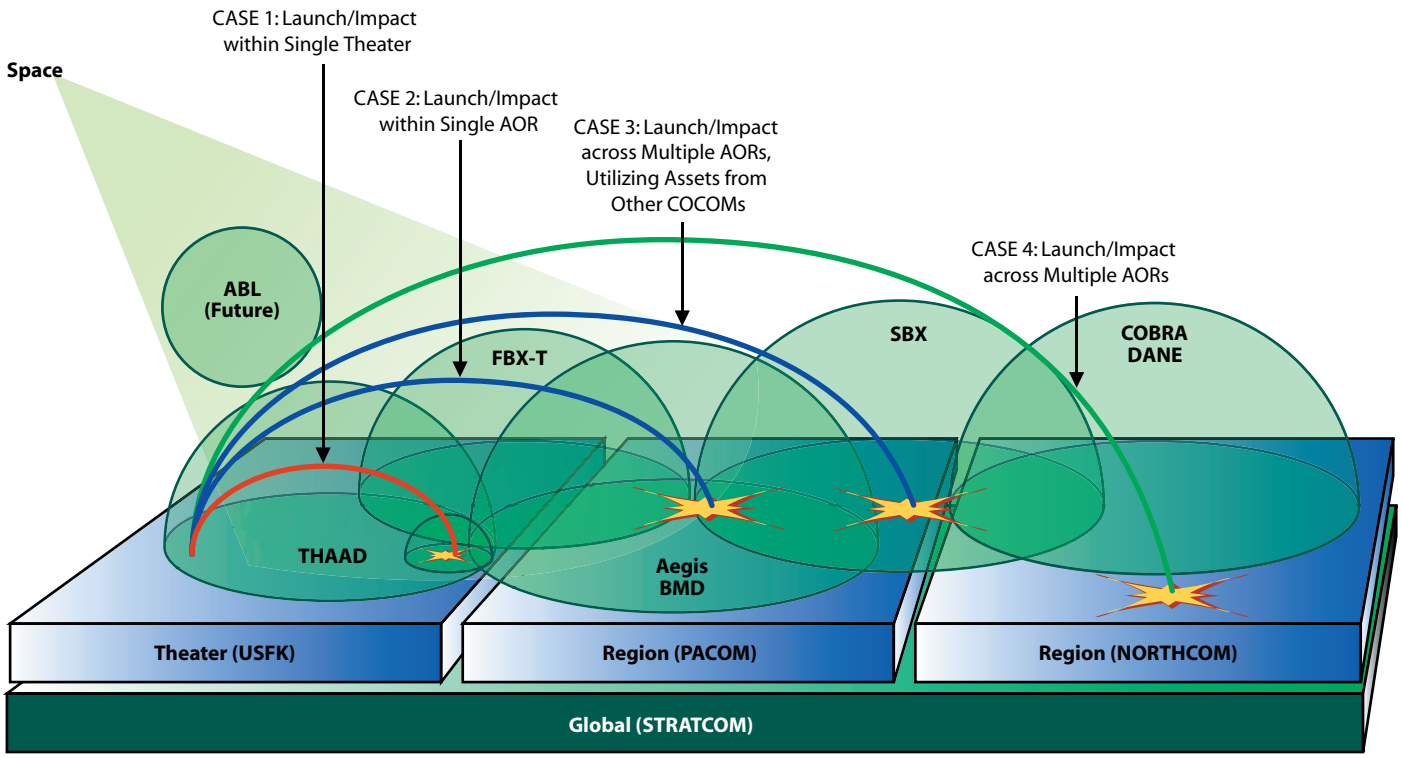
Joint National Integration Center

IDA provides analytic support to the MDA's Joint National Integration Center in Colorado, assisting with the C2BMC system. In particular, IDA has examined planned capabilities, including changes to software applications and to the network and communications architecture; helped establish the requirements for, and review the design of, the upgraded C2BMC test facility; and assessed Missile Defense National Team test plans, procedures, and results.

MDA has been placing increasing emphasis on experimentation to support early element integration, technology maturation, integration risk reduction, and transition. We have been helping in this area as well, assisting in selecting, defining, and planning the C2BMC experiments.

Our researchers also helped define and support the

Ballistic Missile Defense Command and Control



This drawing depicts the problem space for the Ballistic Missile Defense Command and Control System. The span of the threat across the theater, region, and globe demands integration planning, command and control, and communications networks.

execution of a suite of C2BMC international experiments and events, including identifying and demonstrating means, mechanisms, and specific data that can be released to NATO for missile defense planning, situational awareness, and consequence mitigation.

C3, Surveillance, and Space Systems

GMTI and CMD Sensor Tradeoffs

DoD is developing a variety of systems to improve detection and tracking of moving targets on the ground and in the air. The proposed E-10A Multi-Sensor Command-and-Control Aircraft will have both ground moving target indicator (GMTI) and cruise missile defense (CMD) capabilities. Other developmental systems with CMD capabilities include the Joint Land Attack Cruise Missile Elevated Netted Sensor and the Medium Extended Air Defense System. GMTI systems in development include Space-Based Radar and an enhanced radar for the Global Hawk unmanned air vehicle. The developmental Joint Unmanned Combat Air System may also include GMTI capability. DoD asked IDA to examine whether these systems provide desired capabilities without unnecessary duplication.

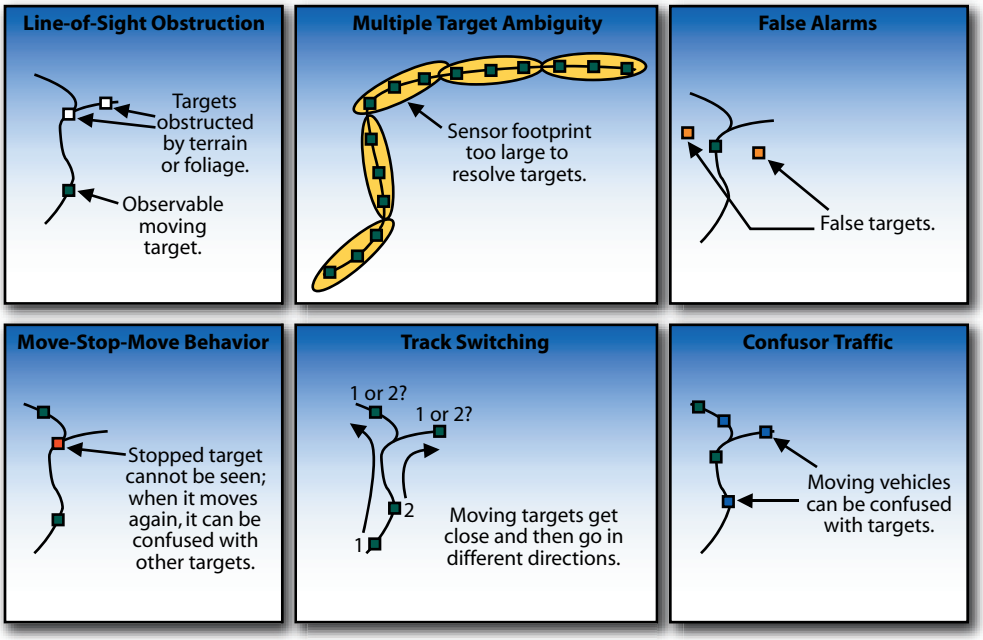
IDA analyzed tradeoffs of alternative mixes of GMTI and CMD sensor systems to support warfighting needs. We examined technical performance of the systems and took account of operational considerations associated with the GMTI and CMD sensors. We identified relative strengths and limitations and used force-on-force modeling to compare the effectiveness of mixes of these systems in operational scenarios. DoD is using the results of this research to help set program and budget priorities.

Joint Command and Control Capability

DoD is striving to enhance battlespace awareness, to increase the timeliness of information exchange, and to improve net-centric operational capabilities for joint and multinational forces. In support of these goals, the Global Command and Control System (GCCS) Family of Systems is evolving from its current state of joint and Service variants to a single joint C2 architecture. The resultant joint command and control (JC2) capability will be DoD's principal C2 information technology system. IDA led the Analysis of Alternatives (AoA) of JC2 acquisition options.

The JC2 AoA identified current capability gaps, prioritized the gaps by assessing their impact on four critical JC2 processes, and identified potential means for closing the gaps. Proposed solutions were organized into capability sets from which we formulated and evaluated JC2 program alternatives. We concluded that the JC2 development program should emphasize the development of joint situational awareness, intelligence, and deployment planning capabilities, and we provided recommendations regarding program execution plans.

Factors Impacting GMTI Sensor Performance



IDA took into account many factors (some of which are depicted here) that impact the capability of ground moving target indicator (GMTI) sensors to maintain a track on high-value targets. GMTI sensor characteristics that aid in overcoming these complications are revisit frequency; the minimum detectable velocity; angular, range, and velocity resolutions; sensor elevation; geolocation accuracy; availability of high-range resolution modes; and the capability to interleave GMTI with synthetic aperture radar modes.

Analysis of Airborne Datalinks

Wireless communications are used to control or monitor unmanned aerial vehicles (UAVs), and to pass sensor data to ground stations. However, the proliferation of UAVs using the same datalink systems has caused command and control problems resulting in the loss of aircraft. IDA was asked to assess the cost and effectiveness of various commercial off-the-shelf and government off-the-shelf radio-frequency datalinks to remotely

offload data from medium-sized UAVs such as the Predator. Our survey identified readily available alternate datalinks that could reduce considerably the possibility of loss of these valuable craft due to overcrowding of the radio frequency spectrum and subsequent loss of control. IDA researchers also provided the following:

- A market survey including cost and near-term availability of datalinks.
- A summary of technical parameters of the datalink components.
- An evaluation of the technology employed by the datalinks.
- An evaluation and analysis of the viable systems themselves.
- Recommendations for the procurement of cost-effective systems.

We concluded that satellite communications SATCOM links are useful for range extension and other niche applications where line of sight is not guaranteed, but SATCOM does not obviate the need for effective point-to-point, line-of-sight datalinks between UAVs and nearby ground stations.

Joint Tactical Radio System

The Joint Tactical Radio System (JTRS) is a software-defined radio currently under development for use by all Services. DoD asked IDA, in conjunction with Johns Hopkins University Applied Physics Laboratory, to conduct an Analysis of Alternatives (AoA) to:

- Examine the feasibility of extending JTRS design principles to communications systems above 2 GHz (higher frequencies than the current program utilizes).
- Assess warfighter capability needs in the current frequency band (below 2 GHz).
- Determine the best acquisition approach for procuring these capabilities.

The AoA concluded that extension of JTRS design principles could be accomplished through the spiral introduction of common core modules supporting networking, cryptology, and waveforms. Our analysis also concluded that the benefits of continuing certain JTRS capabilities were unproven and that proliferation of networking waveforms without an overall architecture could increase interoperability problems. Finally, the AoA established an acquisition tradespace; defined metrics; examined multiple acquisition approaches; and assessed technical, schedule, and capability risks associated with each approach.

Moving Military Materiel to Ports

IDA's pilot system provides a common operating picture to those organizations supporting the movement of war materiel between the forts and depots in the United States and the Port of Philadelphia. It also enables those in RAPID Center to send out alerts to stakeholders to inform them of significant events. The map shown here was displayed by the Army's Battle Command Sustainment Support System. The ship was bringing materiel from theater operations back to the U.S. to be distributed to forts and depots via railroad and truck. The red traces represent the approximate location of the railroad tracks to 6 of the 16 destination locations. When a user clicks on a fort on the map, the pilot system sends that workstation the latest information on the cargo destined for that location.

Delaware River Maritime Enterprise Council

The Delaware River Maritime Enterprise Council (DRMEC) has developed an operational facility (RAPID Center) to help the U.S. military's Surface Deployment and Distribution Command improve the security and tracking of war materiel moving between Army bases and the commercial port of Philadelphia. In 2003, the Department of Transportation asked IDA to help design and develop an automated system to support RAPID Center, and in 2004, DRMEC asked IDA for technical support in devising a pilot version of that system.

The pilot system supports two major functions: logistics and security. The logistics element automates the tracking of each item of cargo being moved and provides a common operating picture for the stakeholders involved. The security element enables RAPID Center to send alerts to the stakeholders by mobile phone or email. To date, the system has been used in support of the movement of war materiel to and from five ships. In part because of the development of RAPID Center, DoD has designated the Port of Philadelphia a National Model Strategic Seaport.

Information and Computing Systems

Information Sharing Environment

The Intelligence Reform and Terrorism Prevention Act of 2004 created a new entity called the Information Sharing Environment (ISE). The Program Manager for ISE is responsible for planning for, overseeing the implementation of, and managing the ISE-related counterterrorism information. The Program Manager also chairs the Information Sharing Council and works with it to develop policies, procedures, guidelines, rules, and standards for sharing counterterrorism information among federal, state, local, tribal entities, and the private sector.

IDA is providing broad analytic and strategic planning support to the Program Manager to assist in establishing and managing the ISE. This support includes describing the current state of terrorism information sharing, identifying key issues related to greater sharing of terrorism information, helping establish goals for the future ISE, and creating a roadmap to achieve the goals.

OIF Communications Architecture and Network Performance

U.S. Joint Forces Command asked IDA to examine network performance (bandwidth, latency, quality of service, availability) during the major combat phase of Operation Iraqi Freedom (OIF), and to develop lessons regarding network and communications architectures for use by agencies involved in planning for future contingencies.

We examined specific systems, resources, and capabilities used in OIF, extending from the heart of the joint integrated network and command and control infrastructure to the last tactical mile. The performance analyses, key conclusions, and high-level recommendations have been disseminated to relevant organizations throughout DoD.

An assessment of networked communications for tsunami relief operations and recent changes in OIF network capabilities will complete this multiyear effort.

Test and Evaluation

IDA this past year continued to participate in a wide variety of test and evaluation activities in support primarily to the Director, Operational Test and Evaluation (DOT&E), the principal advisor to the Secretary of Defense on operational test matters. With IDA's continuing support, DOT&E ensures that major weapons systems undergo operational and live fire tests and evaluations that are sufficiently realistic to determine their operational effectiveness, suitability, lethality, and survivability. In addition, IDA helps DOT&E ensure that the nation's test infrastructure is capable of supporting future weapon development.

Joint Biological Agent Identification and Diagnostic System

The Joint Biological Agent Identification and Diagnostic System (JBAIDS) is a portable and reusable biological agent identification and diagnostic system capable of identifying many biological agents simultaneously. In assessing the system's portability, IDA looked at all the material needed to support the system. While the JBAIDS analyzer and laptop are compact, the size and weight of the accompanying support equipment and consumables (shown on a forklift) affects its efficient deployment to support biological agent monitoring missions.

Land Warfare Systems

The Army Battle Command System (ABCS) refers to the systems that form the command and control infrastructure for Army echelons corps and below. IDA participated in planning the ABCS 6.4 test event, which was completed in March 2005 during the 4th Infantry Division's participation in the Joint Red Flag/Roving Sands training exercise.

Combining ABCS testing with a large-scale training event provided a unique opportunity to assess the performance of many interdependent systems and to understand

how well these systems operate together and against a threat using modern information warfare techniques. In addition, using a training event as an operational test allows for a more realistic test environment, while at the same time limiting the burden on units. IDA's analysis provided insights to support acquisition decisions for individual programs and identified significant system-of-systems issues with network planning, information assurance, and collective training that require resolution for effective employment of the command and control systems.

IDA also assisted DOT&E in analyzing the Joint Biological Agent Identification and Diagnostic System (JBAIDS) in support of a full-rate production decision. JBAIDS is a reusable, portable, modifiable biological agent identification and diagnostic system being designed to reliably identify multiple biological agents simultaneously.

Our researchers were on site when the JBAIDS Multi-Service Operational Test and Evaluation was conducted at Brooks City Base, San Antonio, Texas, and on the USS *Blue Ridge* in the western Pacific. Emerging results indicate the JBAIDS is operationally effective and suitable for land-based use but not for shipboard use because of limitations in sample preparation. We recommended that the JBAIDS footprint be reduced and the extraction kit protocol be revised to accommodate shipboard safety concerns. Although the JBAIDS analyzer and laptop are compact in size, the size and weight of the accompanying support equipment and consumables affect their efficient deployment. Corrective actions to revise sample preparation kits will require follow-on operational testing.

V-22 Operational Evaluation Onboard the USS *Bataan*

As part of our evaluation of the V-22, IDA observed all aspects of V-22 testings including operations on the USS *Bataan*. The V-22 is shown here picking up an external load from the USS *Bataan* during the operational evaluation.

IDA observed and assessed the three-month Operational Evaluation Phase 2 test of the V-22 Osprey. This work supported DOT&E's second report to Congress on the V-22 and was a continuation of our close observations of developmental testing and operational assessments leading up to the operational test itself.

IDA researchers participated in all aspects of the testing. We flew on selected V-22 missions; attended pilot briefs, debriefs, and maintenance data scoring boards; and embarked on USS *Bataan* during the shipboard testing phases. An unexpected result of the testing was the aircraft's significant improvement in reliability relative to previous testing. In addition, the safety issues are now much better understood, although there are still some uncertainties, such as stability in hard combat maneuvering and landing at night in dusty areas, that should be addressed in future testing. With the assistance of our analysis, DOT&E concluded that the V-22 is now operationally effective, suitable, and survivable.

F-22 Drops a JDAM During Operational Testing

IDA participated in the planning and evaluation of F-22A tests designed to demonstrate the aircraft's ability to deploy JDAM, as well as to demonstrate fixes to problems uncovered in the initial operational test.

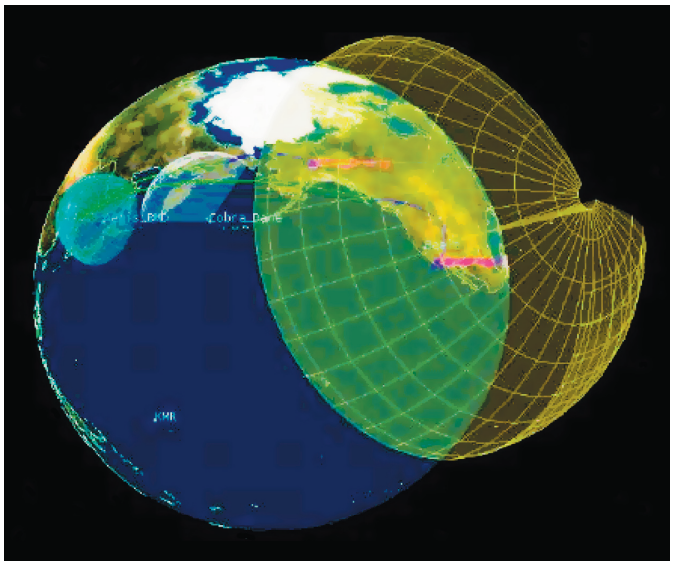
Air Warfare Systems

IDA analyzed the F-22A Raptor's performance during its initial operational testing, which was completed in late 2004. This analysis supported DOT&E's report to Congress in February 2005.

After passing this important milestone, the F-22A began two subsequent test programs: follow-on operational test and evaluation and force development evaluation. These programs were established to evaluate the ability of the F-22A to deliver the air-to-ground Joint Direct Attack Munition (JDAM), correct deficiencies uncovered in initial operational test and evaluation, and develop tactics. IDA was involved in planning these tests, and we were fre-

quently on-site monitoring test activities, which included open-air force-on-force trials against surrogate adversaries in simulated ground-attack missions at the Nevada Test and Training Range, live missile firings at White Sands Missile Range, and JDAM releases at Utah Test and Training Range. IDA will analyze the data from these trials. DOT&E's resulting report will be an important factor in approving the purchase of the next lot of F-22As.

Ballistic Missile Defense



This display shows the radar coverage (Aegis BMD (blue), Cobra Dane (white), and Beale (yellow) radar footprints) for intercontinental ballistic missiles (ICBMs) launched from North Korea (green trajectories). Interceptors could be launched from Fort Greely, Alaska, or Vandenberg AFB, California. During 2005, IDA was tasked to use existing test data to assess the integration and interoperability of this complex system. Our analysis raised issues with the individual elements of this system as well as with the validation of the models used to estimate the overall performance of the BMD system.

Strategic Warfare and Net-Centric Systems

The Missile Defense Agency (MDA) is developing the Ballistic Missile Defense System (BMDS) to defend against ballistic missiles in all phases of flight. Current emphasis is on defending the United States against long-range ballistic missiles from rogue nations such as North Korea. During 2005, IDA was asked to assess the multiple ground tests and capability demonstrations that MDA performed during the year to assess integration and interoperability. Our analyses raised issues regarding the availability of individual BMDS elements, the timeliness of BMDS elements to move from test to operational status, and the validation of models and simulations that DoD uses for performance assessment.

The Global Broadcast Service (GBS) delivers classified and unclassified video and data using either dedicated military satellites or leased commercial satellites. Its initial operational test was conducted this year using Army, Marine Corps, and Air Force units to support a full-rate production decision for the tactical ground receive suites. IDA personnel observed operations and testing at the broadcast locations in Virginia, Hawaii, and Italy, as well as at all the deployed user locations during the test.

During the GBS operational test, our researchers noted that the Army was fielding and testing a modified equipment configuration that had not been identified in the test plan and had not been incorporated into the program equipment baseline. We worked closely with the operational test agencies to ensure that this configuration was tracked separately while the program office developed a corrective plan of action, thus allowing the operational test to continue. Operational test results confirmed the utility of the GBS system but also identified effectiveness and suitability issues that will need to be resolved before the system is fielded.

Naval Warfare Systems

Over the next decade, the Navy plans to spend over a billion dollars testing the self-defense capabilities of various ship classes against anti-ship missiles. To reduce test and evaluation costs and to provide more robust testing, IDA worked with the Navy to develop the Anti-Air Warfare Ship Self-Defense Test and Evaluation Enterprise Strategy.

The basic concept is to bring the various combat system element programs (e.g., radars and missiles) along with the various ship class programs under one umbrella to coordinate and integrate their test programs. Rather than focusing on a slice of a combat system, the test would look at the end-to-end performance of the full combat system. IDA proposed the Enterprise Strategy's major components: identifying an organization to coordinate and integrate the test programs, funding and equipping an unmanned Self-Defense Test Ship, and coordinating modeling and simulation efforts. Under the Enterprise Strategy, the Navy will reduce test and evaluation costs by about $240 million over the next decade.

Live Fire Test and Evaluation

Live fire test and evaluation involves assessing the lethality of developmental and fielded munitions and missiles and the survivability of U.S. manned combat systems. One recent live fire program centers on the Small Diameter Bomb (SDB). Although the SDB has a smaller warhead than current bombs, its highly accurate Global Positioning

Live Fire of a Small Diameter Bomb

A Small Diameter Bomb is fired against a U.S. A-7 aircraft in a simulated shelter. The shelter's wall-thickness and cross-section are representative of an actual threat shelter. A major factor in the LFT&E testing is ensuring that weapon systems are tested against realistic threat targets or surrogates.

System guidance should allow it to kill its intended targets, while reducing collateral damage.

The SDB Live Fire program relies heavily on flight testing to provide data for the lethality evaluation. Traditionally, flight tests assessing weapon accuracy were conducted separately from tests of the weapon's lethality against actual targets. Combining the two test types eliminates the need for costly dedicated live fire testing, while increasing test realism. The availability of realistic targets is essential, and IDA has worked with DOT&E and the Air Force since early in the program to select realistic targets. In 2005, we observed several flight tests and documented the target damage. Also, our analysis led DOT&E to question the removal of SDB's low-airburst fusing option without adequate test and evaluation to support the decision. After flight test successes with two additional live-warhead SDBs, the Air Force decided to retain the low-airburst option, thus providing operational users with more options to engage targets.

Resource Analysis for Test and Evaluation

IDA also supports DOT&E by providing research and analyses examining DoD's test resources and technical test capabilities to ensure that they can support DoD testing requirements for current, emerging, and future weapons systems. These activities include identifying promising science and technology efforts for use in future testing; assessing investment options to meet joint test and evaluation needs; and examining test facility costs, sustaining funding needs, and user charge polices.

A major part of IDA's effort in 2005 focused on research and analysis to support DoD's implementation of a new net-centric Joint Mission Environment Test Capability. We have also conducted special studies on test infrastructure needed to support emerging weapon systems – directed energy, non-lethal, and hypersonic aerospace systems – and on potential impacts of planned closures of non-DoD test facilities and capabilities on DoD test and evaluation requirements.

This year, IDA expanded its analytic support to the new Defense Test Resource Management Center. This center was established by Congress to provide oversight of DoD's Major Range and Test Facility Base and to certify the adequacy of the various OSD and Service budgets supporting test and evaluation. Our wide-ranging support includes research and analysis of budget options, technology reviews, program and project assessments, and review of certification techniques. We have also continued to provide analytic support to the Central Test and Evaluation Investment Program and the Test and Evaluation Science and Technology Program after their transfer from DOT&E to the Defense Test Resource Management Center.

Technology Assessments

IDA provides scientific, technical, and analytical support related to identifying, evaluating, developing, and using advanced technologies for defense systems. This work involves assessments of technology feasibility, performance, producibility, demonstrations, and development risks. IDA also assists DoD in developing technology strategies, plans, standards, and investment priorities, and assessing the domestic and international implications of trade and technology cooperation, plans, and controls.

Sensors, Surveillance, and Target Acquisition

Autonomous Mine Detection Sensors

DoD's Autonomous Mine Detection Sensors (AMDS) program was established to develop an automated sensor that performs at least as well as current hand-held sensors and that is small enough to be deployed on a man-portable robot. This would allow a soldier to remain safe while a minefield is marked or cleared by the robot.

Two contractors are currently developing sensors for the AMDS program. One contractor and several universities are aiding the program by writing computer algorithms designed to automatically analyze sensor data and detect mines. IDA is assisting DoD by comparing data from the competing contractors and assessing different mine detection technologies and state-of-the-art machine learning tools.

Testing Autonomous Mine Detection Sensors

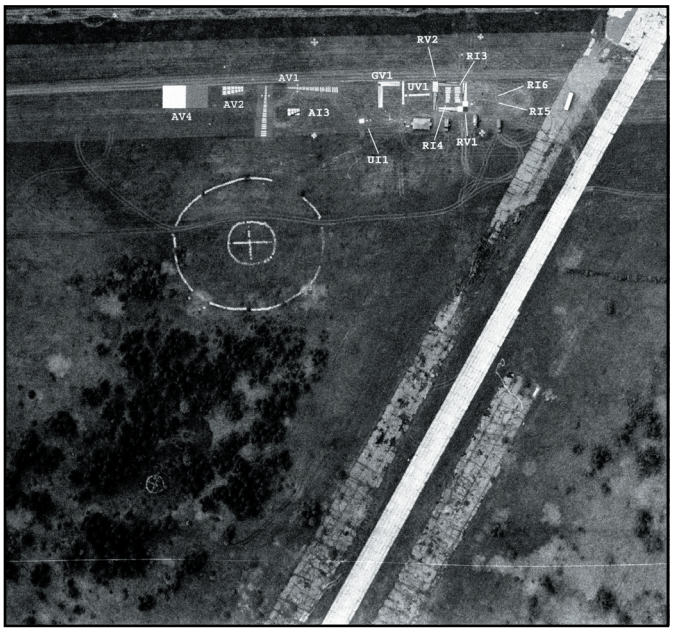
IDA's Dr. Michael May (left) and AMDS Project Engineer Mr. Brian DeGrano from the U.S. Army's Night Vision and Electronic Sensors Directorate take a break from emplacing test targets at Fort A.P. Hill, Virgina.

Open Skies Treaty

The Open Skies Treaty gives the 32 participating nations the right to fly surveillance aircraft over each other's territory with film-based, video, infrared, and radar sensors of limited and specified resolution. The process of "certifying" the sensors as treaty compliant is complex, demanding technically sound procedures for calibrating sensors and evaluating image quality.

IDA examines the capabilities of U.S. and other nations' sensors, the design of flight tests and the flight test data, and provides analytic support for related negotiations. Our researchers contributed to the treaty decisions governing the certification and use of infrared sensors and video cameras, and we are continuing in that role as the performance specifications for sensors are updated to reflect changes in technology.

Labeled Calibration Target - Open Skies Treaty



Above is an array of labeled calibration targets used in an international flight test at the Russian airbase of Shatalova, outside Smolensk. The bull's eye was drawn on the terrain to orient the pilots to the location of the targets above it in this image. The bright line (shown) is a road leading up to an airport runway (not shown).

Homeland Security Studies – Chemical Hazards

The Department of Homeland Security asked IDA to analyze the impact of chemical releases on the operation of U.S. seaports. We examined two mid-sized ports: Portland, Oregon, and Savannah, Georgia. The objective was to assess the extent to which port operations would be affected

by various chemical-release scenarios in terms of breadth of immediate impact and the time it would take to resolve an incident.

We looked at three categories of chemicals: toxic industrial chemicals, conventional chemical agents, and nontraditional chemical agents, using a computer model called Hazard Prediction and Assessment Code. For various release points around the ports, we estimated the spread and probable casualties. Our analysis directed significant attention toward the continuity of actions of emergency responders and the organizational structure and equipment. The study highlighted places where the department could invest to improve technical equipment and to enhance overall operational performance.

IDA Researchers Evaluate Rosetta Stone System

IDA staff members, Dr. Joan Cartier and Ms. Felicia Sallis-Peterson, collected data and evaluated the quality of the air picture generated by the Rosetta Stone integration system during an air defense exercise on the carrier USS *Abraham Lincoln*. Dr. Cartier and Ms. Sallis-Peterson are seated in an E2, which was flown during the exercise.

Space, Air, and Missile Technologies

Rosetta Stone

In 2005, IDA researchers participated in a Navy sea trial to assess an approach for improving the quality of the air picture displayed in the Tactical Flag Command Center (TFCC) of aircraft carriers. The Navy has implemented significant procedural and material changes that have resolved many of the communication network problems that formerly plagued shipboard operators. However, the benefits of these changes have been masked in part by limitations in the tactical display system. The sea trial was aimed at exploring a potential way to fix that problem.

The TFCC has two tactical displays for air warfare: the Advanced Combat Direction System (ACDS) and Remote Cooperative Engagement Capability (CEC). ACDS displays Link16 and local air defense radar track reports. Remote CEC provides the CEC network data via an EHF radio link from a ship accompanying the aircraft carrier – the guided-missile destroyer USS *Shoup* in this sea trial. The purpose of the experiment was to see if the two tactical pictures could be integrated into a single display system using the Rosetta Stone universal translator and optical correlation system.

IDA researchers spent two weeks underway on the USS *Abraham Lincoln*, collecting tactical data used to assess the quality of information currently being generated on the two different tactical displays in the TFCC. We found that the experimental CEC sensor netting system provided a stable backbone of tactical data that improved the quality of the picture available via Link16 alone.

New Radar Capabilities

IDA researchers have developed two new methods for processing radar returns: one using synthetic aperture radar (SAR) imagery to find minefields, and the other using high-range resolution (HRR) radar for target identification.

SAR imagery can produce returns from surface mines, but it also generates returns from many other large and small objects, including surface undulations, in the radar's field of view. We employed mathematical morphology to identify isolated mine-like returns in the SAR imagery and then developed and applied pattern recognition techniques to find patterns of returns typically associated with minefields.

For the HRR radar application, we examined the relative benefits of various means of processing the HRR returns and demonstrated the potential capability of a simple analytical method for analyzing returns to make target identification decisions.

Biological Science and Technology

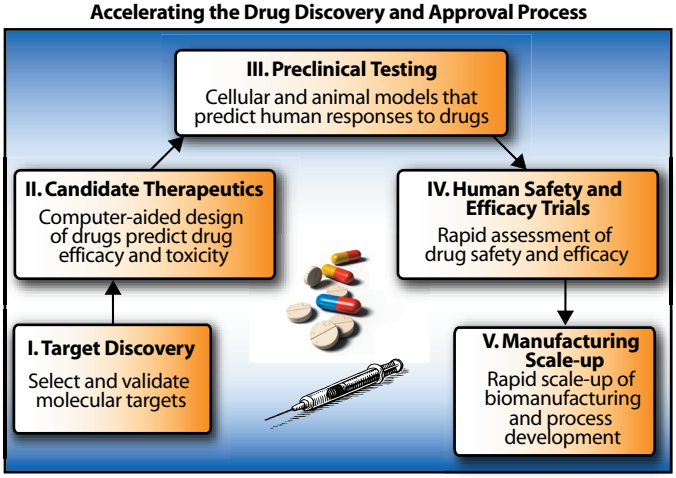
Human-Assisted Neural Devices

IDA is providing technical and analytical support for a Defense Advanced Research Projects Agency-sponsored

effort to develop a new type of upper-arm prosthetic for use by amputees. The objective is to provide the user with the full strength and dexterity of an actual arm and hand, while retaining natural size and weight. Moreover, the goal is for the prosthetic to be fully controlled by brain or nerve activity and have direct-to-brain feedback from force transducers located on the prosthetic hand. In theory, these inputs to brain sensory cortex could restore the sensation of touch and bestow a life-like quality on the prosthetic.

Since the inception of this challenging research project, IDA has provided technical assessments and evaluated the feasibility of new technologies.

Accelerating the Drug Discovery and Approval Process



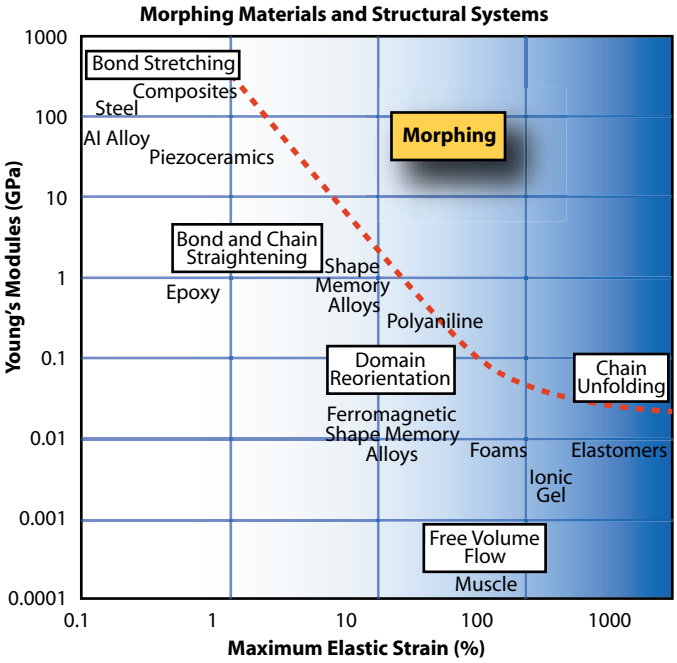
It currently takes up to 14 years for drug discovery and approval. IDA identified key capabilities and nascent technologies that, if brought to maturity, would accelerate each stage of the drug development process.

Critical Therapies

The development of new drugs is a lengthy and costly process, requiring up to 14 years and $800 million. This would be too long a wait for a needed drug or vaccine were the United States attacked with biological weapons or confronted with an emerging disease.

The Defense Advanced Research Projects Agency (DARPA) asked IDA to evaluate the technological bottlenecks in the drug development process and to identify opportunities for investment in new technologies. Our researchers identified several nascent technologies and revolutionary capabilities that, if realized, would significantly shorten the time needed to develop new drugs or vaccines. We are currently working with DARPA to initiate new programs to develop the needed technologies.

Morphing Materials and Structural Systems



Typically, it is not possible for structural load-bearing materials such as steel and aluminum alloys (upper left of the graph) to exhibit large deformations under applied loads. For vehicles to deform or change shape, a material that exhibits both high stiffness and large elongation to failure would be required. The goal of the morphing materials development project is to develop materials and devices whose mechanical, thermal or electromagnetic properties can be quickly changed over a wide range of values.

The graph shows one example of the competing material properties that may be addressed. The graph, developed jointly by IDA and the Air Force Research Laboratory Materials Directorate, plots material relative stiffness, or Young's modulus, versus the recoverable elongation as a percent of specimen length. It clearly shows that morphing is in a new regime with respect to these two material properties. The heavy dashed line represents the practical limit for today's materials.

Materials

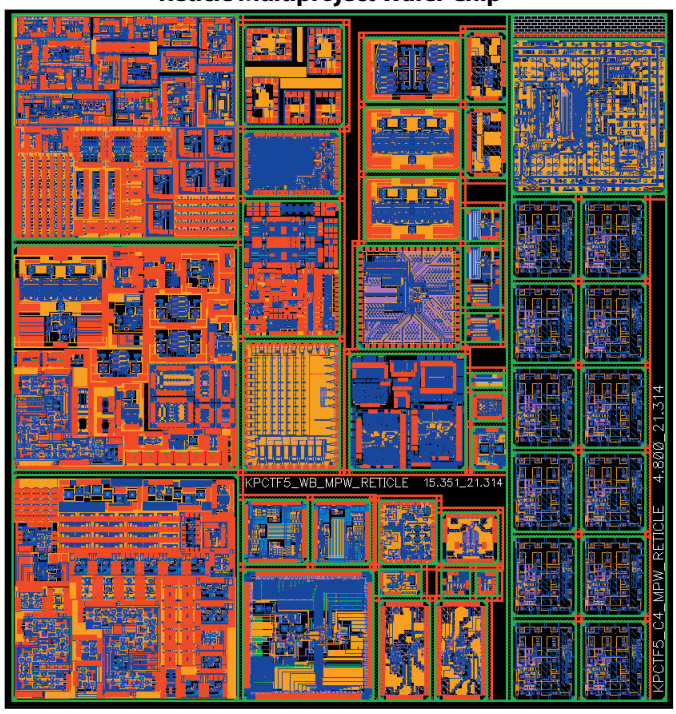
Morphing Material and Structural Systems

Morphing systems are vehicles that attain superior or novel performance through the ability to tailor their state – whether physical, electromagnetic, or mechanical – to the operational environment and missions they are performing. Materials that can change their physical properties – such as stiffness, thermal conductivity, texture, and color – are required for these morphing vehicles.

IDA has played a central role in identifying material needs across a broad range of military applications, including aircraft, ground systems and robots, missiles, propulsion and inlets, and space systems. We organized and hosted two workshops for the Defense Advanced Research Projects Agency to assess the state-of-the-art of new materials and devices whose properties can be rapidly changed by application of energy sources such as electromagnetic

radiation, light (photons), magnetic fields, or electric fields. Output from the two workshops has contributed significantly to developing technical specifications and project plans for further DoD-sponsored research on morphing materials.

Reticle Multiproject Wafer Chip



The reticle multiproject wafer chip is fabricated in the IBM Trusted Foundry.

Our researchers have played a central role in developing the underlying concepts in this area, identifying technical opportunities and providing policy recommendations. We brought together leading researchers to consider the problem of trusted ICs. The result of this IDA-run workshop helped DoD identify directions for research investment. Currently, IDA researchers are examining acquisition policies appropriate for "trusted suppliers" and management approaches for dealing with the risks associated with using technologies and products from off-shore sources.

In a separate study of microelectronics supply chain vulnerabilities and threat opportunities, we examined design and manufacturing processes and found a number of feasible methods that an adversary could employ to tamper with products. We highlighted examples of microelectronics failures that could seriously jeopardize communications, intelligence, and other operational capabilities, and showed how deliberately induced failures could be made to appear accidental, complicating threat assessments.

In conducting this analysis, we postulated hypothetical attacks and took account of known flaws and potential new types of defects that could be introduced into integrated circuits. Our researchers concluded that the DoD microelectronics supply chain is vulnerable to adversary threats, and that similar vulnerabilities exist in other government departments and agencies.

Computer and Information Technologies

Trusted Integrated Circuit Strategy

The global technology and manufacturing base for integrated circuits (ICs) – which are critical components in many defense systems – has changed significantly. Domestic fabrication sources of advanced semiconductors are in jeopardy, as a variety of technical and economic pressures have reduced both on-shore suppliers and those that are focused on supporting defense systems.

DoD has been developing strategies to address this concern. Initially, it articulated why the continued availability of domestic sources for ICs would be important for U.S. national security. This led to the concepts of trust and of "trusted supplier," which is a manufacturer that can be depended on to provide services or products that are free of exploitation, to protect confidentiality, and to maintain availability or integrity. As a tangible consequence of this policy, DoD initiated the Trusted Foundry Program, which establishes a long-term agreement with a leading U.S. integrated circuit manufacturer.

National Information Assurance Program

The National Strategy to Secure Cyberspace, issued in February 2003, called for the federal government to conduct a comprehensive review of the National Information Assurance Partnership (NIAP), an initiative to meet the security testing needs of both information technology (IT) consumers and producers.

IDA was asked to conduct this review, which placed particular emphasis on DoD and Department of Homeland Security critical infrastructure issues and concerns with respect to cyber security. We also examined the policy and support infrastructure, as well as the IT system development and acquisition processes.

The review evaluated findings against the overall NIAP program goal of increasing security of the IT infrastructure by making products available that users will trust. We recommended formalizing the partnership in order to stabilize funding and improve oversight, and integrating and modernizing the product evaluation process. The IDA study provided six options for moving forward and recommendations for actions in the near, mid-, and long term.

Global Positioning System Assessments

Left: The antenna farm on one of the GPS II-R satellites is inspected during checkout.
Right: The GPS II-R satellite gets its final wrapping in preparation for shipping to the launch facility at Cape Canaveral, Florida.

Technology Planning and Strategy

Global Positioning System Assessments

For the last eight years, IDA has been reviewing various issues related to the Global Positioning System (GPS) for DoD. Our Independent Review Team (IRT) examined approaches for getting new civil and military GPS signals, reviewed the proposed roadmap leading to a future GPS III system, and recommended spectrum locations for the second and third civil frequencies and a new signal structure for the military.

We also have been helping the Federal Aviation Administration on GPS-related matters. For example, we examined the expected performance of the Wide Area Augmentation System that provides increased accuracy and integrity of GPS service for users with appropriately enabled equipment.

The IDA team continues to study all phases of the GPS system. Most recently, we assessed the performance requirements for the GPS III system and analyzed ways to implement new operational capabilities into the GPS Control Segment.

Independent Assessments for Combatant Commands

For many years, IDA has been running Independent Strategic Assessment Groups (ISAGs) to support U.S. Northern Command, U.S. Strategic Command, and Air Force Space Command, and their predecessor organizations. The ISAGs provide assessments and advice regarding the capabilities necessary to address long-term strategic issues.

Some recent work in support of U.S. Nothern Command has included:

- Reconnaissance and surveillance technologies. We evaluated passive and active technologies for tracking and identifying airborne vehicles, ranging from cruise missiles to civilian commercial aircraft.
- Integrated missile defenses. IDA examined the plans for fielding of the missile defense initial operating capability systems and follow-on spirals.
- Organizational and policy issues. We focused on the composition of the joint functional component command structure, on Northern Command's continued organizational maturation, and on options for a new NORAD agreement.
- Intelligence support. We examined the current sources of intelligence information available from other government agencies and what would be needed in the future to contribute to NORAD/Northern Command's operational tasks.
- Reserve forces and civil agencies. We conducted on-site visits in Michigan and Texas to talk with emergency management leaders about their processes and capabilities. We also talked with key state and executive branch officials to glean lessons learned from the Katrina and Rita hurricane experiences.

In a joint project for all three commands, an IDA team examined the effects of future net-centric systems on current Cheyenne Mountain Air Force Base operational tasks and missions and estimated the impact on the tactical warning/attack assessment process.

The Space Command ISAG continued to address organizational, provisioning, and acquisition issues. This year, the work focused primarily on assisting Space Command in establishing the space situational awareness community-of-interest pilot program, examining potential near-earth platforms and sensors, and identifying technologies that could potentially be used in prompt global strike operations.

Technology Readiness Assessments

DoD requires that acquisition programs prepare a Technology Readiness Assessment (TRA) in which key subsystems are evaluated for their technical maturity. The largest programs must submit these assessments to OSD for review at major milestones in the program.

IDA has helped write the guidance employed by the Services and agencies for conducting their TRAs, reviewed reports on major programs in support of OSD milestone decisions, and summarized these results for a DoD report to Congress. In 2005, we published the second edition of the TRA Deskbook and reviewed about 10 TRAs. Our researchers also developed and conducted TRA training, gave several invited talks, and co-authored papers.

Defense Science Study Group

Defense Science Study Group members being briefed on operations at the National Training Center, Ft. Irwin, California.

Defense Science Study Group

The Defense Science Study Group (DSSG) was established 20 years ago to introduce emerging leaders of science and technology to the technical dimensions of national security issues and to give them an appreciation for the people and operations involved. The DARPA-sponsored program provides members – a typical class has about 17 academics – with an overview of the systems, missions, and operations of the armed forces and the intelligence community, and encourages them to continue their involvement in research related to national security matters. Senior mentors and advisors work with the members by providing perspectives on defense issues and helping with research projects. Alumni of the program have participated in many DoD advisory committees and study groups, and some have chosen to become engaged full time in defense technology matters.

The ninth DSSG class completed the final year of its two-year program in 2005. After traveling to many U.S. military bases and defense industry facilities in 2004, members this year visited the National Reconnaissance Office, National Security Agency, Army Medical Research Institute of Infectious Diseases, Defense Threat Reduction Agency, National Training Center, Department of Homeland Security, and the Lawrence Livermore, Sandia, and Lawrence Berkeley National Laboratories. At the final session, members presented the results of their research studies and were briefed by representatives from government study boards, who provided an overview of their various activities, future projects, and how DSSG alumni can participate.

International Tech Planning and Controls

Critical Technologies Support

For more than 25 years, IDA has assisted DoD by providing technical and analytic support for U.S. participants involved in international negotiations on export controls, most recently the multilateral Wassenaar Arrangement on export controls for conventional arms and dual-use goods and technologies. This year, our researchers supported the U.S. delegation in preparatory meetings in Washington and on-site in Vienna, Austria, at Expert Group and Intersessional Meetings.

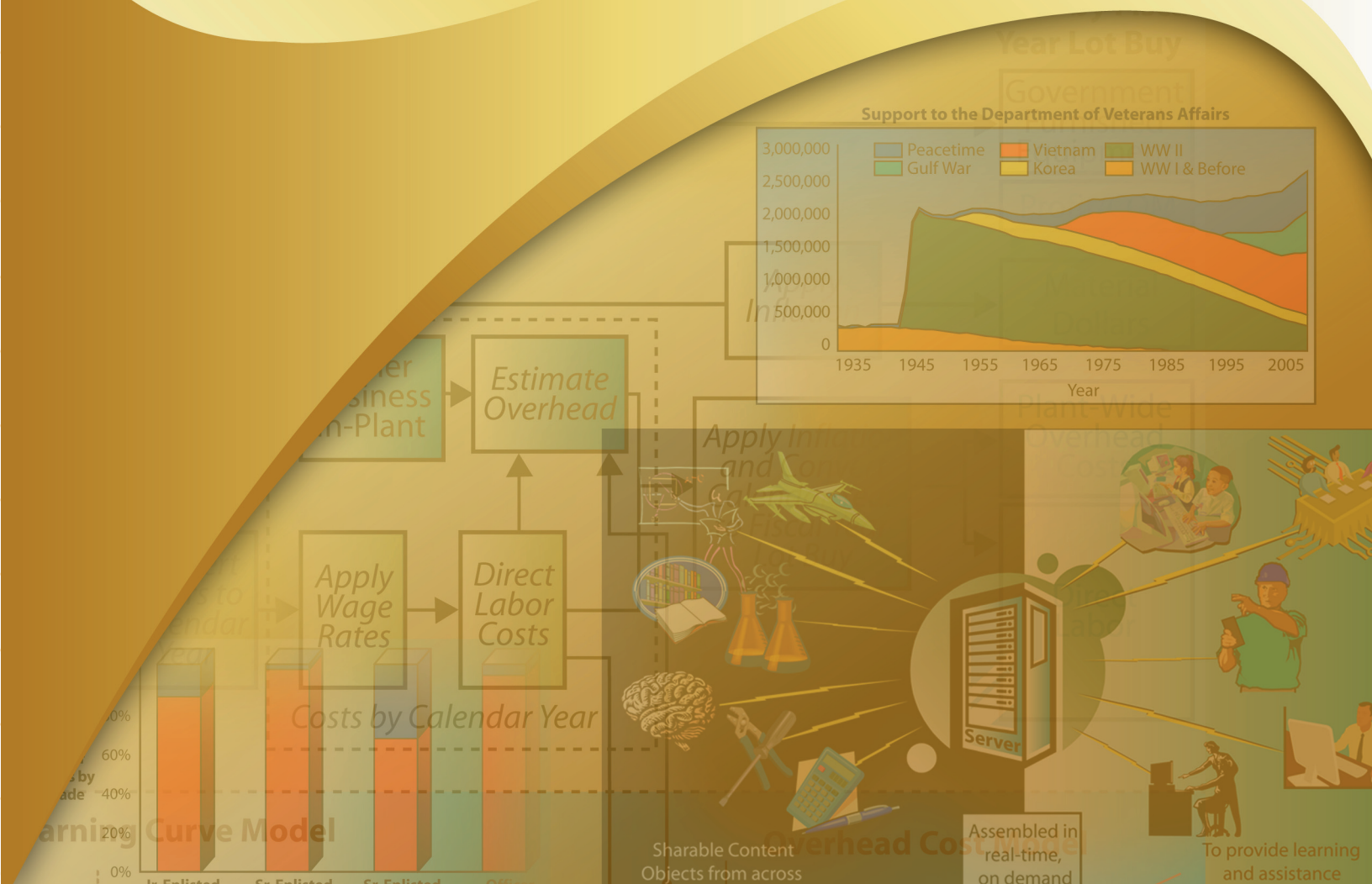
Our researchers played a key role in a number of proposals that were accepted, including:

- A modification to the controls on magnetorheological finishing machines.
- Controls on underwater electric field sensors, a proposal initiated by IDA and supported by DoD.
- A proposal to relax controls on certain epitaxy equipment.
- New controls on high performance computers.

We also were involved in assessing a number of complicated proposals that did not reach consensus but set the stage for further discussion in next year's review. For example, we provided an extensive update of possible controls on laser technologies. Although more work remains, our researchers made significant progress in identifying key issues related to controlling lasers and laid the groundwork for future resolution.

Resource and Support Analyses

IDA develops methods and models for estimating the costs to develop, test, procure, operate, and support defense forces and systems. We apply these techniques when evaluating the resource consequences of defense policy, planning, programming, and acquisition decisions. Our work improves the understanding of the cost implications of pending decisions and leads to better tools and methods for addressing resource issues. IDA also examines infrastructure and support activities, including the military health care system; the military and commercial suppliers and technology base; the training establishment; environmental technologies and plans; naval and air warfare; strategic systems and missile defense; mobility systems; command, control, communications, computers, intelligence, surveillance, and reconnaissance systems; space systems; and information and computing systems. Our research helps DoD set force and inventory levels, identify suitable concepts for system employment in wartime, and choose among alternative weapon systems.



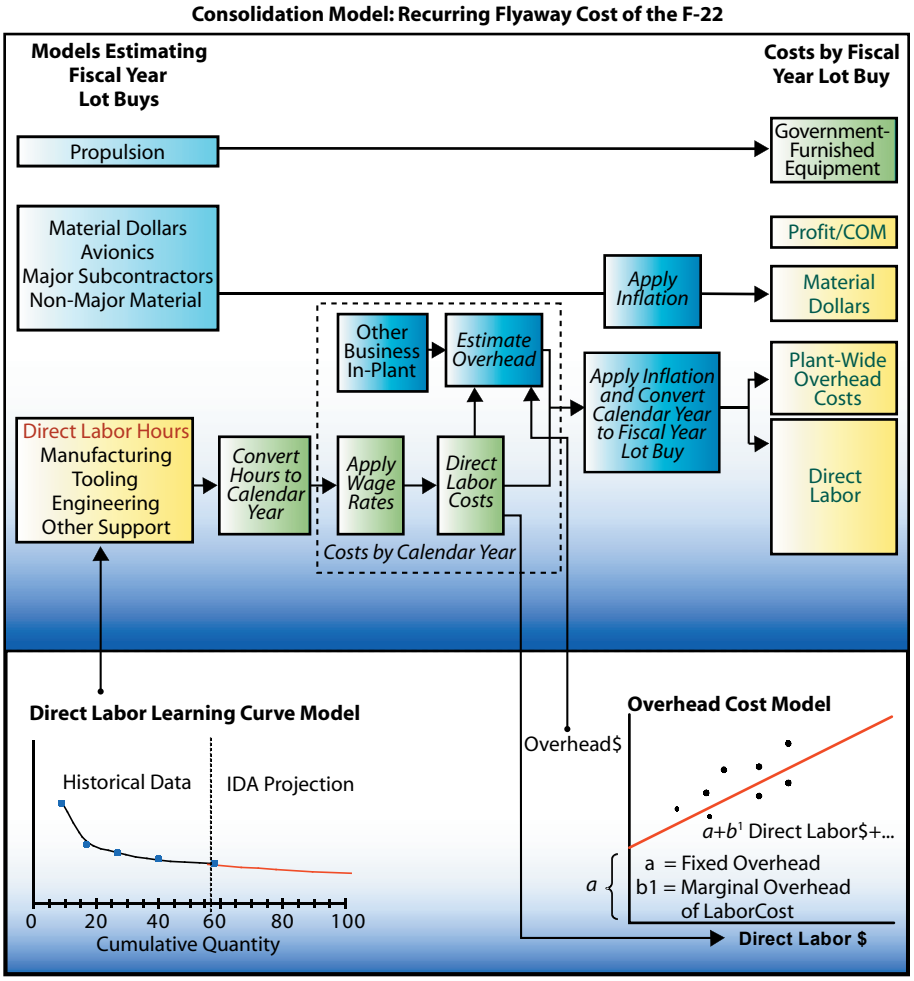
Cost Analyses

F-22 Independent Cost Estimate

In 2004, DoD asked IDA to conduct a congressionally mandated study of the cost of completing engineering and manufacturing development for the F-22 program and to determine how many aircraft could be procured with both the DoD and the congressionally imposed procurement cost constraints then in effect.

When the study began, DoD planned to purchase 275 F-22 aircraft. In late 2004, the F-22 program was cut by $10.5 billion, and the number of aircraft to be procured went down accordingly. This decision – implemented in Program Budget Decision 753 – created a third budget cap that the IDA study was asked to address.

Our researchers developed learning curves – which relate unit costs to the cumulative quantity of aircraft produced – for more than 75 cost categories and components, using statistical techniques and data from completed F-22 production. IDA developed a Consolidation Model to bring the learning curve modules and factored cost elements together into a single cost estimate for recurring flyaway costs. The model takes into account the economics of the aircraft production facilities, including fixed and variable portions of overhead cost. These overhead effects are important when estimating the consequences of variable aircraft production rates.



In estimating future F-22 costs, IDA employed learning curves as the core analytical tool. Learning curves relate unit costs to the cumulative quantity of aircraft produced. IDA estimated learning curves for multiple cost categories and components (more than 75 in all) using statistical techniques and data from completed F-22 production. The Consolidation Model brings all of the learning curve modules and factored cost elements together into a single cost estimate for recurring flyaway costs. The Consolidation Model takes into account the economics of the production plants building the aircraft, including fixed and variable portions of overhead cost. These effects are important when estimating how cost changes with the different production rates in the scenarios examined.

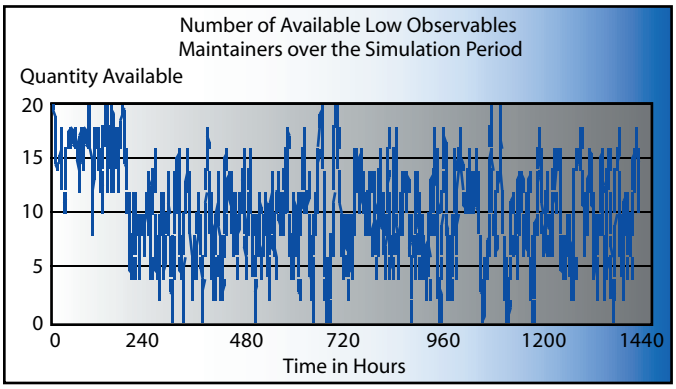
F-22 Operating and Support Cost Data Collection and Estimating

To support the Quadrennial Defense Review, IDA was asked to collect actual F-22 operating and support (O&S) cost data for 2004 and 2005 and to use the data to help estimate the O&S costs at maturity.

Our researchers also examined historical fighter cost drivers, with particular focus on manpower needs for maintenance related to the low-observable features of modern aircraft.

To estimate the maintenance manpower needs, we updated the IDA Manpower Estimation and Sortie Utilization Rate Evaluation (I-MEASURE) simulation. This unique model allows us to assess maintenance manpower requirements at a level of aggregation appropriate for cost analyses and without the detailed inputs needed for most maintenance manpower simulations. The critical outputs of the model are the sortie generation rates and maintenance staffing requirements by type of maintenance career field.

F-22 Low Observables Maintenance Personnel



The I-MEASURE model demonstrates how the number of available Low Observables (LO) maintainers changes during the simulation period. LO repair requirements for the F-22A determine an important portion of the direct maintenance staffing because the LO finishes and material sometimes need to be repaired or penetrated to access hardware repairs of non-LO systems, and the subsequent LO repair process can be demanding and lengthy. This graph, along with maintainer utilization rate and sortie generation rate, is analyzed to determine if LO manpower should be increased or decreased.

Contingency Operations Support Tool

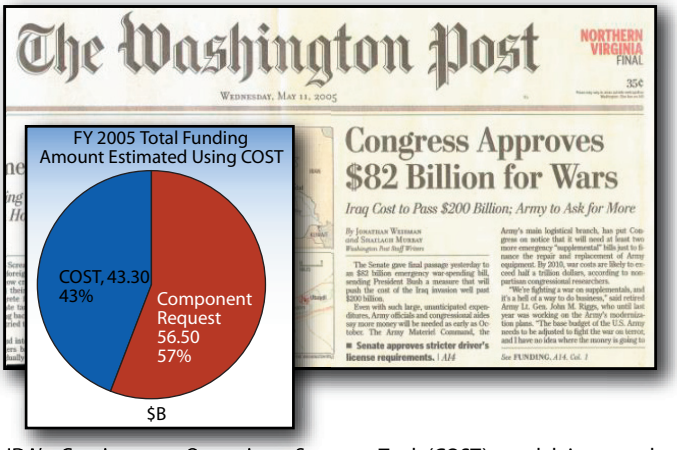
IDA developed the Contingency Operations Support Tool (COST) to provide DoD with improved methods and a common platform for estimating the cost of contingency operations. COST can be used to create an initial estimate in the early stages of planning when relatively little is known about an operation, followed later by more detailed estimates as additional information becomes available.

COST has three modules:

- Estimate – allows users to estimate the incremental cost of specific contingency operations based on information entered about the timeline, locations, and forces (units, equipment, and personnel) involved.
- Analyses – allows users to compare selected estimates using a variety of metrics focusing on aggregated deployment data.
- Reports – allows users to select from a number of comprehensive reports detailing estimated costs by Service, appropriation, phase of the operation, month, etc., including a detailed deployment summary for documenting user inputs.

Through the summer of 2005, DoD had used COST to develop more than $150 billion of supplemental funding requests. In addition, DoD's Financial Management Regulations mandate the use of COST as the common estimating platform for reimbursement of war-related costs, and COST is one of the two automated systems used by DoD to plan and execute joint contingency operations.

Contingency Operations Support Tool



IDA's Contingency Operations Support Tool (COST) model is now the common estimating platform for reimbursement of Service and agency war-related costs. In FY2005, COST was used to estimate 43% of the total funding requirement. (The remaining 57% represented advance funding requests from the military Services and requests from the State Department.)

Evaluation and Forecasting of TRICARE Program Costs

The DoD medical budget has been rising dramatically and is projected to reach $50 billion by 2015 from its current level of $31 billion. The growth largely reflects increases in the quantity of health care DoD buys from the private sector and increases in the prices paid for it. To improve the accuracy of future budget estimates, IDA was asked to provide an independent estimate of the costs of private-sector care that DoD will buy between 2007 and 2013.

IDA's analysis focused on the primary causes of rising purchases of private-sector health care: the large mobilizations of National Guard and Reserve members due to the wars in Iraq and Afghanistan and the increasing numbers of military retirees who have dropped their private insurance and enrolled in TRICARE Prime, the military health system's health maintenance organization option.

IDA analyzed the insurance choices, utilization trends, and costs per unit of service (inpatient, outpatient, and prescriptions) for beneficiaries under age 65. Using data from DoD surveys, supplemented with civilian-sector surveys and economic data, our researchers forecasted the effects of increases in private health insurance premiums, deductibles, and co-pays on private-sector care costs in 2007-13. Compared with recent trends, our estimates indicate that

growth in DoD payments for private-sector care will abate somewhat; however, it will continue to outpace the growth of health care costs in the civilian economy.

We also estimated the savings to DoD from proposed increases in TRICARE fees. We found that unless TRICARE premiums, deductibles, and co-pays are indexed to the growth in private insurance premiums, private-sector care costs will continue to grow more rapidly than the U.S. average.

Proportion of SAFETY Act Applications by Firm Size	
Annual Revenue ($M)	Percentage of Applications
$10,001+	24.51%
$5,001 - $10,000	5.88%
$1,001 - $5,000	12.75%
$501 - $1,001	6.86%
$201 - $500	3.92%
$0 - $200	46.08%

Almost half of the firms applying for protection under the SAFETY Act are relatively small (revenues of $0–$200 million annually), and about 25% have annual revenues exceeding $10 billion.

Acquisition Planning and Resource Management

SAFETY Act

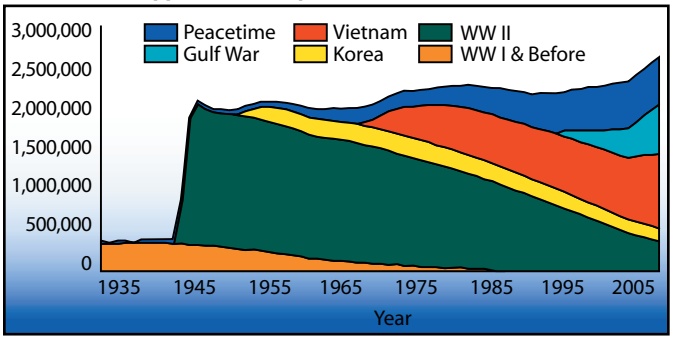
The magnitude of legal actions following the terrorist attacks on September 11, 2001, led to the concern that development of future technologies needed for homeland security could be impeded by the liability risks to the corporations that develop and sell anti-terrorist products. To address that concern, Congress passed the Support Antiterrorism by Fostering Effective Technologies Act of 2002 (SAFETY Act), which helps ensure that appropriate technologies are deployed in the war on terrorism by limiting the legal liabilities of the developers. The Department of Homeland Security asked IDA to assist in implementing a program to carry out the provisions of the SAFETY Act.

Applicants seeking the protections of the SAFETY Act for their technologies begin the process by submitting an Internet-based application at *www.safetyact.gov*. The completed applications contain information concerning the specifics of the technology, the intended use of the technology, the liability environment, and selected financial information. IDA constructed a peer review evaluation process that evaluates each application against the technical and economic criteria specified in the law. Experts drawn from IDA, other Federally Funded Research and Development Centers, the federal government, and academia serve as reviewers of the applications for SAFETY Act protections.

As of November 2005, the Office of SAFETY Act Implementation had received 123 full applications and 255 pre-applications. Of the 123 full applications, 31 have been granted Designation and Certification; 16 have received Designation only; and 15 have been denied or withdrawn by the applicant. The remaining applications are either actively undergoing review or awaiting a response to a request for further information from the applicant.

This past year saw an increase in the numbers of pre- and full applications. Technologies used in agent/object detection represented almost 40% of the total, mostly biological and chemical detectors and personnel screening devices.

Support to the Department of Veterans Affairs



In 1945, a large influx of World War II veterans dramatically changed the composition of veterans receiving disability compensation claims from the Department of Veterans Affairs. Over time, veterans from the Korean, Vietnam, and Gulf wars have begun receiving disability compensation. Now, WW II veterans comprise less than 15% of all veterans receiving disability compensation.

This change has had a large impact on the types of disability claims received by the VA and the corresponding monetary awards. WWII veterans filed claims for a variety of disabilities, including anxiety disorder, impaired hearing, flat feet, and traumatic arthritis. In contrast, for Vietnam era veterans, a large portion of disability compensation claims are for post-traumatic stress disorder.

Over time, court rulings and legislative actions have contributed to changes in the types of disability claims received by the VA. For instance, in 2000, Congress passed legislation making adult onset diabetes mellitus presumptive for all Vietnam veterans who served in-country. This has resulted in a large number of disability compensation awards for diabetes to Vietnam-era veterans.

Support to the Department of Veteran Affairs

In December 2004, *The Chicago Sun-Times* ran a series of articles about the large disparity among states in disability compensation payments to veterans. In response, the Department of Veterans Affairs (VA) Inspector General reviewed the observed state variances. The review concluded that the factors influencing disability compensation payments are complex and intertwined.

The VA asked IDA to determine the major factors that contribute to disability compensation payments. The results will improve the VA's understanding of the causes of the observed variances by state and region and help determine if corrective actions are required.

Systems Engineering in the New Acquisition Environment

Systems Engineering is an interdisciplinary, technical effort through which systems and processes are simultaneously defined and developed to satisfy capability needs. In 2005, DoD issued additional guidance for the institutionalization of systems engineering. IDA continued its longstanding analytic support for the Systems Engineering Office, focusing this year on the quality management aspects of systems engineering, which included:

- Development of the Quality Management Roadmap, including improving quality management activities by acquisition program offices and quality assessment and oversight activities.
- Development of guidance on quality as a design consideration and quality management for inclusion in the Defense Acquisition Guidebook.
- Development of quality management questions for the Technical Review Templates to be used on acquisition programs.

Telecommunications in a Net-Centric Environment

This year, the Defense Information Systems Agency began transitioning to a new, net-centric information technology approach called DISN Subscription Services. Before, the agency had in place 15 different price structures to recover telecommunications expenditures in support of global customer needs. DISN customers were faced with more than 40,000 different prices when they attempted to determine their costs. To simplify the pricing structure and to encourage customers to share data, DoD initiated the Subscription Services methodology in FY 2006.

To assist in this transition, IDA produced an automated database tool to analyze subscription data. The tool allows users to develop a series of alternate scenarios and determine funding outcomes. IDA also prepared a publication outlining the development, implementation, and execution of DISN Subscription Services. The document, along with the database, will assist customers in understanding the new concept.

National Defense Stockpile Analyses

Since the 1940s, the United States has maintained a National Defense Stockpile of strategic and critical nonfuel materials. DoD is required to submit biennial reports to Congress stating the amounts of material that the stockpile should contain. IDA has been doing the analyses and preparing these reports since 1988.

Our process involves first determining the strategic and critical materials required to support military and essential civilian economic activity in a national emergency. We then compare these material demands against estimated material supplies. Shortfalls, if any, become recommended stockpile amounts. The process involves several IDA-developed mathematical models and uses databases from a number of sources, including the Departments of Defense, Commerce, State, and Interior. IDA's analyses have determined that for many materials there are no shortfalls. As a result, Congress authorized the sale of more than $5.5 billion of stockpile inventory.

DLA Supply Center Systematic Issues

The Defense Supply Center Richmond, in conjunction with Headquarters, Defense Logistics Agency (DLA), is trying to improve the efficiency and effectiveness of the engineering support that the military Services provide to DLA. IDA has supported this effort, addressing two major engineering support issues: the misuse of First Article Testing as a method of improving the quality of weapon system repair parts, and the limitations of the engineering support communications system that is employed to request and obtain the needed engineering support services.

IDA's analysis of the First Article Test issue has examined and described, for the first time, the dynamics of that process. As a result, a joint ad-hoc DLA-military Services committee has been formed to address the IDA recommendations and related issues.

IDA's system analysis of the engineering support communication system has resulted in the development of a new and expanded procedural approach to engineering

support communications. This approach is being manifested in an IDA-developed engineering support training course for the DLA Training Center.

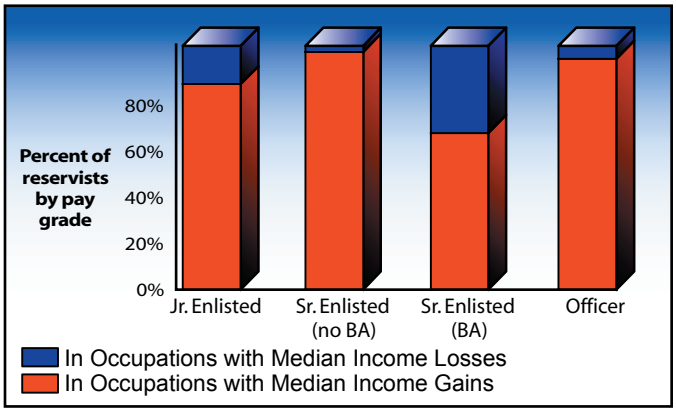
Training, Readiness, and Personnel Issues

Income Gains and Losses of Mobilized Reservists

In recent years, reservists have been called to active duty in large numbers and often for long durations. These activations put reservists at risk of losing income – with potentially serious consequences for recruiting and retention. IDA was asked to determine if typical (median) reservists in 270 different civilian occupations tend to suffer income losses or experience income gains – partly due to advantageous tax treatment and pay received while in areas of hostile fire – from being called to active duty.

We found that income losses are not widespread and are likely to be concentrated in a small group of occupations, such as physicians, engineers, and other professionals. The typical reservists in most civilian occupations – representing a large majority of reservists – gained income while on active duty. Senior enlisted personnel without bachelor's degrees were more likely to experience income gains than junior enlisteds, senior enlisteds with bachelor's degrees, and officers. Occupations with median earnings losses for officers included physicians and surgeons, lawyers, and dentists. Occupations with median earnings losses for senior enlisted personnel with bachelor's degrees included various types of engineers, managers, and other professionals.

Reservist Gains and Losses



Analyzing 270 different civilian occupations, IDA examined the percentages of reservists in occupations with median earnings losses and gains. In most occupations—representing a large majority of reservists—median civilian earnings were less than median military incomes while on active duty. Median income comparisons cannot tell us the actual percentages of reservists who experienced losses or gains when called to active duty. The results are clear, however, that income losses are not widespread and suggest that losses are likely to be concentrated in a small group of occupations (e.g., physicians, engineers, and other professionals).

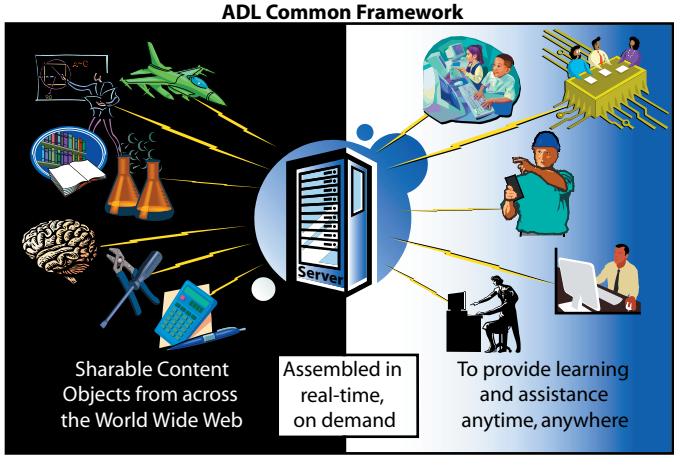
Training Superiority

As advanced technology is proliferated globally, the critical difference between success and failure in military operations may increasingly depend on effective human performance. Effective performance alone will not ensure operational success, but its absence can lead directly to failure. The human performance needed for successful military operations must be developed through training.

Some past developments have produced "revolutionary" increases in training capability and some are likely to do so in the future. The military value of these improvements is substantial, but significant investment and focused effort is often required to identify, develop, and demonstrate this potential. This is the purpose of the Defense Advanced Research Projects Agency's Training Superiority program.

IDA is helping DARPA identify and develop training advances of sufficient impact to provide a decisive edge in the conduct of military operations through their enhancement of human performance.

ADL Common Framework



The ADL initiative is based on the view of future education, training, and performance aiding illustrated here. This view, or "vision," keys on three main components: (1) a Global Information Grid—currently the World Wide Web—shown on the left side of the figure, which provides an infrastructure populated by reusable instructional objects; (2) a Server, shown in the middle of the figure, which locates and then assembles instructional objects into education, training, and/or performance aiding materials tailored to user needs; and (3) Devices, shown on the right side of the figure, which may be carried or worn, and serve as Personal Learning Associates that deliver education, training, and performance aiding to users anywhere, anytime.

Advanced Distributed Learning

The Advanced Distributed Learning (ADL) initiative responds to DoD's desire to transform Defense training. IDA is helping to identify, develop, implement, and assess advanced learning technology, with the goal of making training, education, and performance aids available anytime, anywhere.

IDA has guided collaborative development of a common framework and specifications for ADL through partnerships

with military components, other federal agencies, academia, and information technology companies. The specifications are expressed as the Sharable Content Object Reference Model, which is being adopted by military (including NATO/Partnership for Peace), industrial, and academic organizations in the Americas, Europe, Asia, and the Pacific Rim as a means of ensuring interoperability and standardization.

IDA also is providing technical leadership for the Content Object Repository, Discovery, and Resolution Architecture and ADL-Registry initiatives that are being undertaken in cooperation with the Corporation for National Research Initiatives. This program is seeking to ensure locally controlled, globally accessible instructional objects.

IDA is also responsible for technical leadership and oversight of the ADL Co-Laboratory network, in which the Services, the combatant commands, the Joint Staff, other defense components, other government agencies, industry, and academia collaborate in developing, testing, and certifying interoperability specifications, content repositories, and content registries for sharable learning content objects. In doing so, IDA synchronizes and integrates the technical efforts among all members of the Co-Laboratory network.

Our researchers design, organize, and oversee the national and international "Plugfests," which assess the practicability of ADL specifications, record developer experiences in implementing them, and help ensure training interoperability between U.S. military Services and among those of allied nations. Through the Co-Laboratories, IDA also provides technical assistance and testing support to the Joint Knowledge Development and Distribution Capability, Joint Assessment and Enabling Capability, and Joint Forces Command in efforts to effect DoD Training Transformation.

Training Transformation

The central goal of Training Transformation (T2) is to enhance the capability of joint force operations through improved individual and collective training. IDA has been helping the Office of the Undersecretary of Defense for Personnel and Readiness to perform the first assessment of the T2 program. This report covers T2 from inception in 2003 to December 2005. It addresses both individual and collective training. The assessment focuses on how well T2 is improving joint force readiness by aligning education and training capabilities and resources with combatant commander needs.

IDA helped develop an evaluative structure that identifies the following key attributes of a successful T2:

- Focusing on the right skills/tasks/learning. We seek to answer the question: Is the right material taught and is it learned?
- Training the right audience. This includes all echelons of all organizations, including the reserves, support organizations, and non-DoD organizations.
- Providing flexible, adaptive, and timely training. If circumstances change, the training system should quickly adjust. In addition, people and units should be taught to adapt to the unexpected.
- Providing training efficiencies. As training gets more efficient, DoD can afford more of it, as well as other means of improving operational effectiveness.

The assessment found that T2 has made progress with respect to all of the attributes. Examination of a sample of major exercises found that 98% of combatant command-identified mission-essential tasks were addressed. Also, timeliness has been improved. In the sample examined, the amount of time it takes to set up a major exercise has been reduced by 32%.

Despite its progress, the program could benefit from some reorientation. Greater emphasis on flexibility, adaptability, and assessment would be particularly valuable. Additional focus on enhancing the efficiency of individual training could yield significant payoffs.

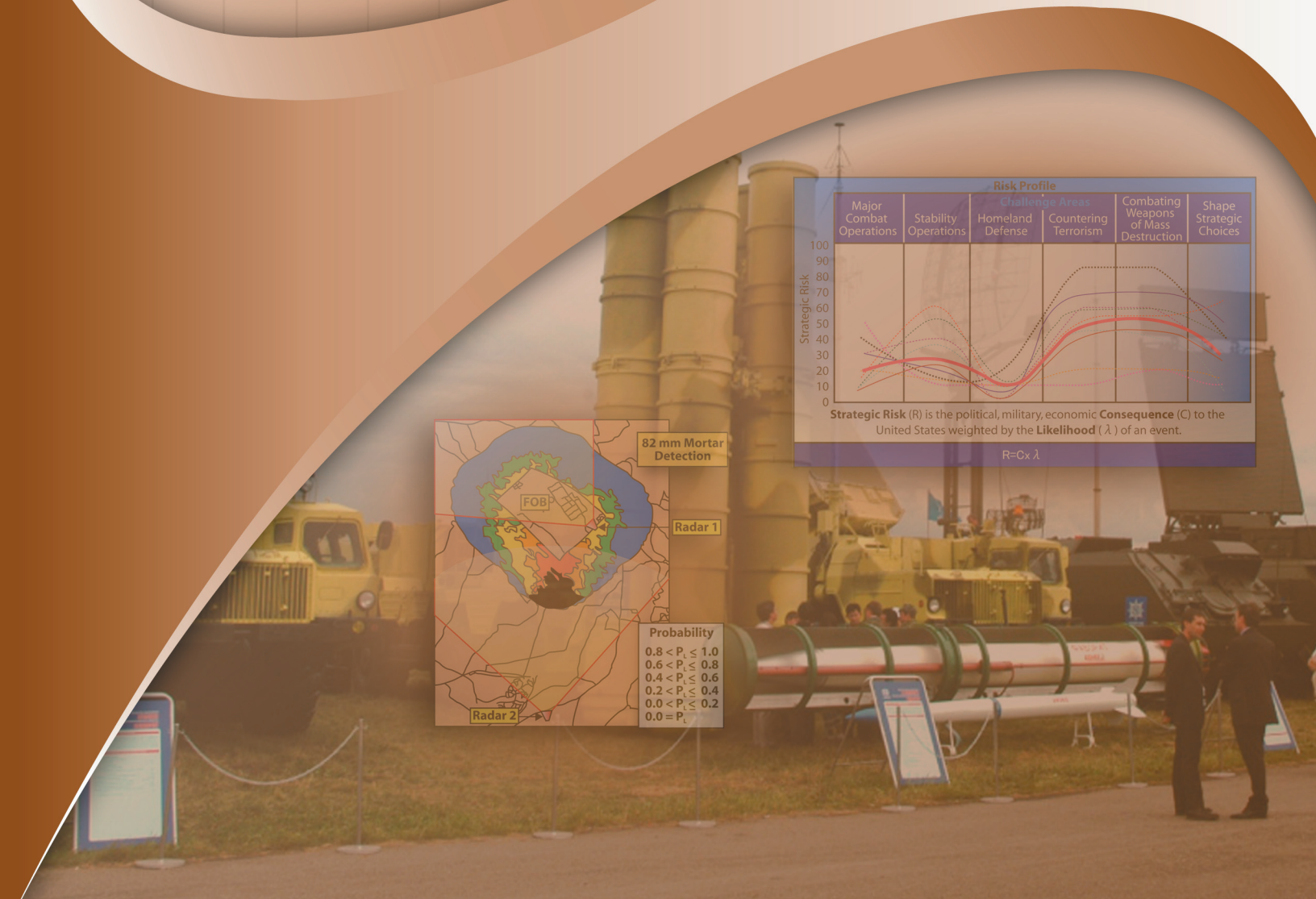
Human Systems

DoD's Training Transformation Initiative is aimed at preparing forces to learn, improvise, and adapt to rapidly evolving and unanticipated threats. To support this initiative over the longer term, DoD wants to ensure that science and technology (S&T) efforts that underpin training transformation are given appropriate priority.

The Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs provide innovative adjuncts to more traditional sources of S&T support. Through workshops and comprehensive review of reports and briefings, our researchers are analyzing 1999-2004 training and education SBIR/STTR projects, identifying promising human systems S&T efforts for potential support under the Training Transformation Initiative, and recommending future SBIR/STTR funding priorities.

Force and Strategy Assessments

The security environment of the United States continues to evolve with the appearance of new and unpredictable threats. Weapons of mass destruction, information warfare, and terrorism are among the increased challenges that the United States expects to face in the 21st century. To address these threats, the Department of Defense has given higher priority to areas such as air and missile defense, chemical and biological defense, and information assurance. IDA is helping DoD analyze the implications of these changing priorities for force structure and readiness, and to develop new plans, programs, and strategies. Our researchers have developed unique expertise to help evaluate and implement new technologies, operational concepts, and force and support capabilities. IDA's work is a key input to the Department's efforts to transform its forces for the future, while modernizing existing systems and preserving near-term readiness.



Irregular Warfare Planning and Experimentation

Defeating Improvised Explosive Devices

Improvised explosive devices (IEDs) have produced most of the recent battle casualties among U.S. and Coalition forces in Iraq and are the weapon of choice of terrorists worldwide. In 2005, the Joint IED-Defeat Task Force asked IDA to review existing DoD organizations and processes established to defeat the IED threat and to identify opportunities for improvement.

IDA formed a team of more than 30 researchers from six research divisions, including the military component of IDA's Joint Advanced Warfighting Program (JAWP). The study's main source of information was the IED-Defeat community itself – from soldiers and Marines in the field to home-based organizations supporting their efforts.

The team formed task groups that focused on functional dimensions of the IED challenge. JAWP's senior military officer led a team of military and civilian analysts in Iraq for five weeks that collected warfighters' perspectives throughout the region, ranging from headquarters to combat patrols. A complementary effort in the United States visited training installations and gathered insights from recently returned veterans. Other teams addressed the following:

- The adequacy of IED training programs.
- The intelligence community's support to the warfighter.
- The process for identifying, developing, and rapidly fielding new counter-IED technologies.
- The process for developing and disseminating new IED-defeat tactics.
- The process for tracking and analyzing operational performance in order to gauge progress and determine the effectiveness of tactics or technologies.
- DoD's capacity to integrate these elements into a coordinated and responsive program.

In each area, teams made recommendations, which DoD is considering as it refines its approach to defeating the IED threat.

Joint Training for Irregular Warfare

Throughout the Cold War, DoD faced a known threat and developed training and education processes that were appropriate for preparing forces to meet that threat. Today, faced with unpredictable asymmetric threats, DoD must prepare individuals and units to adapt to these new challenges. IDA was asked to identify new training approaches that might better prepare military forces to meet the challenges of irregular warfare.

IDA reviewed the current training system, the lessons-learned process, and new learning theories and approaches. We found that while the training and education techniques and approaches currently employed are useful and should be sustained, learning tools are available that would enhance the ability of military forces to adapt to unpredicted challenges and missions.

One area for increased focus is "adaptability," which involves the cognitive skills of intuition and critical and creative thinking, and the relational skills of self-awareness and team interaction. Efforts to acquire these skills are underway in some parts of DoD, but IDA's research suggests they need to become more widely distributed. The current Training Transformation program offers a way to accomplish this goal, and we are now preparing a roadmap to guide DoD efforts to adjust its learning system to meet the new demands.

Joint Interagency Concept Development and Experimentation

The Joint Forces Command established a series of experiments to develop and refine organizational and procedural concepts and prototypes that would enhance interagency coordination. IDA supported this effort by analyzing national and multinational experiments and exercises, and by assisting in concept development, testing, and refinement.

Our analyses incorporated organizational mapping, process identification and information tracing, and product analysis techniques. We provided outreach to the planning and operating organs of U.S. government agencies; other nations; and intergovernmental, multilateral, and nongovernmental organizations. These outreach efforts brought together diverse communities that typically operate in overseas contingencies, permitting U.S. planners and operators to experiment and learn in a more realistic context.

Improving U.S. Capacity for Stability Operations

In two related studies, IDA assessed the current capacities of military and civilian agencies to conduct stability and reconstruction operations and recommended changes in organizations and procedures to integrate existing capabilities and build new ones. The first study analyzed current and proposed organizations and processes. The second task, sponsored by U.S. Joint Forces Command on behalf of the State Department, examined personnel and manning models used by various organizations that operate in stability and reconstruction missions, and recommended methods to staff a proposed Civil Response Corps for the Department of State's Coordinator for Reconstruction and Stabilization.

Both studies found that while authorities, organizations, and processes exist, their scope, scale, and application are inadequate to meet the needs of stability and reconstruction missions. Personnel are available but not in the right skills, numbers, organizations, or time frames. Funding authorities are fragmented and impede effective and efficient application of resources in the field. Concepts of operation do not take into account indigenous institutions or populations, and the context of multinational/multilateral assistance is not well-recognized in military doctrine or civilian planning.

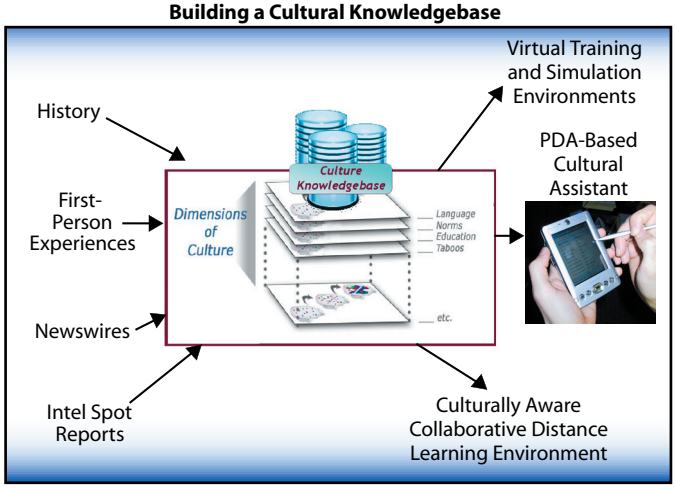
DoD is using the results of these IDA studies to focus and streamline efforts in the field to deliver services and assist indigenous populations in taking responsibility for running their own countries.

Cultural Intelligence for Stability Operations

Given recent experiences in post-conflict stability operations, DoD is examining how best to convey region-specific cultural information to U.S. military personnel to improve their effectiveness in dealing with people from widely different cultures. A variety of options are being considered, including formal education curricula, models and simulations, performance improvement tools, decision aids, and other means that would help U.S. forces assess the impact that cultural factors might have on operational plans and assumptions.

IDA was asked to review the resources related to cultural knowledge of various regions and to identify mechanisms for passing key parts of this knowledge to military personnel who are deployed – or about to be – in these areas. Our study provided a baseline of currently available cultural resources and technical means to get the information to individuals in the field.

Building a Cultural Knowledgebase



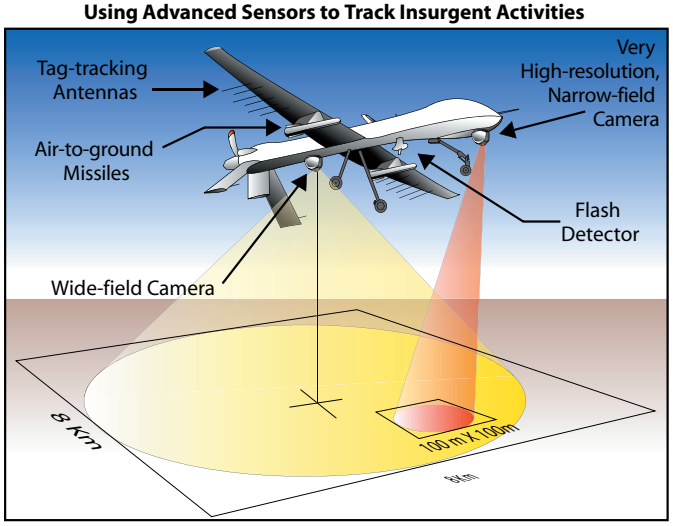
A variety of inputs (left) are used to build a Culture Knowledgebase (center), which in turn supports several training and performance tools (right). Each input has a variety of sources. For example, some of the sources for history data that are used to build the Culture Knowledgebase are the Brigham Young University's Culture Grams, Yale University's Human Relations Area Files, UNESCO's Best Practices on Indigenous Knowledge, the Peace Corps Library, the World Bank Data of Indigenous Knowledge, and the Center for World Indigenous Studies Virtual Library. The Knowledgebase has various degrees of detail and has many dimensions, such as language, norms, education, taboos, etc. One output of the Knowledgebase is the PDA-based cultural assistant, which has been found to be very useful in prototype trials.

Support to Multinational Force-Iraq

Since the summer 2005, an IDA cross-divisional team provided support to Multi National Force-Iraq (MNF-I), via video teleconferences with MNF-I's Director for Strategic Effects and his staff in Baghdad. The sessions focused on political-military issues of current interest to the command. These activities included:

- Reviewing parts of the draft Rule of Law Annex to MNF-I's Campaign Plan.
- Organizing and leading a day-long roundtable of economics experts from government and academia to review the Economic Annex of MNF-I's Campaign Plan and conveying the results to MNF-I headquarters.
- Organizing a day-long roundtable of regional political affairs experts from government and academia to discuss implications of the December 2005 Iraqi election and the political processes that would follow.
- Organizing a roundtable of subject-matter experts from industry, government, and academia to review the Strategic Communications Annex of MNF-I's Campaign Plan.

Using Advanced Sensors to Track Insurgent Activities



This UAV is equipped with a wide-field electro-optic/infrared imaging capability that would continuously record portions of a 50km² section of a city, looking into urban canyons from a steep, constantly varying perspective. The UAV can be programmed to detect suspicious activity patterns of both people and vehicles in predesignated areas-of-interest, and would automatically cue a narrow-field camera to confirm insurgent activity and initiate visual tracking. Imagery from the wide-field camera may also be examined by image analysts in a forensic mode to uncover subtle clues of insurgent activity. The Flash Detector, which detects explosive flashes, instantly locates and classifies mortar, rocket, and improvised explosive device attacks while cueing the narrow-field imager to search for perpetrators. Suspected insurgents and their vehicles that have been tagged by friendly human agents can be tracked through the city by antenna arrays on the aircraft. Air-to-ground missiles carried by the aircraft enable near-instant interdiction of insurgents engaged in attacks.

Urban Resolve: Experimentation to Improve Urban Operations

U.S. Joint Forces Command (JFCOM) asked IDA to provide technical assistance as a follow-on to the Urban Resolve Phase I experiment conducted in 2004. This new work focused on improving current joint operations in an urban environment.

Our researchers designed and conducted the 2005 experiment to identify and evaluate potential near-term improvements in command and control, sensors, and intelligence to support operations in Baghdad. In the process, IDA helped JFCOM develop an advanced synthetic experimentation environment to explore current issues in simulation.

In addition, JFCOM initiated the Urban Resolve 2015 Experiment, which will build on the 2005 environment to identify more effective concepts for future stability operations than those currently available for Iraq and Afghanistan. IDA participated in a series of workshops that defined the kinds of information needed to attack insurgent networks, the most effective means for obtaining that information, and the details needed to incorporate these concepts into supporting models used to execute the event.

We developed a concept involving tags and unmanned aerial vehicles equipped with advanced sensors that blends both human and technical means for detecting insurgent activities, tracking their vehicles and personnel, and locating their facilities. Tag and sensor models were developed to take advantage of the existing JFCOM simulation suite in order to bring the concepts to life in the Urban Resolve 2015 human-in-the-loop simulation. The goal is to refine and quantify the battlefield utility of these and other concepts, providing a guide for the DoD science and technology community that will lead to advanced concept technology demonstrations and transition to field operations.

Joint Force Planning, Operations, and Assessments

War through the Eyes of the Adversary

Prior to Operation Iraqi Freedom, members of IDA's Joint Advanced Warfighting Program – in combination with a team from U.S. Joint Forces Command – deployed to joint headquarters in the Middle East to capture, analyze, and report lessons learned during major combat operations. When the results of that effort were reported to senior government officials, they asked IDA to analyze how different the campaign might have appeared through the eyes of Iraqi military commanders.

Our researchers involved in the resulting Iraqi Perspectives Project interviewed many of Iraq's former senior civilian and military leaders and reviewed exploited documents and tapes captured from Saddam's regime. In 2005, we reported on the actions of Saddam's regime just before and during the Coalition's offensive. A second report will explore a wider range of topics relating to strategic and operational challenges when confronting a closed, autocratic regime.

To help disseminate findings, the Iraqi Perspectives Project has been briefed to an average of two senior national security audiences a week, and many seminars and lectures have been given at Joint professional military education institutions throughout DoD. The project is also being used to help develop intelligence analysts. The team

War through the Eyes of the Adversary

1. *Sayf al-Adel*: Former Egyptian Army colonel and writer on military topics for al Qaeda.
2. *Ayman al-Zawahiri*: #2 man in al Qaeda and author of 2001 book, *Knights Under the Prophet's banner.*
3. *Abu Musab al-Suri*: One of the most sophisticated military thinkers of the AQAM.

A. Seminal book by Abdullah Azzam, Bin Laden's mentor, about "jihad" in Afghanistan in 1987.
B. Book on guerilla warfare published in Indonesia and disseminated through a political organization thought to be associated with the Indonesian terrorist group, Jemaah Islamiyah.
C. Cover of a *Sawt al-Jihad*, an online military magazine intermittently published by al Qaeda.
D. Cover of *A Call for Global Islamic Resistance* published online last year by Abu Musab al-Suri.

Representative sampling of the sources IDA used as part of its Terrorist Perspectives Project to analyze the operational and strategic thought of al Qaeda and associated movements.

recently completed a study comparing pre-war estimates of Iraq's conventional military capabilities with the emerging evidence.

In a related effort, called the Terrorist Perspectives Project, IDA was asked to identify ways to exploit schisms within al Qaeda and associated movements. We are synthesizing the enemy's own body of writings to improve understanding of how they see themselves.

More specifically, we are focusing on the strategy debates within al Qaeda and the implications of friction between those who fight for a political end state and those who fight merely for the sake of fighting, or for their own martyrdom. We also documented a learning process among enemy leaders who pay close attention to western military writings and try to profit from the movement's own failures.

Joint Biological Agent Identification and Diagnostic System

Defense against weapons of mass destruction requires a mixture of technical, medical, and operational solutions. DoD often asks IDA to review the utility of systems and to determine whether their performance requirements will lead to meaningful operational capabilities. This year, IDA examined the Joint Biological Agent Identification and Diagnostic System (JBAIDS), which is being developed to allow forces in the field to determine if there is a biological agent in environmental, clinical, or food samples.

The performance requirements for JBAIDS had not differentiated among the three types of samples – environmental, clinical and food – which led to the concern that such a general performance specification might actually hinder the identification and diagnosis of a biological event in some circumstances.

To address this issue, IDA modeled attack scenarios that would cause environmental and food contamination and compared the estimated contamination levels with those in the existing JBAIDS requirements. Our assessment of clinical samples proved more challenging because of the scarcity of data available regarding the course of biological-agent-induced disease in humans. A review of animal data provided some insight into potential concentrations of organisms in clinical samples.

Our review indicated that some tests that had long been recommended to detect disease may not be as valuable as previously had been thought, and that performance requirements for clinical samples might have to differ from those for environmental or food samples. We suggested that further laboratory research to delineate the pathology of biological agent disease might be warranted to support not only requirements for diagnostic devices such as JBAIDS, but also recommendations for clinicians as to what medical samples might be most likely to support diagnosis.

Army and Marine Corps Force Planning

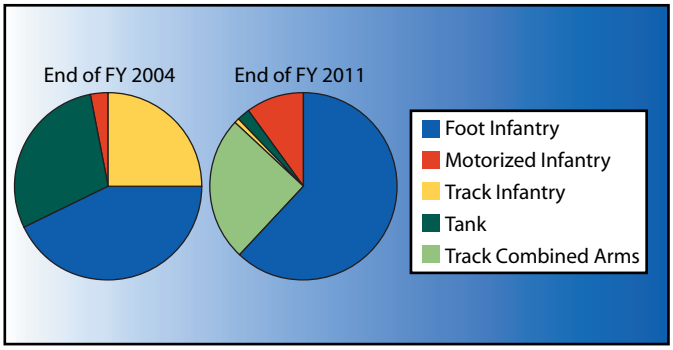
In preparation for the Quadrennial Defense Review, OSD asked IDA to review the Army and Marine Corps active and reserve component force structure plans. Army plans had changed significantly recently due to its conversion from a division-based to a modular, brigade-based structure. The Army is pursuing the new structure in part to increase the numbers of deployable brigades to facilitate rotational plans

for the active and reserve components.

The Marine Corps plans had changed in relatively modest ways: The numbers of active component infantry battalions and of active and reserve Light Armored Vehicle companies had increased, and the number of reserve component tank companies had decreased. Our researchers focused on the following:

- Assessing the linkages between force structure and strategy, and Department-wide methods for determining aggregate combatant command needs.
- Developing alternatives for structuring Army and Marine Corps forces, and estimating the combat power provided in terms of the planned program.
- Examining trends in the relative "heaviness" of Army and Marine Corps ground combat maneuver forces over time and evaluating those trends in the context of irregular warfare scenarios.
- Analyzing the combat service support needed to sustain the Army's rotational concept.

Combined Army and Marine Maneuver Battalions (as Percent of Total)



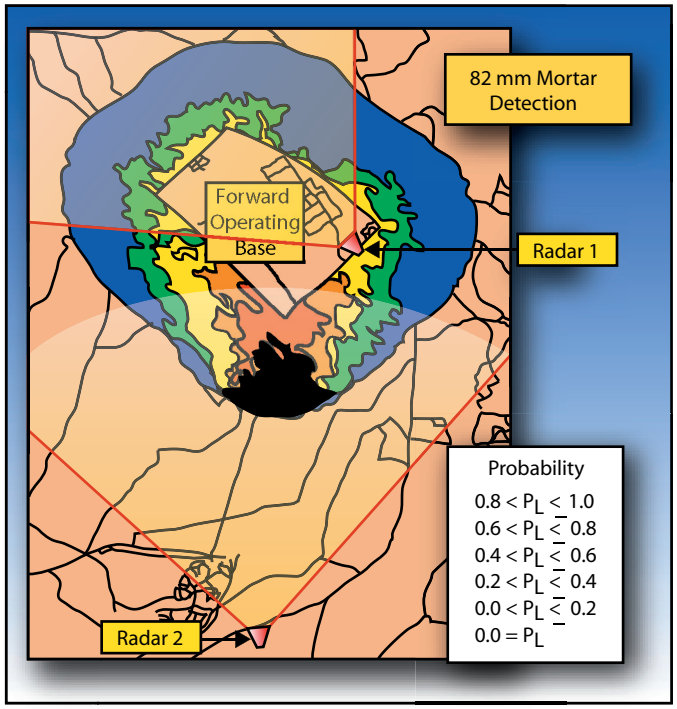
IDA compared the Marine Corps force structure at the end of FY 2004, and, as projected, at the end of FY 2011.

Evaluation of Pentagon Shield 2

The Pentagon Force Protection Agency is investigating a chemical and biological agent mitigation system called Pentagon Shield 2. This system, which was initially developed by the Defense Advanced Research Projects Agency, combines detectors, agent dispersion models, ventilation controls, and algorithms to generate evacuation procedures and is intended to minimize the exposure of Pentagon personnel from a chemical or biological attack.

IDA was asked to review this system, examine test results, and prepare an information package and performance evaluation for the Non-Standard Equipment Review Panel, which ensures that equipment procured for non-battlefield defense against chemical and biological attacks is effective. We identified information requirements, assisted in specifying measures of effectiveness, and monitored tests, which comprised releases of simulant. Since then, IDA has been working with the shield developers to coordinate the information package required by the review panel.

Mission Modeling Tool: Optimizing Placement of Firefinder Radars



A sample output of a Mission Modeling Tool developed to optimize the location and orientation of two Firefinder radars defending a forward operating base. In this notional case, one radar is located on-base with its 90° field-of-view oriented northwest, while a second radar is located south of the base with its field of view oriented north. The colored areas around the base show the probability that at least one of the radars will detect an incoming 82mm mortar round fired from those directions. Note that the maximum range of the 82mm mortar is defined by the outer edge of the blue area. The probability of locating a mortar round (PL) is zero in the shaded black area, because the radars can only detect rounds with approach vectors moving toward the radar. Even with this limitation, troops in the field can evaluate various combinations of radar types, numbers, and orientations to optimize coverage against the kinds of mortars and rockets commonly used by insurgents in their region.

Mission Modeling Tools

As they plan their daily operational activities, ground units in Iraq and Afghanistan have limited capability to visualize and optimize mission variables, predict enemy responses, or fully rehearse their missions. U.S. Joint Forces Command (JFCOM) is addressing this shortfall by developing

PC-compatible modeling and simulation tools that are easy to use and customized for specific units. JFCOM intends to provide training on the tools for units before they deploy.

IDA is modeling sensors, verifying that their behavior is accurately portrayed in the models, and organizing some of the initial training. To date, tools have been developed to enable the 10th Mountain Division to more effectively detect and track insurgents infiltrating from Pakistan into Afghanistan.

National Personnel Recovery Architecture

Congress asked DoD to develop a National Personnel Recovery Architecture (NPRA) that would account for U.S. government civilians and contractors. This would be in addition to DoD's traditional policy, which calls for U.S. military personnel to be recovered if they are isolated behind enemy lines or captured. DoD asked IDA to conduct this study, which was completed in summer 2004.

In follow-on work, our researchers focused on issues related to recovering contractor personnel and on an overall NPRA Implementation Plan. The Implementation Plan organizes activities into national policy development, interagency personnel recovery readiness, isolated personnel training and equipping, and contractor issues and actions. IDA also facilitated an interagency workshop to share information and to develop the next steps in implementing an interagency NPRA.

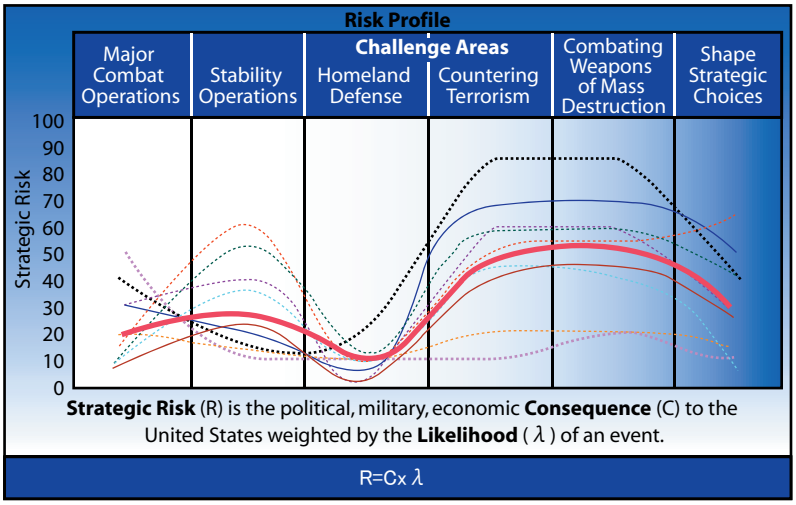
Improving DoD Processes and Organizations

Roles and Missions of Special Operations Forces

Faced with newly assigned responsibilities as the lead combatant command for planning, synchronizing, and, when directed, executing global operations against terrorist networks, U.S. Special Operations Command (SOCOM) asked IDA to identify changes in special operations roles and missions that would increase the command's effectiveness. IDA reviewed initiatives taken by DoD to enable the command to fulfill this new responsibility and identified the following additional needs:

- A campaign plan to provide the intellectual foundation for combating terrorism and the basis for force and resource planning.
- Mechanisms to exercise SOCOM's newly assigned authorities and responsibilities for synchronization of the war on terrorism.
- Engagement in interagency campaign planning, especially with the Department of State.
- Establishment of a role for SOCOM as a demanding consumer of intelligence.
- Assessment and provision of necessary resources.

Integrated Cross-Capability Assessment and Risk Management



IDA's Risk Assessment Methodology. Senior leaders were provided with a baseline security future based on current strategic guidance and planning scenarios and a depiction of the current programmed force. Using a set of scales developed by IDA, the respondents assess both the likelihood of events (λ) and the consequences of the event (C), given how a particular force capability option (FCO) is expected to perform. The resulting assessment provides both quantitative and qualitative views of how the respondent estimates risk for an FCO, given a particular security future, in each of six "challenge areas"—Major Combat Operations, Stability Operations, Homeland Defense, Countering Terrorism, Combating Weapons of Mass Destruction, and Shaping (potential adversaries') Strategic Choices. Results were then aggregated to identify trends, cohorts, and key areas of agreement/disagreement. In the sample Risk Profile above, a set of individual respondents' scores are plotted (a fine curve connects each assessor's scores) along with the mean scores of the group (the bold curve).

Integrated Cross-Capability Assessment and Risk Management

IDA is assisting DoD in building concepts, processes, and analytical approaches for implementing capabilities-based planning at the highest levels of the Department. To this

end, we developed a new approach for improving leadership insights regarding strategy and capability tradeoffs. The Integrated Cross-Capability Assessment and Risk Management (ICCARM) Study accomplished this through the following interrelated efforts:

- Building and testing a Risk Assessment Methodology (RAM), a framework for systematically assessing the strategic risk in and across broad DoD mission areas.
- Using RAM to conduct a Senior Leader Risk Exercise that elicited the perspectives of more than two dozen senior DoD leaders regarding the strategic risks to the United States of relying on the 2010-2020 programmed force, and how they might shift resources to better mitigate overall risk. DoD is now considering how to use this process regularly in future force planning and defense reviews.
- Studying DoD Adaptive Planning "initiation phase" options for the use of business models and analytic tools for addressing priority needs.
- Developing an approach for deriving strategic and operational effects from strategic guidance and operational planning documents.

Insights and methods developed in ICCARM supported the Quadrennial Defense Review and will assist with strategic resource and planning decisions in DoD.

Support for Defense Planning Scenario Development

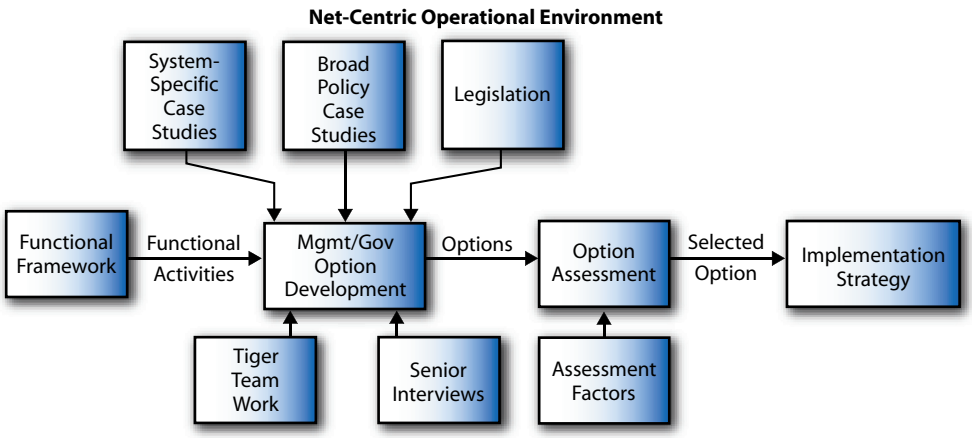
IDA continues to assist DoD in developing Defense Planning Scenarios (DPS). DoD uses the scenarios, along with their associated databases, in developing its "Analytic Agenda," which provides the defense analytic community with common, authoritative, and transparent assumptions and data for joint analysis. The DPS and associated databases are used in a variety of force planning activities, including program and budget analyses; major joint studies; concept development activities; and joint, interagency, and combined war games.

The scenarios include problem descriptions, assumptions and variations of key parameters developed by OSD, threat descriptions developed by the intelligence community, and outlines of concepts of operations for U.S. forces developed by a Joint Staff-led team of Service and other subject-matter experts. IDA researchers develop scenario parameters and review and integrate inputs from DoD components.

This year, scenario development focused on analysis support for the Quadrennial Defense Review, and it placed greater emphasis on nontraditional types of operational challenges.

Net-Centric Operational Environment

Defense operations are becoming increasingly network-centric, which demands effective information sharing and collaboration. Underlying such sharing and collaboration is a net-centric operational environment (NCOE) composed of communications networks and associated services that must be must synchronized and integrated across multiple programs. The programs include communications systems; network management; information assurance; and enterprise services managed by different Services, agencies, and program offices. The number and complexity of the programs and the general shortcomings in current management-



IDA's Net-Centric Operational Environment (NCOE) Study Methodology. Starting with the input of the existing Functional Framework, we explored system-specific and broad policy case studies, and participated in tiger team work and interviews with senior reviewers to generate and assess options for an NCOE management/governance structure.

governance processes for program synchronization and integration make achieving an effective NCOE capability difficult.

IDA is helping define and assess NCOE management-governance structures. Our researchers emphasized that an integrated approach is necessary across all steps, from initial capabilities definition through fielding. To this end, we developed alternative management-governance concepts, examined the strengths and weaknesses of each, and outlined preferred implementation approaches. These results are being used in the Department's efforts to develop further the portfolio concept outlined in the Quadrennial Defense Review.

National Security Strategy Issues

Nuclear Weapons Issues

As part of an overall review of the security of U.S. nuclear weapons, DoD asked IDA to conduct a capabilities-based assessment of nuclear weapons physical security. The assessment takes account of revised nuclear weapons security standards promulgated in response to changes in postulated threats. All nuclear weapons in DoD custody were considered in the study.

In another series of studies, we examined how best to realign the Chemical Demolition and Threat Reduction (CD/TR) portfolio to accommodate updated policy guidance. Our initial analysis focused on roles and responsibilities for monitoring nuclear treaties. We found that some organizations whose roles had been seen as primarily related to the Comprehensive Test Ban Treaty, but whose work supported related monitoring missions, needed to refocus on the monitoring functions. Subsequently, IDA has assisted CD/TR program managers in reevaluating criteria for overseeing technology development activities related to nuclear monitoring. Our researchers are now assessing CD/TR responsibilities and authorities to better define resource needs.

North Korea Propaganda

A typical view of North Korea's countryside, which includes an outdoor display of praise for its leader that reads "Thousand years of long life for General Kim Jong-il, the Sun of the 21st Century." The heavy use of propaganda in North Korea is part of an overall policy of isolation that allows the government to control the perceptions of its citizens.

Inside North Korea

North Korea remains a closed and secretive society. The poverty of its people and the criminal activities of its government threaten regional stability, while its willingness to breach international agreements in order to build nuclear weapons may pose a direct threat to U.S national security.

IDA has studied internal developments in North Korea's society, economy, and politics to discover clues of future trends, including identifying politically important groups in North Korean society today and their attitudes toward the current regime, changes and reforms, and the people and policies of other countries, especially the United States.

Our researchers forecast the ways in which North Korean society may change in the next several years and how the government and people might react in various collapse and conflict scenarios.

Assessing the U.S.-Russia Joint Commission on POW/MIAs

The Defense Prisoners of War/Missing Personnel Office asked IDA to assess the accomplishments, challenges, and effectiveness of the U.S.-Russia Joint Commission on POW/MIAs, established in 1992. The study examined how well the Commission has met its objectives of determining whether U.S. POW/MIAs might still be held in the former Soviet Union, determining the fate of missing members of the U.S. Armed Forces who were located on the territory of the former Soviet Union during and after World War II, and supplying information about Soviet military personnel losses since World War II.

IDA recommended structural and process changes to enhance the efficiency and effectiveness of the Commission and its U.S. analytical support element, the Joint Commission Support Directorate. Specifically, IDA recommended that the Commission:

- Reduce its structure by eliminating the commissioners and working groups, focusing instead on continued progress through streamlined working-level relationships.

- Reduce the frequency of large, high-level meetings.
- Improve integration of the Commission's work with the rest of the U.S. personnel accounting community's work.
- Develop a strategic plan to specify remaining goals and regularly evaluate progress toward these goals.

To improve the Directorate's work, IDA recommended that it strengthen and expand its archival research program; better target its interview program; and shift the focus of work of some of its research staff. Such changes may allow the Commission to play a more integrated role in wider accounting community efforts.

Assessing the US-Russia Joint Commission on POW/MIAs

An IDA Research Staff Member (fourth from left) in Zhovti Vody in Ukraine with a number of Soviet veterans who served their country during the Korean War. These individuals were interviewed by a U.S. member of the U.S. Russia Joint Commission on POW/MIAs to see if they had any information about missing U.S. personnel from the time period of their service.

Beyond the Moscow Treaty: Alternative Perspectives on the Future Roles and Utility of Nuclear Weapons

IDA has been studying how the roles and utility of strategic nuclear weapons could change beginning in late 2012 when the numerical constraints of the Moscow Treaty between the United States and Russia are scheduled to end. The study examined how relevant trends and plausible shocks to the U.S. security environment might change U.S. demands for nuclear forces. The study has postulated alternative international security environments that could evolve over the next decade and a half.

Our research suggests that additional cuts of U.S. nuclear forces will likely be planned as 2013 approaches but that plausible events in the following decade could substantially increase U.S. dependence on nuclear deterrence. We are examining the kinds of nuclear forces the United States could need for each of the postulated alternative 2022 international security environments. Based on these possibilities, we are considering how the United States could hedge against these potential demands now, taking long research and development and production times into account.

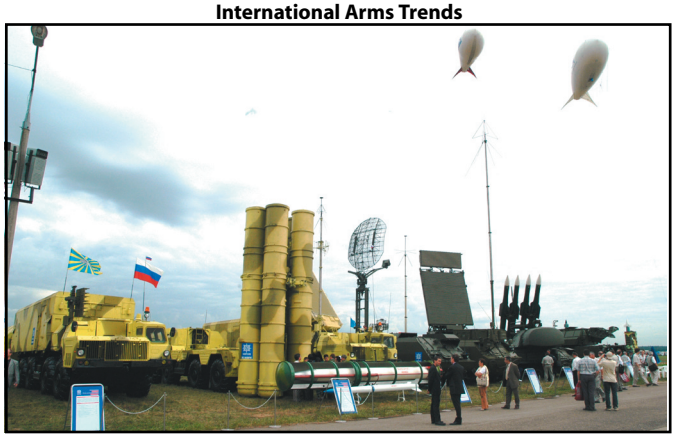
International Arms Trends

The structure and operation of the international arms market has changed radically since the collapse of the Soviet Union. Primary and second-tier weapons producers increasingly have looked to exports for survival. Additionally, major regional conflicts have taught many governments as well as irregular forces the importance of having advanced military capabilities. Consequently, a wider range of military systems and technologies is being offered more openly than ever before at international arms shows, making certain advanced technologies and systems available to virtually anyone.

Emerging trends suggest that U.S. military forces operating abroad will increasingly confront adversaries armed with ever more sophisticated and diverse weapons that either are acquired directly from foreign sources or are the product of collaborative efforts with foreign partners. At the same time, there are also unprecedented opportunities for the DoD to acquire foreign military equipment and technologies for its own use.

IDA is sorting through the flood of information now available from the international arms market and other unclassified sources to develop insights on future threats to U.S. forces.

International Arms Trends



Two of the Russian air defense systems most threatening to U.S. aircraft, cruise missiles and UAVs, were on display at the 2005 Moscow Air Show. Pictured are the SA-20, also referred to as S-300PMU2 (left), and SA-17, referred to as the BUK-M1-2 (right) by their Russian manufacturers. In recent years Russia has become a world leader in supplying very capable and robust air defense systems to such countries as China, India, Iran, Greece, and Egypt. Of particular concern to U.S. planners are the substantial upgrades in capabilities to regional powers through the recent sales of the SA-20 to China and the SA-15 to Iran.

High Performance Communications and Computing

For nearly 50 years IDA has played a key role in the research endeavors of the National Security Agency, providing cutting-edge research in those areas of mathematics and computer science that are fundamental to the NSA missions of protecting our national security information systems against exploitation, and providing the United States with effective foreign signals intelligence. The program has two intertwined research areas: communications research, and computing research. The sensitivity of this work requires most of it to be highly classified, so we can provide only a very general description of the NSA support program here.

Communications Research

The IDA Centers for Communications Research (CCR) in Princeton, New Jersey, and La Jolla, California, perform mathematical research that supports the NSA's two missions: protecting the information and communications of the U.S. government, and deriving foreign signals intelligence.

Mathematics remains the fundamental science employed to create and analyze the complex algorithms used to encipher vulnerable communications. Virtually every branch of pure and applied mathematics has proved to be useful in these efforts. For example, techniques from the geometry of algebraic curves provide better methods for detecting and correcting errors in data transmission. As the modes and means of modern communications become more complex, the Centers have expanded their research into other areas including speech, the processing of signals to remove noise and distortion, and network security.

Systems that transmit or store data must provide confidentiality and reliability in the presence of natural or adversarial interference. Mathematical methods such as signal coding and cryptography are used to accomplish these goals. Many areas of mathematics are important to these endeavors, and the constantly changing intellectual terrain has introduced new mathematical problems that must be solved so that NSA can perform its mission. Even where no explicit mathematical ideas are involved, mathematical modes of thinking seem to be ideally suited to cryptologic problems.

The researchers at CCR, most of whom have Ph.D.s in mathematics, have a broad range of backgrounds and interests, because highly specialized knowledge is needed to solve some of NSA's most difficult problems. When a problem cannot be solved by known methods, insights often come from those who can see how different areas of mathematics can be used in non-obvious ways. As a result, much of CCR's success comes from collaboration in teams, rather than the isolated research.

It is critical to our work that we recruit the very best new mathematical talent. Academic mathematicians and computer scientists contribute to CCR's work by attending workshops and conferences which are held at each CCR site. By far the most important of these is the summer study program known as SCAMP. For eight to ten weeks, visiting mathematicians work side by side with CCR's full-time staff and visitors from NSA, focusing on a few specific problems each year. Most of the visitors are full-time faculty or graduate students. The influx of new people and ideas throughout the history of this program has led to numerous solutions to important NSA problems.

CCR produced a broad set of results and techniques in 2005, ranging from advances on long-term projects to dramatic results of immediate benefit to the NSA.

Computing Research

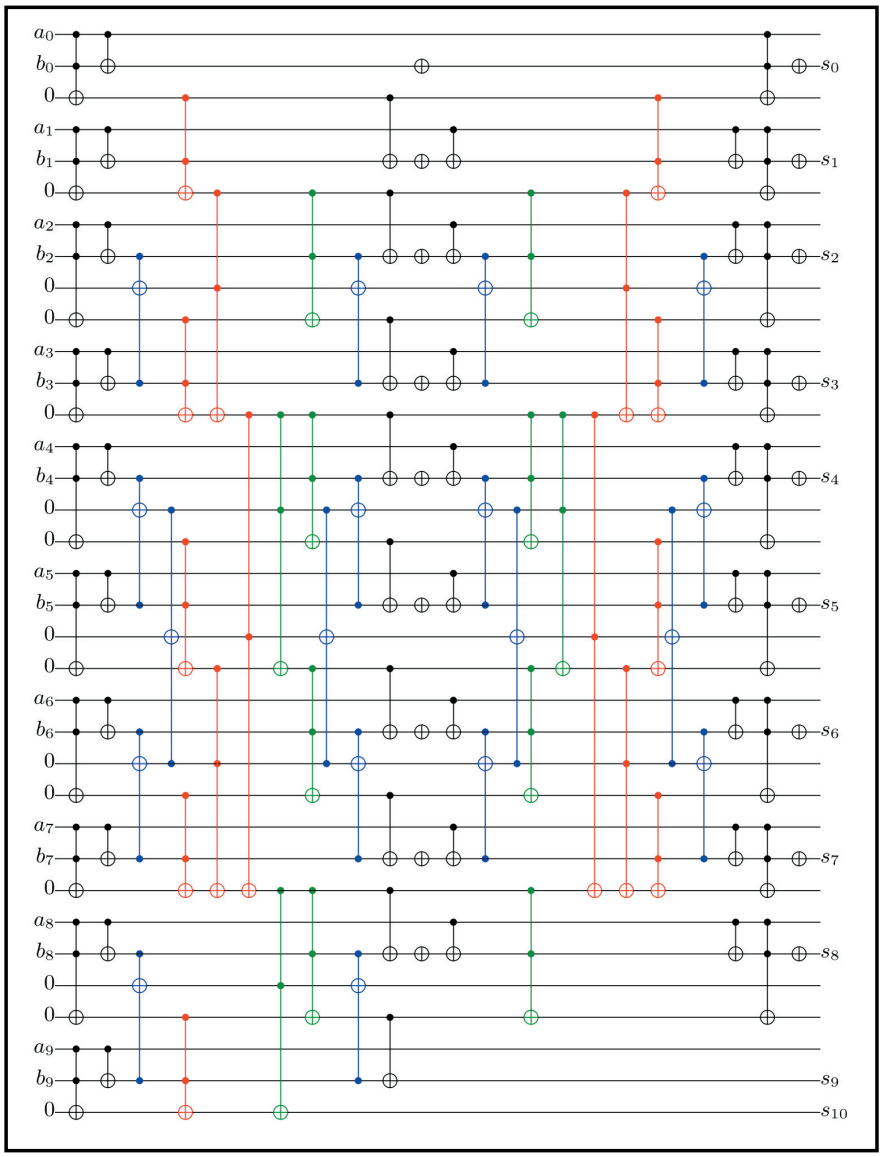
While high-end computing is an important part of the research program at the Center for Computing Sciences (CCS), its mission has broadened over the years to reflect global political and technological changes to include not only high-performance computing for cryptography, but also cryptography itself, network security, signal processing, and computational/mathematical techniques for mining and "understanding" very large data sets. To achieve its mission, CCS focuses the skills of some of the country's best computer scientists, engineers, and mathematicians on using all aspects of computational science to solve intelligence-related problems of importance to national security. Parts of the problem set we confront are clearly not unique to the defense and intelligence communities; these areas are of concern to the entire computing science community and are addressed in many different settings. Indeed, initiating discussions with academia and industry is an important component of the CCS mission.

Senior technology policymakers have concluded that continued development of high-performance computing platforms will require government research and development support. The amount of computing power available from architecture intended primarily for the consumer market is not, and probably never will be, sufficient to meet the specialized requirements of the most demanding national security-related computations. CCS is active in this discussion because of its depth of experience in NSA's most advanced computing problems and its active collaborations with the Department of Energy's Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratory. CCS also maintains a vigorous dialogue with many of the leading U.S. makers of high-end computers.

As every personal computer user knows, various software components interact with each other in complex, sometimes unintended, and possibly unpleasant ways. Protecting computer networks and other U.S. communications is now as important as designing and using these computers and networks. For several years, the CCS SCAMP sum-

mer program has concentrated on understanding the origin and consequences of these remarkable side effects. The effort has gradually broadened to include interactions among programs communicating over very large networks, such as the World Wide Web. The studies at the SCAMPs highlighted the need for a great improvement in tools and techniques for understanding structure and for predicting consequences of execution of large programs.

An additional complexity for this topic results from the fact that adversaries of the United States "live" on the same World Wide Web and use the same technology as U.S. entities. Hence, the traditional distinction made between two NSA missions – protect data and collect data – is far from clear and a new, blended mission is developing. All three IDA Centers are working closely with NSA to bring the best talent to bear on the scientific problems generated by this blending.



The quantum carry-lookahead (QCLA) adder accepts two n-bit numbers and adds them in O(log n) depth using O(n) ancillary qubits. Previously, the linear-depth ripple-carry addition circuit had been the method of choice. This circuit reduces the cost of addition dramatically with only a slight increase in the number of required qubits. The QCLA adder can be used to reduce substantially the run-time of Shor's factorization algorithm.

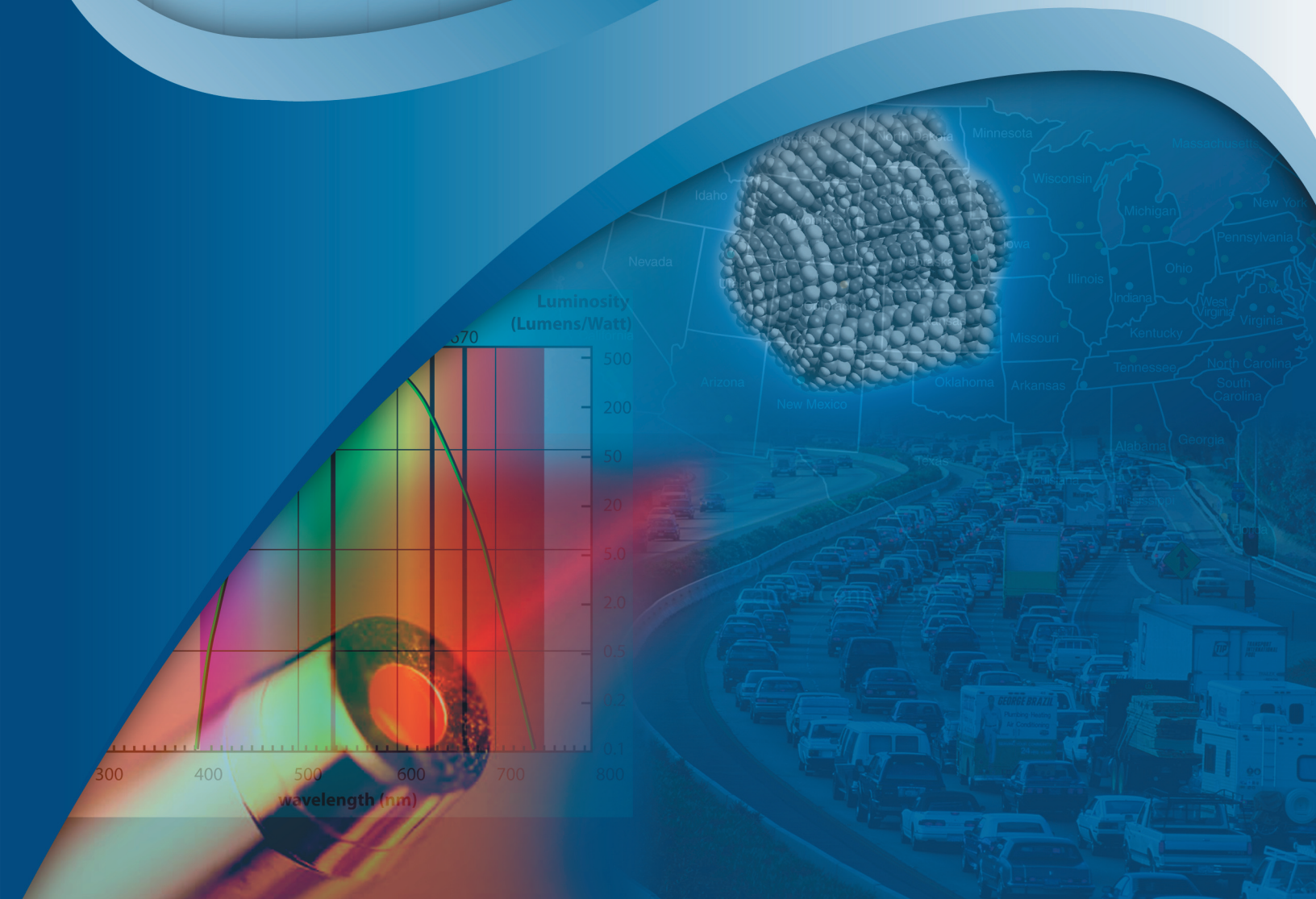
For the past decade, CCS has provided NSA with research tools for massively parallel processors. In addition to continuing this fundamental effort, CCS and the CCRs have focused on research problems associated with the processing, searching and "understanding" of massive amounts of data. The main emphasis has been on building software research tools that use the most current web-based technology to increase capabilities to absorb and explore giant data sets.

Quantum computation is an active area of research in applied physics and computer science. If successful, this research would result in a radically different computer architecture built on principles of quantum mechanics. In the 1990s, Peter Shor, then at AT&T Research, showed that such a computer could factor large integers in polynomial time, a result which would have important consequences for public key cryptography. In the summer of 2003, CCR-P held a workshop on quantum algorithms and circuits, and we have continued research in this area since. The quantum circuit shown here is an example of a circuit design IDA recently published.

In the figure – in-place QCLA adder for 10 bits – propagate bits are in blue, generate bits are in red, and carry bits are in green.

Science and Technology Policy Institute

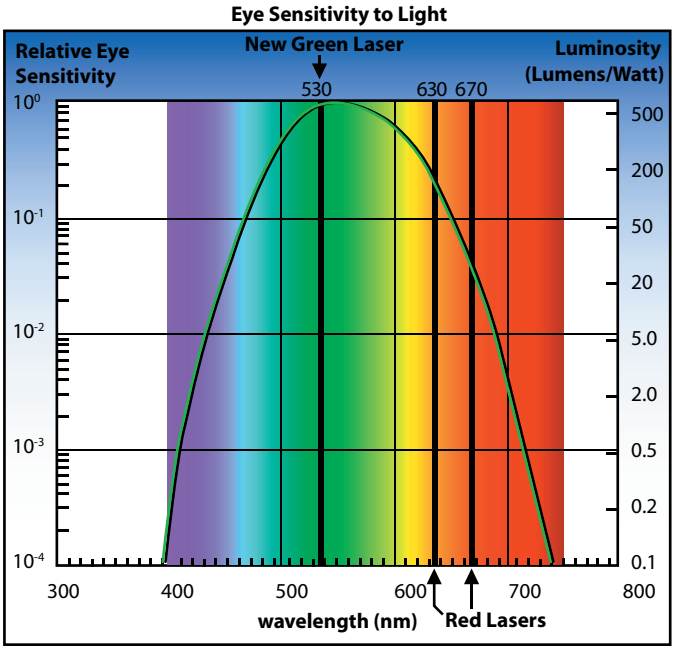
IDA's Science and Technology Policy Institute (STPI) provides technical and analytic support to the Office of Science and Technology Policy (OSTP), an agency of the Executive Office of the President, and to a growing number of other government organizations. Our researchers have worked on a wide range of topics, including the ethical, legal and societal implications of nanotechnology research; aeronautics research and development; the effects of U.S. visa policies; and efforts related to international research collaboration.



Encouraging Innovation in Manufacturing

The Department of Commerce's 2004 report on Manufacturing in America recommended ways to leverage innovation in small- and medium-size manufacturing companies through the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs. Subsequently, the President signed Executive Order 13329, Encouraging Innovation in Manufacturing, which calls for Federal agencies to give manufacturing a high priority in their SBIR programs.

STPI provided analytic support to help OSTP carry out its oversight responsibilities for this Executive Order. Our researchers developed a comprehensive, user-friendly SBIR award database useful in monitoring implementation efforts. We also assisted OSTP in developing guidelines to Federal agencies for implementing the new Executive Order in their future SBIR programs.



A curve of the spectral response of the photopic (light-adapted) human eye. The new green laser pointer output at 530 nanometers is close to the peak of the sensitivity of the eye. The older red laser pointers had outputs in the range from about 630 to 670 nanometers where the eye is much less sensitive to light.

Laser Irradiation of Civilian Aircraft

In 2004, there were a number of reported incidents in which the cockpits of civilian aircraft were illuminated by lasers from external sources. OSTP asked STPI for a quick-response study of the technical aspects of what was happening.

We showed that, although there had been hundreds of incidents of laser irradiation of aircraft in the previous decade, most of them involved ordinary laser pointers, which produced a red-colored beam generated by a small diode laser. However, in 2004, a new, relatively inexpensive laser pointer became available that produced a green-colored beam generated by doubling the frequency of an infrared-diode-pumped, solid-state laser. As part of the analysis, STPI calculated the ranges for various optical effects on pilots of the green laser. STPI also studied the following:

- Eye damage that could be caused by laser pointers.
- Glare and startle caused by legal green-laser pointers.
- The potential effects of illegally modified green-laser pointers, which could have increased power; diode pumped solid-state lasers used in scientific research and industry; and large entertainment lasers used for light shows.

International Science and Technology Conferences

OSTP asked STPI to examine the effects of post-9/11 U.S. visa policies and other security measures on science and technology (S&T) meetings in the United States. We investigated the experiences of scientific organizations in arranging U.S.-based events with international participants; disruptions to international collaborations based in the United States or involving U.S. scientists; and perceptions of U.S. entry processes and the resulting effects on international participation in conferences and collaborations in the United States. Our researchers also estimated annual revenue losses that resulted from disrupted or relocated conferences.

Based on interviews with personnel from more than two dozen scientific societies, we found that S&T event disruptions appear to be widespread, small, and persistent, with certain technical fields – and a limited number of countries – affected more than others. Anecdotal evidence suggested that collaborations – as opposed to formal conferences and events – also have experienced disruptions and relocations. Though many interviewees recognized recent improvements in U.S. entry processes, there is still a hesitance to host events and to collaborate in the United States due to delays and perceptions of U.S. entry processes.

Computational Fluid Dynamics

OSTP asked STPI to review the state of computational fluid dynamics (CFD) as applied to the aircraft design process. Specifically, we examined the following questions: What is the current interaction between CFD and physical test facilities? Under what circumstances are CFD or physical test infrastructures more appropriate, and how do they complement each other? What are the major opportunities for improving CFD over the next 15 to 20 years to gain additional benefits in aircraft design?

Our researchers interviewed more than 30 experts at over 20 academic, government, and industry facilities; assessed computing requirements for implementing CFD and projected computing power over the next 20 years; and evaluated the capabilities of CFD as applied to 12 different aspects of aircraft performance.

We found that physical test infrastructure and CFD are largely complementary design tools. Though there are significant opportunities to expand the use of CFD and improve aircraft design processes, it is unlikely that computational capabilities could replace physical test infrastructure in the next 20 years. Instead, CFD development should focus on improving integration of distinct steps in the analysis process and on pushing CFD practitioners to develop and adopt the next generation of algorithms.

Traffic Congestion Mitigation Technologies

With the steady increase of traffic in many U.S. metropolitan areas, congestion on major roadways has become a major issue that impacts both economic growth and the environment. STPI reviewed the current status of congestion, identified technologies that had the potential to help reduce traffic congestion, and assessed possible opportunities/scenarios for implementing these technologies.

Our researchers identified several potential long-term and short-term strategies for mitigating congestion. In the long term, technology-enabled vehicle automation will increase, potentially allowing higher traffic densities at highway speeds and resulting increases in roadway capacity. However, these technologies likely will not mature or be adopted in the marketplace for at least 20 years.

Federal Education Strategies

In 1958, Congress enacted the National Defense Education Act to achieve the "fullest development of the mental resources and technical skills of its young men and women." Key features of the original NDEA legislation included a student loan program to colleges and universities to increase the flow of talent into science and mathematics careers; National Defense Fellowships for graduate study toward a college teaching career; and a wide array of programs to enhance pre-college teacher training as well as public understanding of science and technology. Subsequent amendments to NDEA modified and even eliminated many of the original legislative provisions.

OSTP asked STPI to summarize what is known about the effects of NDEA on increasing the nation's capabilities in science and technology, with emphasis on its impact in promoting the growth of the college teaching workforce in those areas.

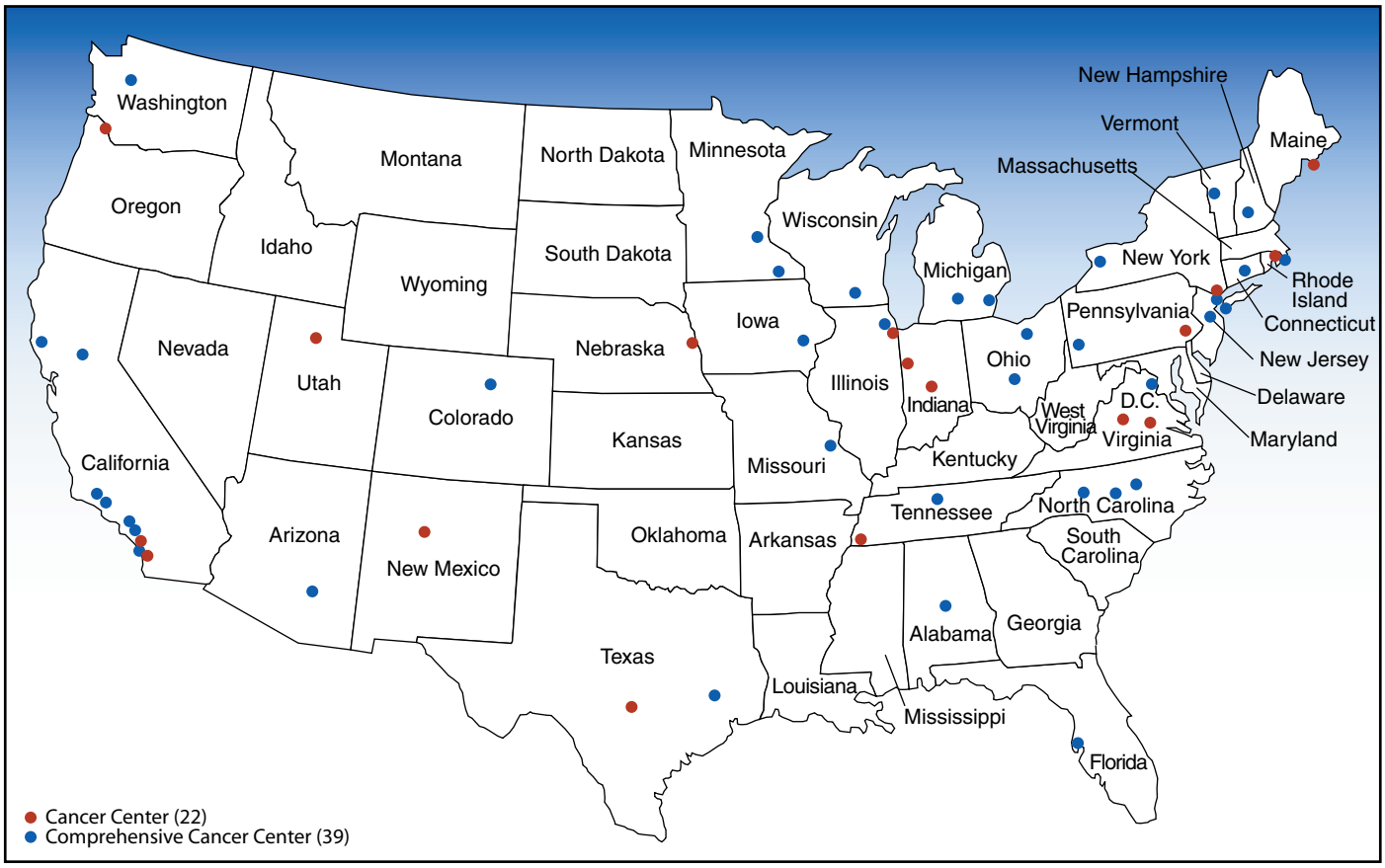
We found that one of the long-lasting effects of NDEA was the establishment of low-interest student loans, still available today in the form of Pell grants and Perkins loans. NDEA also equipped thousands of elementary and secondary school laboratories for science and technology education.

However, owing to its modest size, the NDEA Fellowship program appears to have done little more than complement a growing program of more selective federal support already in place during the 1950s, such as research training available through the National Institutes of Health. In comparison with other federal programs, NDEA produced lower rates of doctoral degree completion and career entry into the university sector, and thus NDEA was not a central force in expanding the scientific and technical workforce in the United States between 1958 and 1973 – the last year of NDEA fellowships.

National Cancer Institute Clinical Trials Working Group

The Director of the National Cancer Institute (NCI) established the Clinical Trials Working Group to advise the National Cancer Advisory Board on whether and in what ways the NCI-supported national clinical trials enterprise should be restructured to realize the promise

National Cancer Institute Designated Cancer Centers



The Cancer Centers Program of the NCI supports major academic and research institutions throughout the United States to sustain broad-based, coordinated, interdisciplinary programs in cancer research. These institutions are characterized by scientific excellence and capability to integrate a diversity of research approaches to focus on the problem of cancer. The NCI and its Cancer Centers Program are dedicated to the advancement of cancer research to ultimately impact on the reduction of cancer incidence, morbidity, and mortality.

of molecular medicine for advancing cancer clinical practice. NCI asked STPI to provide strategic and analytical support to the Working Group to help refine and set priorities among initiatives for improving the effectiveness and efficiency of NCI-sponsored clinical trials, and to help develop implementation plans.

Working closely with Working Group members, we prepared the final Clinical Trials Working Group Report, "Restructuring the National Cancer Clinical Trials Enterprise," which contained detailed five-year implementation plans with associated timelines and budgets for 22 separate initiatives covering all aspects of the NCI-funded clinical trials system. Our researchers continue to assist the NCI leadership in establishing new organizational structures for managing implementation.

Support for the National Science Board

The National Science Board Office (NSBO) asked STPI to review the NSB's biennial report, Science and Engineering Indicators (SEI) 2006, with respect to both content and presentation. We assisted the NSBO in developing a strategy for enhancing the utility of the SEI publication for policy development and planning related to the health of U.S. science, engineering, and technology efforts. We expect to continue this role during the production of SEI 2008.

IDA Community

The Institute

The Institute for Defense Analyses provides independent and objective scientific and technological expertise to assist national security decision-makers address urgent and challenging issues. Incorporated in 1956, the Institute operates three Federally Funded Research and Development Centers: the IDA Studies & Analyses Center, which assists the Office of the Secretary of Defense, the Joint Staff, the Combatant Commands, and Defense agencies; the IDA Center for Communications and Computing, which assists the National Security Agency; and the Science and Technology Policy Institute, which provides analytic support for the National Science Foundation and the Office of Science and Technology Policy in the Executive Office of the President.

For nearly 50 years, the Institute for Defense Analyses has provided national security decision-makers with independent and objective analyses of some of the most challenging scientific and technical problems they face.

Since its formation in 1956, IDA has maintained a special relationship with its sponsors that allows it to perform research and analytic tasks that are integral to the missions of sponsoring offices. IDA's three federally funded research and development centers provide objective analyses and advice to the federal government on issues related to advanced technologies; complex systems; management processes; national security strategies, plans and resources; operational concepts, readiness and performance; training and other support functions; sophisticated cryptological algorithms, and national science policy.

IDA Studies and Analyses Center Alexandria, Virginia

IDA's Studies and Analyses Center, the largest of our three FFRDCs, consists of seven research divisions whose work focuses on a broad range of issues spanning diverse disciplines.

Cost Analysis and Research Division

Dr. David McNicol, Director

CARD estimates the full life-cycle costs of acquiring defense systems and undertakes tasks that advance the state of the art of weapons system cost estimation. The division also undertakes a wide variety of projects that involve costing issues or concerns with resource allocation mechanisms in federal agencies.

Information Technology and Systems Division

Dr. L. Roger Mason, Jr., Director

ITSD analyzes multi-dimensional problems in the areas of information integration, information assurance and intelligence systems which are built around the major challenges of IT in the national security community. The work assesses all major aspects of information systems including data, communications, enterprise services, applications and emerging technology. The results of this work help sponsors plan research and development programs, make informed acquisition decisions on highly technical subjects, formulate technology polices and develop organizational practices that better leverage advanced information technology.

Joint Advanced Warfighting Program

Mr. Karl Lowe, Director

JAWP was established at IDA in 1998 at the request of the Vice Chairman of the Joint Chiefs of Staff and the Under Secretary of Defense for Acquisition, Technology, and Logistics to serve as a catalyst for stimulating innovation and breakthrough improvements in joint military capabilities. The team's core work includes advanced concept development, operations analysis, and joint experimentation in support of the Joint Staff, Joint Forces Command, and the Office of the Secretary of Defense. The JAWP is composed of both military personnel on joint assignments (three from each Service) and civilian analysts from IDA. Located mainly at IDA's Alexandria, Virginia campus, JAWP also maintains an office in Norfolk, Virginia, to facilitate interaction with U.S. Joint Forces Command.

Operational Evaluation Division

Mr. Robert D. Soule, Director

OED supports the Office of the Secretary of Defense in the planning, observation, and evaluation of Service and defense agency operational tests of major new weapon systems and the Live Fire Tests of the lethality and vulnerability of weapons and platforms. The division also supports the Office of the Secretary of Defense, the Joint Staff, and the Combatant Commands in evaluating military deployments and operations, and in developing, integrating, and improving the interagency mission planning process.

Science and Technology Division

Dr. Michael A. Rigdon, Director

STD researchers investigate and model scientific phenomena and conduct technical characterizations and

evaluations of devices and systems to assess the limits of performance available in their operational environments and the mission capability they provide. The division also conducts technology assessments critical to research and development programs, acquisition decisions, technology planning, and technology proliferation.

Strategy, Forces, and Resources Division

Mr. Michael Leonard, Director

SFRD performs integrated, interdisciplinary studies of plans and policies related to national security strategy, the structure and capabilities of U.S. and foreign forces, and the infrastructure supporting U.S. forces. The division also assists in streamlining government organizations, management systems and processes.

System Evaluation Division

Dr. George E. Koleszar, Director

SED assesses military force effectiveness, system performance, and joint and allied interoperability. It also examines mission needs, develops system architectures, performs system-of-systems analyses, investigates new operational concepts, and assesses the risks and costs that accompany technological integration. These studies help sponsors choose among competing systems, set force or inventory levels, and identify suitable concepts for employing systems.

Center for Communications and Computing

IDA's Centers for Communications and Computing play a key role in the research endeavors of the National Security Agency, providing cutting-edge research in those areas of mathematics and computer science that are fundamental to the NSA missions of protecting our national security information systems against exploitation and providing the United States with effective foreign signals intelligence.

Centers for Communications Research
Princeton, New Jersey, and La Jolla, California

Dr. David M. Goldschmidt, Director, CCR–Princeton

Dr. Joe P. Buhler, Director, CCR–La Jolla

The two CCRs conduct fundamental research supporting the National Security Agency in cryptology and related disciplines. Their work includes creating and analyzing complex encipherment algorithms, conducting speech and signal analyses, and developing information processing algorithms.

Center for Computing Sciences
Bowie, Maryland

Dr. Francis Sullivan, Director

CCS conducts fundamental research for the National Security Agency in support of signals intelligence and information assurance missions in supercomputing and parallel processing technologies, including the development of parallel processing algorithms and applications; computer network technologies in support of communications security applications; and information processing technologies, focusing on applications for large data sets.

Science and Technology Policy Institute
Washington, DC

Dr. Robert E. Roberts, Director

The Science and Technology Policy Institute supports the White House Office of Science & Technology Policy. STPI assembles timely and authoritative information regarding significant science and technology developments and trends in the United States and abroad, and analyzes this information, with particular attention to how it affects the federal science and technology research and development portfolio and interagency and national issues. STPI also provides analytic support on S&T issues for other federal agencies who need the independence and objectivity of an FFRDC.

Leadership

The dedication of IDA's talented staff is coupled with the knowledge and commitment of IDA's Board of Trustees and Corporate Officers, whose years of experience provide sound guidance and leadership to the Institute.

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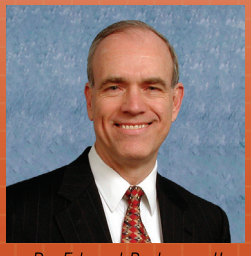
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Former Manager of Computational Biology and Bioinformatics, IBM; Director of Research, Thinking Machines Corporation

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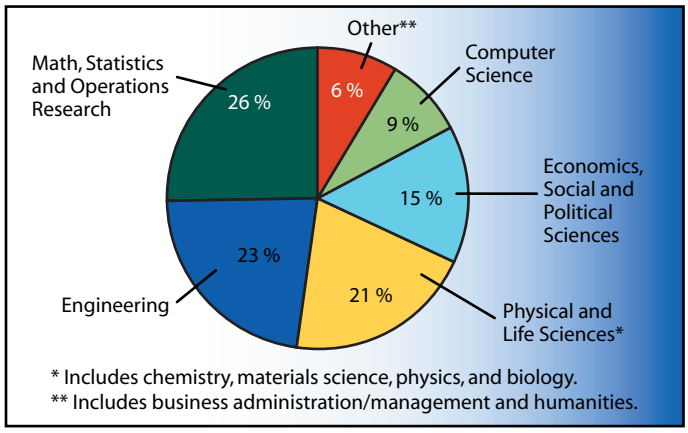
Dr. Suzanne H. Woolsey

Diverse Staff

In addition to working on some of the most challenging projects in national security, researchers at IDA – whether at our Studies & Analyses Center, the Centers for Communications and Computing, or the Science & Technology Policy Institute -- collaborate with a diverse and talented set of colleagues, many of whom are at the top of their fields. When appropriate for the particular research at hand, those colleagues may include not only other IDA employees, but also academic and other professionals from around the globe.

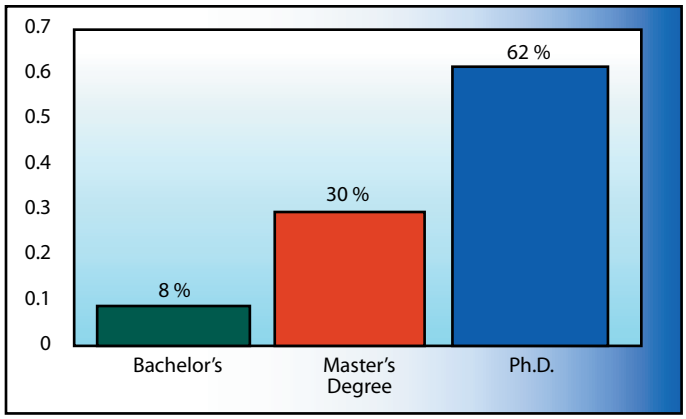
IDA's success is driven by an extraordinary team of research analysts supported by a dedicated cadre of IDA employees providing the myriad of needed support services.. Building on our core values of excellence and objectivity, IDA has established itself as an FFRDC leader that attracts the country's best talent.

Disciplines



* Includes chemistry, materials science, physics, and biology.
** Includes business administration/management and humanities.

Level of Education



Awarding Excellence

Each year, IDA recognizes those employees who demonstrate unusual excellence. Annually, we present the Andrew J. Goodpaster Award for Excellence in Research to an individual who has demonstrated intellectual leadership within the IDA community; the W.Y. Smith Award for Excellence for outstanding contributions by a non-research professional staff member, and the IDA President's Award for Excellence to recognize sustained superior performance that contributes significantly to IDA's success. And three times per year, IDA presents the IDA Achievement Award to recognize staff whose outstanding achievements or accomplishments are above and beyond the normal scope of an employee's job and are not usually visible to sponsors.

This year, the following individuals were singled out for their exceptional contributions to IDA's mission:

Dr. David Sparrow

Andrew J. Goodpaster Award for Excellence in Research – Dr. David A. Sparrow of the Science and Technology Division. Since joining IDA's staff in 1986, Dr. Sparrow's work has ranged widely, from demonstrating how thermal management issues rendered the 80's Gamma-Ray Laser concept infeasible, to conducting research on the Joint Land Attack Cruise Missile that led to the development of air picture metrics that remain the basis for DoD thinking on air defenses today. As the first director of our simulation center, his work helped build the intellectual infrastructure for expanding modeling and simulation at IDA and, as a senior member of IDA's research staff, he has served as a committed mentor to numerous new analysts and has helped foster collaboration across divisional lines. In these efforts and many others, Dr. Sparrow has consistently demonstrated the attributes of the best IDA researchers – innovative and rigorous analysis, broad intellectual curiosity, and a sustained commitment to providing honest answers to tough problems confronting the national security community.

W.Y. Smith Award for Exellence – Mr. Paul Dupree, IDA Conference Coordinator, Information Services. Since joining IDA, Mr. Dupree's constant attention to detail, his ability to listen, and his desire to understand the needs of the research staff have raised IT conference support to a new and higher level and have greatly facilitated the success of the numerous meetings, symposia, and other forums held at IDA.

(left to right) Mr. Paul Dupree, Ms. Deborah Ewert, and Mrs. Yolanda Prescott

IDA President's Award for Excellence –Mrs. Yolanda Prescott, Senior Administrative Specialists in the System Evaluation Division, and **Ms. Deborah J. Ewert** of the Operational Evaluation Division were presented with the IDA President's Award for Excellence. Both Mrs. Prescott and Ms. Ewert have provided not only their respective Divisions with consistently high-quality support, but have willingly extended their skills and individual talents to assist many in other Divisions and Directorates.

Enriching Environment

IDA's value to the government as a reliable source of quality research derives not only from a first-rate staff, but also from a research atmosphere that fosters integrity, independence, and an openness to the views of others.

Each year, IDA invites members of the national defense research and analytic communities to share their knowledge and experiences with IDA staff. The speaker program includes the President's Colloquia Series, which features distinguished military and civilian leaders who talk on a range of technical and policy issues related to national security. IDA also conducts seminars on specialized topics capitalizing on the knowledge of experts in the fields relevant to IDA's research programs.

Seminars are conducted at four of IDA's primary facilities and include presenters both from within and outside the classified and Defense communities. Speakers from diverse backgrounds covered topics including:

- "American Foreign Policy in the Second Bush Term: A Conversation with Strobe Talbott" (Ambassador Strobe Talbot, President, The Brookings Institution).

Dr. Jane H. Lute, Assistant Secretary General of the United Nations for Peacekeeping Operations, delivers her address – "Peace Operations in the Field: What Works, What Doesn't, and Why," to IDA employees. Dr. Lute is one of nearly 40 speakers who have shared their knowledge and experience with IDA staff in 2005.

- "Information Sharing at DHS" (Mr. Richard A. Russell, Director, Information Sharing and Collaboration, Department of Homeland Security).
- "Major Challenges Facing Personnel and Readiness" (Dr. David S.C. Chu, Under Secretary of Defense, Personnel and Readiness).
- "The U.S. Coast Guard after 9/11" (Admiral Thomas H. Collins, Commandant, United States Coast Guard).
- "Remote Device Fingerprinting" (Mr. Tadayoshi Kohno, Cryptography and Security Laboratory, University of California, San Diego).
- "Theory and Applicatins of Process Detection" (Dr. George Cybenko, Dorothy and Walter Gram Professor of Engineering, Dartmouth College).

Good Citizens

For more than 10 years, IDA has been playing an active role in its community. Past activities have included tutoring and mentorship arrangements in conjunction with local schools and work with local Eagle Scout Troops. This year witnessed a noticeable growth in the level of IDA's commitment to the City of Alexandria Public Schools, with staff participating inside and outside the classrooms of the local elementary, middle, and high schools in a variety of capacities, ranging from mentoring and tutoring students at all grade levels and in a number of subjects to serving as judges at science fairs and providing insights into various career paths for math and science students.

Jaggot Singh of IDA's Information Technology and Systems Division shows a trio of young students some simple chemistry experiments at an IDA-sponsored Science Fair for the children in the Alexandria City Public School's elementary, middle, and high schools.

Sponsors

IDA works primarily for the Office of the Secretary of Defense, Joint Staff, Combatant Commands, and Defense agencies. We also conduct research for other government agencies. IDA does no work for industry.

Office of the Secretary of Defense

- Under Secretary of Defense, Acquisition, Technology and Logistics
  - Director, Defense Research and Engineering
  - Assistant to the Secretary of Defense, Nuclear, Chemical, and Biological Defense Programs
  - Deputy Under Secretary of Defense, Advanced Systems and Concepts
  - Deputy Under Secretary of Defense, Industrial Policy
  - Deputy Under Secretary of Defense, Installations and Environment
  - Deputy Under Secretary of Defense, International Technology Security
  - Deputy Under Secretary of Defense, Logistics & Materiel Readiness
  - Deputy Under Secretary of Defense, Science and Technology
  - Director, Acquisition Resources and Analysis
  - Director, Defense Systems
  - Director, International Cooperation
  - Executive Director, Defense Science Board
- Under Secretary of Defense, Policy
- Under Secretary of Defense, Comptroller
- Under Secretary of Defense, Personnel and Readiness
- Under Secretary of Defense, Intelligence
- Assistant Secretary of Defense, Networks and Information Integration
- Director, Force Transformation
- Director, Operational Test and Evaluation
- Director, Program Analysis and Evaluation

Joint Staff and Commands

Defense Agencies

- Defense Advanced Research Projects Agency
- Defense Information Systems Agency
- Defense Intelligence Agency
- Defense Logistics Agency
- Defense Security Cooperation Agency
- Defense Security Service
- Defense Threat Reduction Agency
- Missile Defense Agency
- National Geospatial-Intelligence Agency
- National Security Agency

Joint Program Offices

- Interagency Global Positioning System Executive Board
- Joint Computer Aided Acquisition and Logistic Support Program Office
- Joint Land Elevated Netted Sensor Program Office
- Joint Program Office for Biological Defense
- Joint Strike Fighter Program Office
- Joint Tactical Radio System Joint Program Office

Non-DoD

- Central Intelligence Agency
- Delaware River Maritime Enterprise Council
- Department of Commerce
- Department of Health and Human Services
- Department of Homeland Security
- Department of Transportation
- Department of Veterans Affairs
- Director of National Intelligence
- Federal Bureau of Investigation
- National Aeronautics and Space Administration
- Office of National Drug Control Policy
- United States Coast Guard

Institute for Defense Analyses