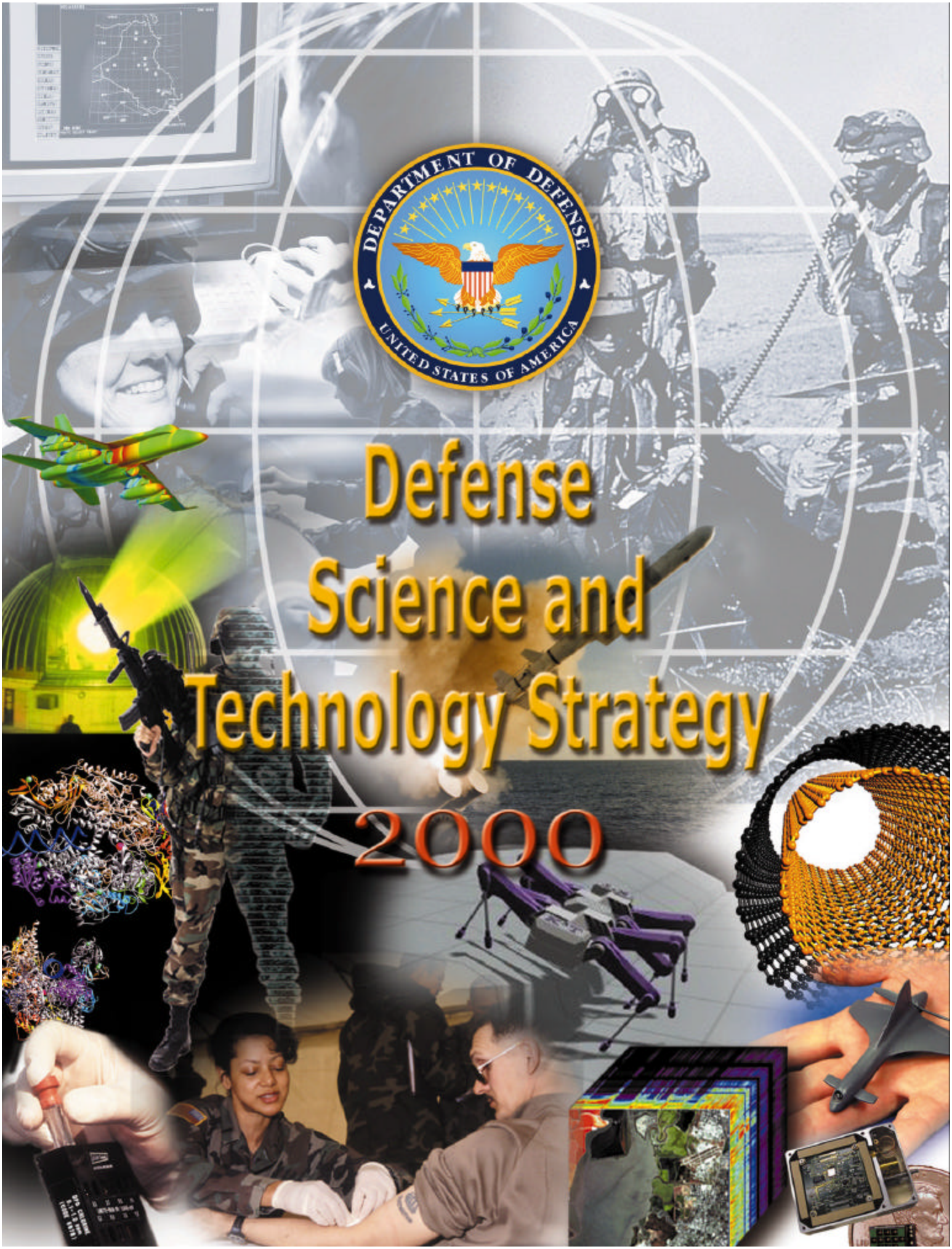

Defense Science and Technology Strategy 2000

OFFICE OF THE SECRETARY OF DEFENSE

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The mission of the Defense Science and Technology (S&T) Program is to ensure that warfighters today and tomorrow have superior and affordable technology to support their missions and to provide revolutionary capabilities. The development of a strategy to support this mission requires that one understand the full range of operations that must be performed by our military and the range of threats, including asymmetric threats such as biological warfare and information warfare. A successful strategy must foster research that develops new ideas and new innovations. It must also use the advances in information technologies to enable a revolution in military affairs based on total battlespace situation awareness and information assurance.

The strength of the Defense S&T Program depends directly on the health of its partners. These partners together provide the environment that supports the needs of the warfighter—from the universities that provide new ideas and knowledge; to Service laboratories that provide stability and ties to the operational forces; to DARPA for its commitment to high-risk, high-payoff programs; to other agencies that allow us to leverage our combined resources; to industry that provides innovation and transition of technology; and to our international allies for joint research programs that address interoperability from the beginning.

This document is a high-level description of a strategy that enables the Defense S&T Program to first understand what it must accomplish, and then to use a reliance process to implement those goals. For more details on the specific goals and the implementation process, I encourage you to review the other pieces of our defense S&T documentation: the *Joint Warfighting S&T Plan*, the *Defense Technology Area Plan*, the *Defense Technology Objectives* document, and the *Basic Research Plan.*

Technological superiority is a critical component to our national security. In peace it provides deterrence; in crisis it provides options; in war it provides the edge.

Delores M. Etter

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Deputy Under Secretary of Defense
(Science & Technology)

Defense
Science and Technology
Strategy

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Department of Defense
Deputy Under Secretary of Defense
(Science and Technology)

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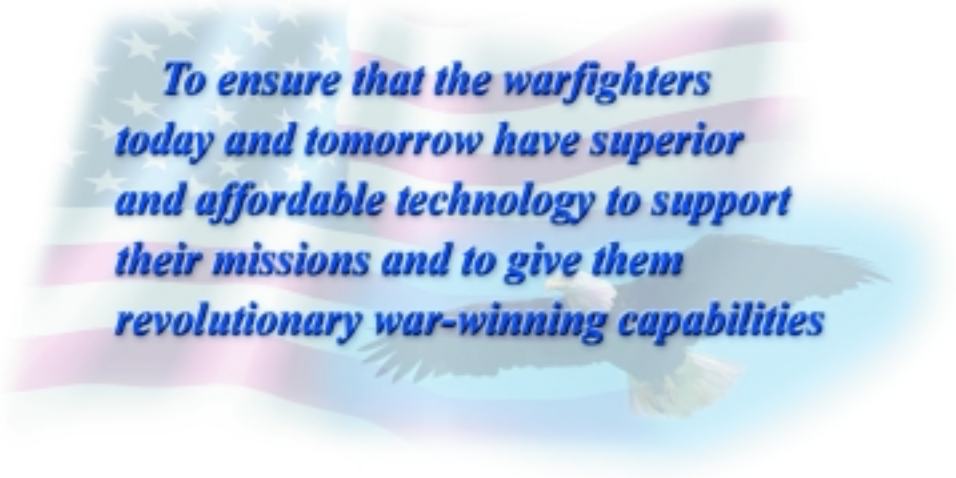
Summary

Focusing on Warfighter Needs

The nation relies on the technological superiority of its armed forces. First and foremost, the mission of the Defense Science and Technology (S&T) Program is to ensure the warfighters today and tomorrow have superior and affordable technology to support their missions and provide revolutionary war-winning capabilities. To do this, we must understand the warfighters' needs. Fundamental to understanding those needs is an understanding of the strategic environment in which the warfighter operates, now and in the future.

DoD S&T Mission

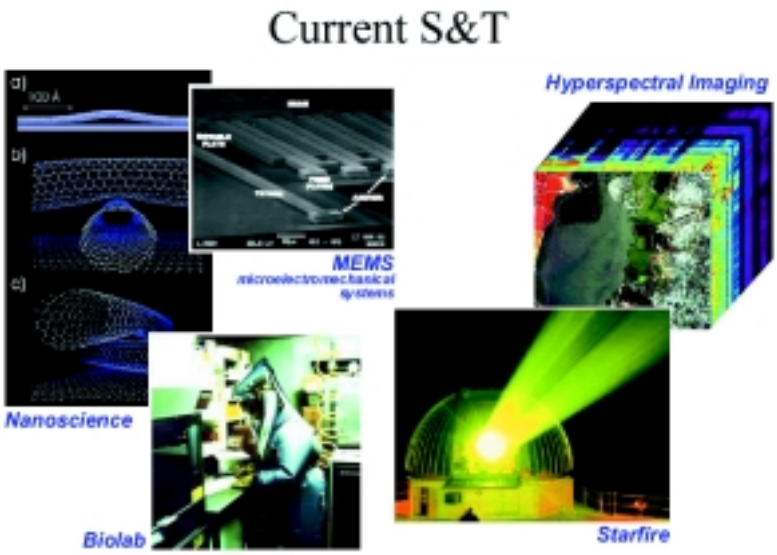


The Strategic Environment

To provide for national security in the 21st century, the U.S. military must be able to dominate the full range of military operations, from humanitarian assistance to major theater warfare. This strategy requires the Department of Defense to help shape the international security environment in ways favorable to U.S. interests, respond to the full spectrum of crises, and prepare now to meet the challenges of an uncertain future. Key to achieving this full spectrum dominance will be the ability of U.S. forces to acquire information superiority and the technologies that enable it. The importance of information superiority is discussed in detail in the Chairman of the Joint Chiefs of Staff's *Joint Vision 2010* (JV 2010). Additionally, the technologies that will make our forces lighter, more mobile, and more lethal will also be key. Now is the time to focus defense investments on the research and technology development needed to meet new and undefined threats. Technological superiority is a principal characteristic of our military advantage. In building our portfolio of technology investments, three important concerns will influence our choices: asymmetric threats, leveraging the technology explosion, and enabling the Revolution in Military Affairs (RMA).

Asymmetric Threats

The global spread of advanced technology is transforming the military threats faced by the United States and will challenge our ability to achieve full spectrum dominance. In order to carry out our defense strategy, the U.S. military must be prepared to conduct multiple, concurrent, contingency operations worldwide. It must be able to do so in any environment, including one in which an adversary uses asymmetric means such as nuclear, chemical, or biological weapons; information operations; ballistic missiles; and terrorism. Future adversaries will increasingly rely on unconventional strategies and tactics to offset the superiority of U.S. forces. Our combat forces must be organized, trained, equipped, and managed with multiple missions in mind. We must be conscious of these threats as we foster technology breakthroughs that will lead to new capabilities to cope with that environment.



Leveraging the Technology Explosion

Increasingly many defense needs can be met by leveraging the commercial technology explosion and utilizing commercial products such as computers, software, electronics, and communications. As military capability moves toward information-based warfare and as the information age continues to experience a technology explosion in the civilian economy, there will be an abundance of opportunities to leverage commercial technologies and products for military use. The Department will monitor commercial technology and product developments and adopt or leverage such offerings when they show promise of enhancing military capability. The Department will bring together the warfighters, DoD planners, scientists, and engineers to explore ways to take advantage of the opportunities offered by rapid commercial technology advancements. Even in areas where applicable, the commercial technology explosion will not by itself satisfy our warfighter's needs. Many warfighter needs are exclusively military, so there is no commercial technology. Other warfighter needs have elements in common with commercial technology, but are driven by military requirements. The challenge for the defense S&T community will be to choose what technology to leverage and what technologies we must develop with our own investments.

Enabling the Revolution in Military Affairs

Our vision for the 21st century is a warfighter who is fast, lean, mobile, and prepared for battle with total battlespace situation awareness and information assurance. Our military strategy, as stated in JV 2010, is to be based on Information Superiority—real-time intelligence from "sensor to shooter." Our Defense S&T Program is a critical step in providing the weapons and equipment our combat forces will need to meet our strategic objectives in 2010 and beyond. The RMA is a conceptual point of departure for future joint operations. The dawn of the information age has given rise to a new RMA sparked by leap-ahead advances in information technologies and information processing

capabilities. Our nation has led, and maintains a significant advantage, in the development of information-based technologies. The Department has been actively pursuing improvements such as precision-guided munitions, the Global Positioning System, and satellite communications for decades. We are only now beginning to understand how significantly this new information-based RMA will transform the essential elements of U.S. forces. To succeed across the full spectrum of operations, the Department will develop innovative new concepts for conducting operations, test them through demonstrations and rigorous experimentation, and rapidly transition the enabling technologies into revolutionary war-winning capabilities. The development of revolutionary technology, including but not limited to information technology, will be essential to the RMA. The Defense S&T Program will reorient its portfolio toward more revolutionary technology developments.

Science and Technology Investments

As mentioned above, *Joint Vision 2010* provides a high-level description of the joint warfighter's needs. A more detailed articulation is presented in the Joint Warfighting Capability Objectives (JWCOs) that form the basis of the *Joint Warfighting Science and Technology Plan*. The JWCOs cover a broad area of future warfighting capabilities, and the Defense S&T Program will continue to address each of the JWCOs validated by the Joint Requirements Oversight Council. However, cross-cutting topics deserve special priority. The Department will focus a significant portion of its S&T investment in the following five areas.

Information Assurance

Information technology has been a core research area for the Department since the beginning of computing. This research area remains vital, and will be even more significant to the Department as commercially available information technology proliferates.

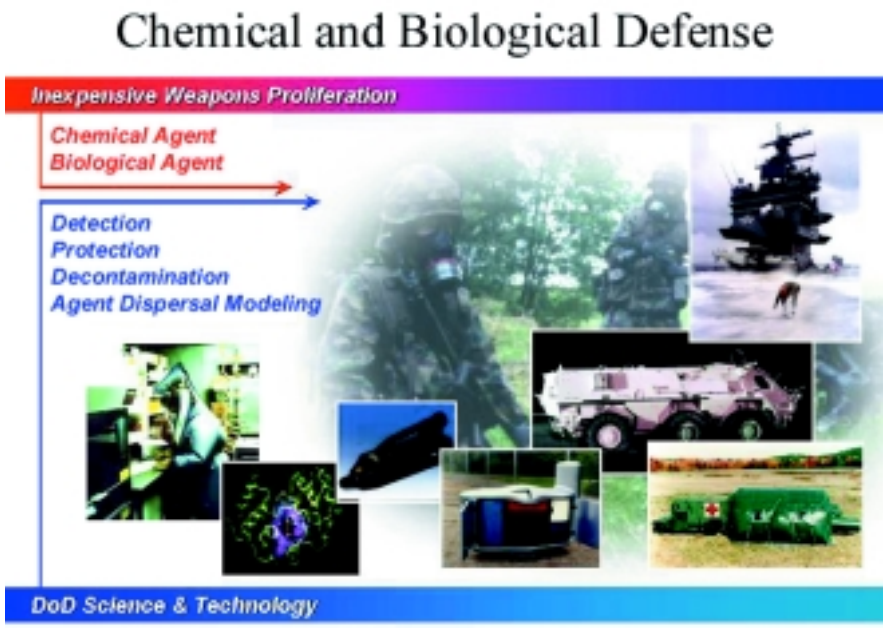
We are identifying technologies that will address activities related to cyberterrorism and better protection for critical information systems, both on the battlefield and throughout the nation. We will provide the technology to ensure our forces can acquire, verify, protect, and assimilate the information needed to effectively neutralize and dominate adversary forces. Information Superiority is a key enabler for Joint Vision 2010. It is the backbone of the RMA that will allow U.S. forces to achieve total battlefield dominance.

Battlespace Awareness

The near future will see a proliferation of sensors and associated processors available for battlefield use. Total battlespace situation awareness and understanding, coupled with information assurance, will provide real-time intelligence from "sensor to shooter." Commercial and military space technology and systems will provide major leaps in coverage, timeliness, and resolution. As a result, the amount of raw information available to the battlefield commander and soldier, sailor, airman, and marine is increasing at an ever-expanding rate. In concept, smart sensor webs will be developed to integrate networks of sensors to provide near-real-time representations of complex battlefield information to the warfighters. The sheer weight of information available to the warfighter will result in the need for technical help in sorting, mining, understanding, and acting on that knowledge. Cognitive readiness will be essential to exploiting battlespace awareness. We will continue to find and develop technologies to increase battlespace awareness.

Force Protection

The 21st century warfighter must have the capabilities to survive, fight, and win in a contaminated environment. The Department's Chemical and Biological Defense program integrates all medical and nonmedical programs and invests in technologies to provide improved capabilities against existing and emerging threats, while minimizing adverse impacts on our warfighting potential. Chemical and biological defense is based on three integrated principles: contamination avoidance, protection, and force



sustainment. The Department has also initiated a technology development program to detect, characterize, and neutralize hardened and deeply buried targets. This focused activity is in response to the emerging threats from nations with underground facilities that protect weapons of mass destruction (WMD) and communications sites. For counterforce applications, automated systems will be developed to accurately process and analyze large volumes of information in near real time. In addition to the identification of hardened and deeply buried targets and timely notification to shooters, improved penetrating munitions will be developed for counterforce missions. Revolutionary new weapon capabilities such as directed-energy weapons will receive increased emphasis. Developing the technologies that protect the force and allow it to operate wherever needed will be a priority of the Defense S&T Program.

Reduced Cost of Ownership

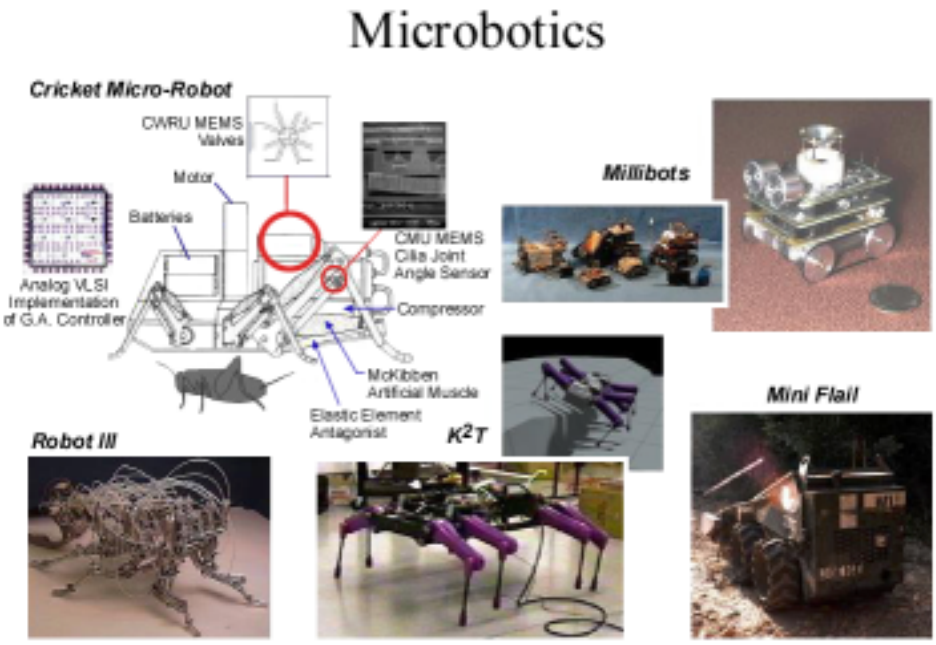
Defense budget reductions have forced an increasing emphasis on affordability as a leading investment factor governing the S&T program. DoD acquisitions will not meet warfighter's needs within current budgets unless we reduce the costs of development, procurement, and life-cycle operation. Since 1989 the Department has dealt with declining budgets by judiciously slowing force modernization to concentrate on maintaining force readiness and quality of life. The Department must now embark on the modernization of our forces to ensure continuing readiness in the 21st century. For this modernization to be possible within our reduced budgets, the Defense S&T Program will provide advanced technology that is timely and affordable. The cost to own, operate, maintain, and upgrade is greater than the cost of initial acquisition for most systems. Thus, full life-cycle costs will be considered during technology development and demonstration, and programs specifically aimed at reducing life-cycle costs will be pursued. As an example, new propulsion technology holds great promise to reduce the cost of fuel and the per-pound cost of launching military payloads into space. Where

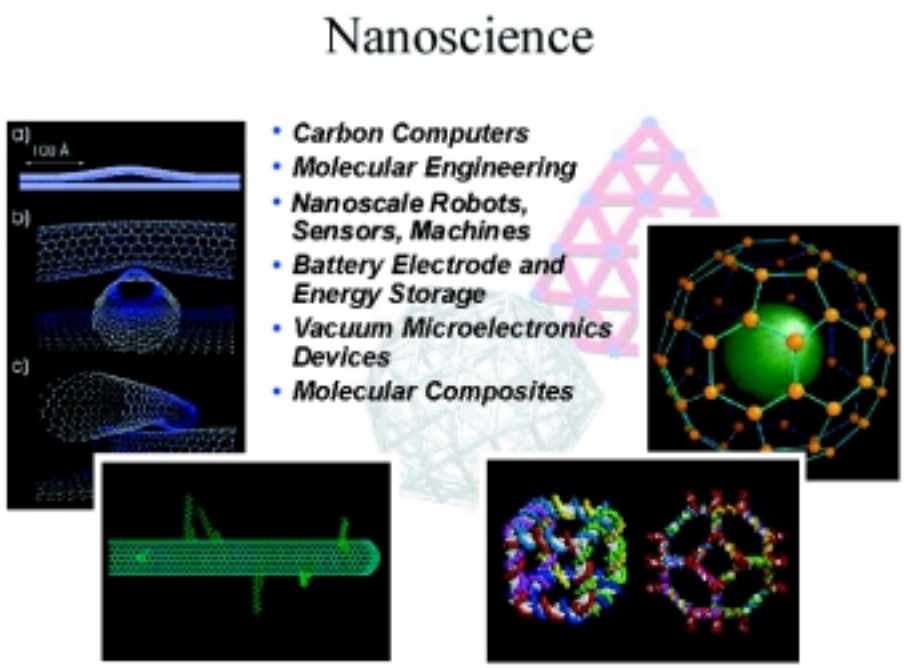
appropriate, S&T projects will focus on increasing the effectiveness and decreasing cost, increasing operational life, and incrementally improving materiel through upgrades. The S&T program will provide options to reduce operating and support costs to enable the modernization of our forces with smaller budgets.

Maintaining Basic Research

New military capability and operational concepts emerge from many different sources. Historically, the Defense S&T Program has responded to the known needs for military capability and enabled the development of totally new operational concepts and capabilities. This has allowed us to keep the technological edge on which our forces have relied. It follows that the way to address future warfighting needs is to invest in broad areas of research that have high potential of yielding revolutionary advances as well as pursuing solutions to known operational problems. An investment in basic research pays dividends in many ways.

Basic research is a long-term investment with emphasis on opportunities for military application far in the future and contributes to our national academic and scientific knowledge base by providing approximately 40 percent of the support for all engineering work. The Department sustains its investment in basic research because of proven, significant, long-term benefits to the military, which in turn enhances our national economic security. Basic research provided the foundation for technological superiority in each of our recent conflicts. Radar made a significant contribution to winning World War II. Stealth, lasers, infrared night vision, and electronics for precision strike played a major role in the Gulf War. Our nation's defense advantage is founded on a wide scope of scientific and engineering knowledge. The Department must continue to invest broadly in defense-relevant scientific fields because it is not possible to predict precisely in which areas the next breakthroughs will occur.





Science and Technology Support for the Warfighter

The Department's S&T Components each play an important role in the Defense S&T Program. The Services provide the stable long-term part of the program, focused on their Services' responsibilities. The Service S&T communities are also constantly looking for opportunities to achieve revolutionary breakthroughs; however, they must also support the acquisition and logistics systems that produce and maintain military equipment. Each Service has a vision of future capabilities required to support the core competencies they are uniquely responsible for maintaining.

Department of the Army

The strategic goal of Army science and technology is to provide technical solutions to accelerate the Army's transformation into a 21st century force that is dominant across the full spectrum of operations. This force must be more strategically responsive and versatile than today's force. The primary challenge is to develop and mature technologies that will eliminate current distinctions between heavy and light force capabilities. This means that heavy forces must become lighter and light forces must become more lethal and mobile. This Objective Force must also be more survivable with overmatching agility while simultaneously reducing logistics demands. The Objective Force will be equipped with technology and organizational designs to rapidly transition from humanitarian assistance to major theater of war operations without loss of momentum. The centerpiece S&T program for achieving Objective Force capabilities is the Future Combat Systems (FCS) program. The FCS is envisioned as a system of systems land combat capability with multimission functionality. FCS primary design characteristics include networked command and control on the move, beyond line of sight "direct fires," advanced long-range precision indirect fires, standoff sensors, and robotics. Simultaneous with FCS development, the Army will mature other essential Objective Force technologies for full spectrum operations. This requires advances in fuel-efficient propulsion (ground and rotorcraft), compact electric power generation, advanced simulation, and medical and soldier system technologies. The Army will also seek "paradigm shifts" in warfighting capabilities perhaps as significant as the introduction of the tank and helicopter in the past. Breakthrough technologies will be pursued in high-payoff basic research investments—the Strategic Research Objectives.

Department of the Navy

The Department of the Navy's (DON) vision for its S&T program is to inspire and guide innovation that will provide technology-based options for future Navy and Marine Corps capabilities. To help focus the Navy's S&T program, the S&T community, in conjunction with the operational, acquisition, and resource communities, developed a set of Future Naval Capabilities (FNCs). These FNCs are approved by the Vice Chief of Naval Operations, the Assistant Commandant of the Marine Corps, the Assistant Secretary of the Navy for Research, Development, and Acquisition, and the Chief of Naval Research. The following 12 overarching FNCs will provide those capabilities that the DON operational forces believe are the most important for future Navy and Marine Corps warfighting dominance: autonomous operations, capable manpower, decision support systems, expeditionary logistics, information distribution, littoral antisubmarine warfare, missile defense, organic mine countermeasures, platform protection, time-critical strike, total ownership cost reduction, and warfighter protection.

The remainder of the Navy's S&T budget will support longer term, high-risk, high-impact efforts; largely support national naval research responsibility; and aim at addressing the DON's identified long-term Grand Challenges.

Department of the Air Force

The Air Force is committed to a strong science and technology investment that will enable a fully integrated aerospace force to meet 21st century challenges. The Air Force S&T investment strategy has been focused through a series of six integrated technology thrusts (space superiority, information dominance, agile combat support, aircraft sustainment, training for warfighting, and precision strike) that directly correlate with and will fully enable the Air Force's six core competencies (aerospace superiority, information superiority, rapid global mobility, agile combat support, precision engagement, and global attack). Through a carefully balanced investment portfolio of basic research, applied research, and advanced technology development, the AF S&T program will both protect the future and transition focused technologies to current/ planned weapon systems to improve their combat effectiveness, supportability, and affordability. Moreover, special emphasis is being placed on technologies that will make both current and future weapon systems "lighter, leaner, and more lethal," thereby directly supporting the Aerospace Expeditionary Force concept.

Defense Advanced Research Projects Agency

The defense S&T agencies are responsible for certain multiservice aspects of S&T and for designated programs that support national security objectives. DARPA focuses its S&T investment on technologies and systems that can provide radical improvements in military capability. DARPA is focused on enabling technical solutions to the national concerns of protection from biological warfare and information warfare attack, providing technologies and systems to give the U.S. military dominance across all types of operations with minimum risk to warfighters, and developing and exploiting disruptive, high-risk, high-payoff core technologies. The programs to provide operational dominance include technologies and systems for affordable, precision, moving target kill; dynamic command and control capabilities for mobile networks; near-real-time logistics planning and replanning; and future warfare concepts such as classification of hard and deeply buried targets and combined manned and unmanned operations. DARPA also sponsors investment in underlying enabling technologies for defense—information technology, microsystems technologies, materials technologies, and mathematics. The newest of these enabling technologies is the combination of biology with information technology, electronics, optoelectronics, sensors, and actuators, which promises to bring tremendous new capabilities to far-future military systems.

Defense Threat Reduction Agency

The Defense Threat Reduction Agency (DTRA) is charged with the mission to reduce the present threat of weapons of mass destruction while preparing for future, uncertain threats. The nuclear, chemical, and biological arsenals of the world must be reduced; weapons that remain must not be allowed to fall into the hands of those opposed to American interests. Should that happen, the United States must be prepared to protect its citizens and allies and to respond decisively should such weapons ever be used. DTRA will develop technology to provide a broad spectrum of options to respond to these emerging threats. Chemical and biological detection technologies, physical protection systems (e.g., masks), and medical countermeasures will exploit discoveries defining common chemical and biological principles in order to achieve a broad-spectrum coverage of threats.

Ballistic Missile Defense Organization

The Ballistic Missile Defense Organization (BMDO) is responsible for managing a ballistic missile defense program that focuses on three areas: theater missile defense (TMD), national missile defense (NMD), and advanced ballistic missile defense technologies. BMDO's technology investment strategy is focused on addressing the future missile threat and pushing our own technologies in response. BMDO leverages other Federal and industry research and development investments where appropriate, and integrates and demonstrates emerging technologies in modest system demonstrations. Using this approach, BMDO ensures that technology thrusts help develop near-term technology insertions to current acquisition programs or provide an advanced ballistic missile defense capability to address evolving missile threats.

Implementation

Reliance

The Defense S&T Reliance process includes a coordinating body that helps eliminate unnecessary duplication and seeks out opportunities for synergy, integrating the various Component programs into a corporate S&T program. Reliance enables the DoD S&T community to work together to enhance S&T's role in supporting the Department's acquisition programs and warfighters. The Reliance planning process is overseen by the Defense S&T Advisory Group chaired by the Deputy Under Secretary of Defense (Science and Technology). Reliance is responsible for preparing the *Joint Warfighting Science and Technology Plan,* the *Defense Technology Area Plan,* and the *Basic Research Plan.* These three documents are often referred to as the Defense S&T

Plans. The Department will continue to use the Defense S&T Reliance process to coordinate and integrate the Department's S&T efforts.

High-Quality S&T Infrastructure

Declining defense budgets have forced reductions of laboratory infrastructure, both in facilities and personnel. This has added risk to the Department's ability to innovate in the long term and respond to new warfighter requirements in the short term. As DoD laboratories become smaller, an emphasis must be placed on ensuring the excellence of the people, the facilities they work in, and the equipment they use. Within its capabilities and authorities, the Department will continue to pursue initiatives to recruit and retain top scientists and engineers and to maintain and operate modern facilities.

Joint Experimentation at U.S. Joint Forces Command

The Secretary of Defense has assigned to the Commander-in-Chief, U.S. Joint Forces Command (USJFCOM) the responsibility for conducting Joint Experimentation. USJFCOM will use the *Joint Warfighting Science and Technology Plan* as a primary source for identifying technological capabilities to be incorporated into concept development and experimentation activities. Feedback from Joint Experimentation will influence where emphasis will be placed in the Defense S&T Program.

Technology Transition

Our cold war acquisition process, while very successful at producing highly effective military systems used in the Gulf War, needs streamlining. We must reduce development time and acquisition costs for fielding critical technology to rapidly meet warfighter needs and remain viable in a constrained resource environment. Increasingly, advanced technology is becoming available on international markets, requiring DoD to accelerate the development process as never before. Rapidly transitioning technology from S&T to an operational capability is crucial. To speed up the technology transition process, three important mechanisms—Advanced Concept Technology Demonstrations (ACTDs), Advanced Technology Demonstrations (ATDs), and Joint Experiments—have been established to ensure the transition of innovative concepts and superior technology to the warfighter and acquisition customer both faster and less expensively. ACTDs are a key element in the S&T program to determine the military utility of proven technologies, expedite technology transition, provide a sound basis for acquisition decisions, and develop the concept of operations that will optimize effectiveness.

Partnerships

Partnerships are critical to a healthy S&T program. Key partners include:

- *Universities*—for their new ideas and knowledge
- *Service Laboratories*—for their stability, long-term investments in S&T, and ties to the operational forces
- *DARPA*—for its focus on high-risk, high-payoff research

- *Industry*—for its innovation and transition of technology
- *Other Agencies*—for their expanded resource base that leverages DoD resources
- *International Allies*—for their interactions that build on our combined technology base and allow us to address issues such as interoperability early in the research activities.

Our S&T program is stronger because of these partnerships, each of which brings something unique to the solution of national security problems.

Summary

In peace, technological superiority is a key element of deterrence. In crisis, it provides a wide spectrum of options to the national command authorities and commanders in chief, while providing confidence to our allies. In war, it provides an edge that enhances combat effectiveness, reduces casualties, and minimizes equipment loss. In view of declining defense budgets and manpower reductions, advancing affordable military technology and ensuring that it undergoes rapid transition to the warfighter are critical national security obligations.

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