Congressional Testimony

EXCERPTS FROM STATEMENT OF

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Mr. Chairman and Members of the Subcommittee: We appreciate the opportunity to appear before you today to report on a wide range of research and development issues. However, before taking your questions, we would like to spend a few minutes giving you our perspective on where we are today in providing our forces with the best equipment and support possible, and where we want to be — both in the near future and within the next 10 or 20 years — and how research and development plays a key role in that future.

Responding to New Threats

The 1997 Quadrennial Defense Review outlined the prospect of continued global dangers and established our strategic goals for meeting projected threats in the early 21st century. It is our strategy to promote regional peacekeeping efforts; to prevent or reduce conflicts and threats; to deter aggression and coercion; and to respond to the full spectrum of potential crises. In order to carry out this 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, biological, or chemical weapons. Our combat forces must be organized, trained, equipped, and managed with multiple missions in mind.

The security environment in which we live is dynamic and uncertain, replete with a host of threats and challenges that have the potential to grow more deadly. We are not facing a few disorganized political zealots armed with pistols and hand grenades. Rather, we must defend against well-organized forces armed with sophisticated, deadly weapons and access to advanced information and technology. They represent a different and difficult challenge to forces organized and equipped around traditional missions (particularly when we must also continue to expend significant resources to be equally prepared for potential, more traditional missions).

Future, hostile forces are unlikely to attempt to match overwhelming U.S. superiority on a plane-for-plane, ship-for-ship, or tank-for-tank basis, but are more likely to use asymmetrical strategies against us — including weapons of mass destruction, information warfare, and large quantities of relatively low-cost cruise and ballistic missiles. They can also utilize commercial navigation, communications, and imagery satellites.

The Defense Science Board, in its 1998 Summer Study Task Force Report on our response to transnational threats, warned that, today, even an adversary with a relatively small defense budget can become a significant regional threat and, increasingly, can project (or threaten to project) this threat worldwide. It noted that this smaller adversary could present a nontraditional military force as deadly and destructive as large conventional forces. Military conflict is being dramatically transformed by the rapidly changing nature of modern technology.

Of course, this is nothing new. Throughout history, advances in technology have directly and indirectly transformed the course of warfare. From spear and longbow, to the invention of gunpowder and dynamite, to the use of aircraft and the machine gun, and on to chemical, nuclear, and biological weapons, as well as the current information age, we have seen how revolutionary advances in weaponry have influenced the nature and extent of combat.

The Revolution in Military Affairs and Business Affairs

How do we counter these changing threats and keep ahead of accelerated modernization by the new adversaries facing us in the early 21st century? Clearly, we must perform better than they do and retain our vast superiority in the quality of our personnel and in our forces' mobility, global projection, and weapon technology. These, combined with information superiority, will assure our nation's future security posture.

Revolution in Military Affairs

Our vision for the 21st century is a warfighting force that is fast, lean, mobile, and prepared for battle with total battlespace situational awareness and information assurance. Our military strategy, as stated in the Joint Chiefs of Staff *Joint Vision 2010* posture statement, is to be based on Information Superiority — real-time intelligence from "sensor to shooter." When combined with precision weapon delivery, this is the backbone of the "Revolution In Military Affairs" that will allow us to achieve total battlefield dominance.

Dominance of the 21st century's digital battlefield will come only to those able to "see" clearly across all intelligence disciplines and maintain a constant stream of information to decision makers, warfighters, and to a new breed of "brilliant" weapons. Modern, so-called "reconnaissance/strike" warfare (often referred to as the essence of the Revolution in Military Affairs) is based on real-time, all-weather, accurate, and secure information systems, combined with long-range, unmanned, "brilliant," highly lethal weapons designed to achieve precision kills. Put more simply, we must be able to find, follow, and engage the enemy with lethal force, using weapons that allow us the flexibility to quickly modify the mission parameters. The digitized battlefield will provide commanders at all levels the information needed for complete situational awareness, and it will allow the acquisition, exchange, and employment of information to support planning and execution in a joint network-centric battlespace. Moreover, the cornerstone of this network-centric warfare is the use of satellites, ground terminal equipment, and modern radios that provide the sensor-to-shooter links so vital to future warfighting.

The 21st century battlespace will also require an entirely new generation of advanced technology on the battlefield — from improved sensor technology to an increased ability to identify moving targets, to far better systems-of-systems integration, not to mention a renewed examination of remote piloted vehicles as platforms for both delivery and observation. Many of these requirements are of course already the targets of our research and development efforts: for instance, hyperspectral imaging will provide us a new resource for "nowhere to hide" capability, including characterization of hardened and deeply buried targets.

"... The complexity, tempo, and dispersion of current military operations stresses traditional training and education systems based in the classroom ... time spent in on-site education and training impacts operational readiness. Development of new learning technologies to address these concerns and provide cost-effective systems will provide high-quality, "learner-centric" systems for military training and education."

Revolution in Business Affairs

To help pay for this Revolution in Military Affairs, Secretary Cohen announced in November of 1997 the Defense Reform Initiative. The DRI, as it is called, is a basic restructuring of the way the Department does business. It calls for a Revolution in Business Affairs. Although our military is unquestionably the strongest in the world, our defense establishment has labored under outdated and outmoded policies, procedures, and infrastructure designed to deal with a Cold War threat — many of which are at least a decade out of date and far behind the private sector, which restructured and revitalized, is now competing strongly in a dynamic global marketplace.

Our technological advantage is quickly lost unless we keep at least two steps — and several technological generations — ahead of the enemy. This requires us to reduce cycle times in the development, procurement, and updating of new and modified weapon systems. In order to meet the demands for such vastly reduced cycle times, we determined that we needed to abandon traditional methods of acquiring advanced technology. We must accelerate, broaden, and institutionalize our acquisition reform — thus shifting resources from infrastructure and support to combat and more effective modernization. This deals with the Business Revolution in its broadest context: from competitive sourcing of all work that is not inherently governmental; to privatization of housing; and, of course, continuation and full implementation of the weapons acquisition reforms begun and expanded over the last few years. If we are to produce affordable systems quickly (which is required to keep up with the new technology cycles), we clearly must pursue nontraditional approaches; such as maximum use of commercial equipment, as well as significant design process changes, and (in the production area), use of integrated — commercial and military — assembly lines for defense-unique items, taking maximum advantage of the potential offered by flexible manufacturing and "lean" design and production techniques.

Clearly, many — if not most — of our future conflicts will require ground forces. But, in general, our approach will be to replace massed forces with massed firepower, precisely placed on targets. Our reaction to new forms of aggression must be swift and decisive. The first few days, if not the first few hours, can easily determine the outcome. Our response must come within hours, with sustainability in place in days — not in weeks or months. Such responsiveness requires a significant change in doctrine, tactics, organization, equipment, and, particularly, decision making — a task made far more

challenging in a coalition environment. Each of the Services and each of the CINCs [Commanders in Chief] are now going through such transformations.

Just a few years ago, performance was our benchmark for developing new weapons systems; today, it is performance at affordable cost—specifically, at a cost that will allow us to obtain the quantities required. Today, "cost" is a requirement that must be considered at every stage of our acquisition process—while still continuing to enhance weapons' performance.

We know we must look across the spectrum in our decision-making process. The Army has developed a simulation based acquisition system know as "SMART"—Simulation and Modeling for Acquisition, Requirements, and Training. The vision for SMART is a process that capitalizes on modeling and simulation [M&S] tools and technology to build high-quality weapon systems and equipment in a cost-effective and efficient manner.

The Crusader program is currently in development and provides a good example of SMART application and the benefits that result. This howitzer and its resupply vehicle will give the Army, for the first time in decades, a system for providing close artillery fires that match and exceed the capabilities of potential enemies. Crusader will be the premier cannon system in the world, with significantly enhanced mobility, range, rate of fire, and survivability. Using the virtual prototype, a physical interference with the two automatic munitions loading arms was discovered. Engineers were able to redesign the prototype and verify that a single arm loader resolved the interference problem and still met weapon system specifications and criteria. This design flaw would have been costly to the program had it not been discovered and resolved early, before the system went into production.

The leadership of the Department of the Navy signed out its first ever DoN Business Vision and Goals [BVG] in July of 1999. The Navy Revolution in Business Affairs is a broad business vision, a set of business goals, and a series of initiatives focused on moving toward that vision. There are many ongoing programs and initiatives that fit into the business vision. The Navy's SMART WORK Program is committed to improving the quality of the work environment. It focuses on the fact that people are our most important asset. We are therefore funding many SMART WORK initiatives focused on achieving efficiencies and relieving our personnel of burdensome or unnecessary work: advanced paint coatings and contractor preservation teams to more effectively and efficiently maintain our ships; automating fuel fill control systems to reduce oil spills; and other initiatives to reduce repetitive maintenance for our personnel. The Navy is also instituting an Enterprise Resource Planning system, which will allow the entering of financial and inventory information just once. It will permit everyone from the Secretary of the Navy to the youngest seaman recruit to work from a common database. Last year, Congress designated the Department of the Navy as the executive agent for implementing SmartCard throughout DoD. They have already issued a SmartCard to every recruit at Great Lakes boot camp, and by this summer should have SmartCard installed on four battle groups and amphibious readiness groups.

Our defense industrial base has undergone necessary consolidation; and we, in turn, must capitalize on the lessons learned from the successful commercial transformation—how to adopt modern business practices; consolidate and streamline; embrace competitive market strategies; and eliminate or reduce excess support structures. Our future direction must include greater competition; greater civilian/military integration; and strengthened global links in order to achieve the full potential of our defense industrial base.

Unfortunately, potential adversaries are able to rapidly capitalize on modern technology, for example: commercial communications/navigation/earth surveillance satellites, low-cost biological/chemical weapons, cruise and ballistic missiles, etc. If they can't develop them, they can purchase them—and the skills to use them—on the world arms market. Therefore, we must develop effective countermeasures to this technology; for example: information warfare defenses, vaccines, and special medical agents to counter biological and chemical weapons, defenses against ballistic and cruise missiles, and the ability to destroy hard and deeply buried targets. In some respects, we have become the victims of our own technological advances. Our successes in using new technology to our advantage in operations such as Desert Storm and Bosnia have made those technologies an object for acquisition by all.

Yet we have no choice. We must develop the defenses, and we must do so in a coalition context. For example, ballistic missile defense—essentially hitting a bullet with a bullet—poses a particularly difficult challenge; and deploying an integrated coalition theater missile defense system—one that collectively hits all the incoming missiles instead of all of us going for the first one coming at us—is an even more demanding technical and management problem. Unless all systems—weapons communications and command and control—are fully interoperable, the complex job of theater missile defense cannot be effectively achieved.

In addition to developing and deploying countermeasures to our adversaries' use of advanced technology (weapons of mass destruction, information warfare, etc.), perhaps the most important implication of the revolution in technology and its global spread is the need for the acceleration of advances in technology in order to maintain superiority on the battlefield.

Research and Development Goals

From a Research and Development perspective, to accomplish this we must ensure that the warfighters today and tomorrow have superior and affordable technology to support their missions, and to give them revolutionary war-winning capabilities. Our number one acquisition priority is providing the

weapons and equipment our combat forces and our allies will need to meet our strategic objectives in 2010 and beyond. One of the difficulties is that we must always be looking with one eye to the day ahead and another eye to the distant future – 10 or 20 years down the line. What do we need to serve the warfighter in 2010 and ensure our national security well into the 21st century? There are five weapons-oriented goals we are working to address:

- First, in the information area, to achieve an interoperable, integrated, secure, and "smart" command, control, communications, computer, intelligence, surveillance, and reconnaissance [C4ISR] infrastructure that encompasses both strategic and tactical needs.
- Second, in the "strike" area, to develop and deploy – in sufficient quantities – long-range, all-weather, low-cost, precise, and "brilliant" weapons for both offensive and defensive use.
- Third, to achieve rapid force projection, global reach, and greater mobility for our forces. With uncertainty over where they will be required, and the need for extremely rapid response to a crisis anywhere in the world, this capability –when combined with the first two elements – will provide us with overwhelming military superiority.
- Fourth, to develop and deploy credible deterrents and, if necessary, military defense against projected, less traditional early 21st century threats, which include: biological, chemical, and nuclear weapons; urban combat; information warfare; and large numbers of relatively low-cost ballistic and cruise missiles. These threats represent priority issues for our resources – even if it means impacting some of our more traditional areas.
- Fifth and finally, to achieve not only inter-Service jointness, but also interoperability with our allies. This is essential for coalition warfare and even more important given the realization that coalition-driven operations will become the norm, rather than the exception, in the future. We must ensure that our allies' technologies complement those of our overall forces. To accomplish our goal of information superiority, we are taking steps to make certain that the C4ISR systems and advanced weapons – such as theater missile defense systems – of ourselves and our allies are fully interoperable.

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Cognitive Readiness

To achieve the capabilities outlined in *Joint Vision 2010*, our Armed Forces will rely on superior learning technologies that must be available on demand, anytime, anywhere. It is known that the complexity, tempo, and dispersion of current military operations stresses traditional training and education systems based in the classroom (synchronous learning). In addition, time spent in on-site education and training impacts operational readiness. The pace of technological change in weapons systems and complex cognitive demands of the variety of missions, including missions-other-than-war, further complicate this concern. Development of new learning technologies to address these concerns and provide cost-effective systems will provide high-quality, "learner-centric" systems for military training and education under the Department's overall Advanced Distributed Learning program.

Learner-centric systems require technologies for both synchronous and asynchronous learning, requiring that we undertake technology development through focused research investments in human factors, cognitive task assessment, learning object modules, adaptive learning, intelligent tutors, information network design, knowledge agent development, advanced distributed learning standards, embedded training, and modeling and simulation-based collaborative tools.

Technology Enablers

"Technology Enablers" are vital to the success of the Department's RDT&E programs. While they do not fit neatly into any particular technology compartmentalization scheme, they are nevertheless critical to the success of individual and collective S&T programs. Examples of such enablers would certainly have to include the Department's High Performance Computing Modernization Program and our Modeling and Simulation program. The Department recognizes the tremendous impact of these technologies in the development, maturation, and evaluation of our existing and future warfighting technologies. Over the last several years, the Department has developed a world-class computational and modeling infrastructure supporting over 5,000 scientists and engineers working on some of our most challenging technical and developmental problems. The Airborne Laser, the design of the Navy's DD-21, global ocean modeling, THAAD and other ballistic missile defense issues, and Automated Target Recognition are just a few of the projects. The progress we have made in these areas and a great host of others would simply not be affordable, or even achievable, without these technology enablers, and we encourage your continued support in the FY 2001 budget for our efforts.

Civil and Military Technologies Merging

As is apparent, warfighter systems and defense doctrines are constantly evolv-

ing to new dimensions. Many of the DoD science and technology achievements, designed to maintain a technologically superior military force, have progressed to the civilian economy and formed the basis of technological advancement in industry. Today, there is much movement of technology in the other direction, from the commercial world to defense. Historically, there had been a distinct difference between the technologies of warfare (gunpowder, cannons, and bombs) and those of the normal day-to-day commercial economy. As defense has moved increasingly toward information-based warfare, however, and as the information age has moved the civilian economy into the high-tech environment, there has been a growing merger of the technologies of the two arenas.

Common technologies, however, are not enough to yield dual-use operations; there are other areas of concern. The commercial sector frequently offers lower-cost, higher-quality, faster new product realization times and state-of-the-art performance and equipment that meet environmental requirements that are at least as rigid as those of the military. The Department has three programs in particular—the Domestic Technology Transfer program, the Commercial Operations and Support Savings Initiative (COSSI), and the Dual Use Science and Technology program —which foster this innovative environment.

Domestic Technology Transfer Program

The DoD Domestic Technology Transfer Program encompasses a wide range of activities involving spin-on, spin-off, and dual use. One technology transfer instrument especially important is the Cooperative Research and Development Agreement [CRADA]. While this instrument was designed to transfer federally developed technology to enhance the economic competitiveness of private industry, we have found CRADAs to be a viable method for the DoD laboratories to jointly develop technology with industry, universities, and state and local governments. Both DoD and the non-Federal partners may contribute personnel, services, and property in support of CRADAs, but all direct funding is provided by the non-Federal entities. The flexibility of this instrument is unparalleled —we have 1,751 active CRADAs — up from 1,364 a year ago. We are doing research in a wide range of technology areas, including vaccine technology, hazardous materials management systems, software development, acoustics and signal processing, imaging technology, and laser development. One project completed this year via CRADA is a forced air de-icing system. It uses a patented nozzle that shoots a 700-mile-per-hour air stream injected with de-icing fluid to remove ice and snow from aircraft surfaces. This system uses 30-50 percent less fluid than current de-icing systems and can de-ice a plane in a fraction of the time it takes with fluid alone. Both American Airlines and the Air Force have ordered this forced air de-icing system. Both the commercial and military sectors will save resources by reducing flight delays and costs associated with the de-icing process.

Commercial Operations and Support Savings Initiative

Many DoD systems are being retained far beyond what was initially anticipated

Section 912c Working Group Completes Final Report

The Section 912c Working Group, chartered by the Office of the Secretary of Defense (OSD) in 1998, has completed its Final Report on the "Future Acquisition and Technology Workforce." Dated April 2000, the Report is the culmination of a series of studies conducted by OSD and the Components to support initiatives described in Section 912(c) of the National Defense Authorization Act (NDAA) for Fiscal Year 1998. The 1998 NDAA directed that the Secretary of Defense submit to Congress an implementation plan to streamline the acquisition organizations, workforce, and infrastructure.

The Director, Systems Acquisition, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (USD[AT&L]) was tasked to chair a Senior Steering Group and to establish a working group to describe the performance characteristics and training requirements of a future acquisition and technology workforce. The group was also directed to outline action plans and the requisite documentation, legislation, and other tools to support career paths for transitioning from today's workforce to the DoD acquisition and technology workforce of the 21st century. The Senior Steering Group and the Working Group membership included representatives from OSD staff, the Military Departments, and the Defense Agencies.

The Final Report recommends measures that will allow DoD to realize a vision of a future acquisition and technology workforce that will be smaller, highly talented and motivated, adaptable, knowledgeable of commercial business practices and information technology, and able to operate in a dynamic, rapidly changing environment. Recommendations were developed in three major categories: Competencies, Developing the Workforce, and Hiring and Recruitment.

The Final Report recommended the following actions be initiated as soon as possible.

—The Deputy Under Secretary of Defense (Acquisition Reform (DUSD[AR]) and the Deputy Assistant Secretary of Defense for Civilian Personnel Policy (DASD[CPP]) should begin the examination of the recommended hiring and retirement initiatives and develop implementation plans for those that are approved. They should also prepare proposals for statutory changes for submission in the earliest possible legislative cycle.

—The DUSD(AR) and the DASD(CPP) should determine strategy for incorporating universal competencies in acquisition and technology professional development programs and submit an implementation plan by July 2000.

—The Overarching Acquisition Integrated Product Team and Functional Integrated Product Teams should compare future functional competencies created in this study with current competencies, determine the required adjustments, and prepare an implementation plan by July 2000. They should conduct a progress review with a senior steering group appointed by the USD(AT&L) as soon as possible and every 60 days thereafter until implementation is completed.

Editor's Note: To read the Group's entire report, visit **http://www.acq.osd.mil/ar/#sat1** on the Defense Acquisition Reform Web site.

and, as equipment ages, operations and support [O&S] costs increase. The Commercial Operations and Support Savings Initiative [COSSI] addresses increasing O&S costs by adapting available commercial technologies for use in military equipment. These technology insertions reduce O&S costs by replacing high-maintenance components with ones that are more reliable, less expensive to buy, and able to be upgraded more easily. For example, one project selected in FY 2000 will provide an electronic propeller control system for P-3 aircraft that will reduce propeller maintenance costs from $26 per flight hour to less than $4 per flight hour. COSSI currently supports 57 projects. The President's Budget requests $51.9 million for COSSI projects in FY 2001. This investment is essential if we are going to get O&S costs under control and keep our legacy systems operating at peak performance.

Dual Use Science and Technology Program

The Department's Dual Use Science & Technology Program allows the DoD and contractors to form partnerships for the purpose of developing technologies that can benefit both parties. A primary Program objective is to help the Department meet future defense requirements by leveraging the technological advances taking place in the commercial marketplace. The Program is meeting that objective. Since the Program began in 1997, the Department has initiated over 200 projects with industry. Over half of the approximately $800 million being spent on these projects has come from industry. In addition, more and more nontraditional suppliers are starting to participate in the Dual Use S&T Program. However, the real measure of success for the Program is how well it is doing in making the development of dual use technology into a normal way of doing business in the Services. Once again, it is working. The Services are increasingly using cooperative development approaches outside the Program as well as inside. For example, the Army's Communications and Electronics Command is initiating six dual use projects this year. Three have received funding from the Dual Use S&T Program, and three are being funded outside of the Program. The other Services and Commands are showing similar progress. The President's Budget for FY 2001 requests $30.4 million for the Dual Use S&T Program. This funding represents that which is required to maintain our momentum and reach our ultimate objective of making dual use technology development a normal way of doing business in the Services.

Manufacturing Technology/ Industry

To implement the DoD's Revolution in Business Affairs, we must take full advantage of the technologies and management lessons that have turned around American commerce and industry during the past decade. This means designing and building affordable systems and, simultaneously, cutting support and infrastructure costs. While continuing to explore long-term qualitative leaps forward in military technology, we must also lead the way in low-cost, advanced technology. Affordability is just as great a technical challenge as performance.

The DoD can achieve lower costs, improved performance, and reduced cycle time. Our efforts are resulting in increased combat readiness, better equipment, faster deployment, and overall superiority for the United States military. For example the Manufacturing Technology, or "MAN-TECH" program, focuses on the needs of weapon system programs for affordable, low-risk development and production, providing the crucial link between technology invention, development, and industrial applications. MAN-TECH is one of our keystone affordability programs, developing the process technology to make defense weapons and material better, faster, and cheaper. Our MAN-TECH request for FY 2001 is $149 million, up from the FY 2000 request of $133 million.

For example, the Army, Defense Logistics Agency, and American Metal casting Consortium invented a metal casting process that enables DoD agencies and suppliers to harness the benefits of metal casting with streamlined weapon systems part design. We use blanket purchase agreements with pre-qualified foundries and improved communications between suppliers and users. Over $4 million in annual life cycle savings is projected as a result of cycle time reductions and reduced parts count generated from redesign of various weapon systems components into casting assemblies, including the M1 tank, 120mm mortar, F-22 Raptor, lightweight howitzer, and other support equipment across the military services. We were honored to present this team the Hammer Award in 1999. While MAN-TECH is focused on developing improved technologies for Defense applications, transition to commercial products frequently occurs. The Navy's Advanced Fiber Placement program, developed in the early to mid-1990s, is now receiving widespread industrial-base application. This technology provides a state-of-the-art, automated machining process for composite material, replacing a more costly and less reliable touch labor process. Following initial implementation by Boeing and Northrop Grumman on F/A-18E/F stabilator, engine inlet ducts, and fuselage, technology application was expanded to include the V-22 Osprey fuselage skin, C-17 landing gear pod fairings, T-45 horizontal stabilator, and AH-1 helicopter main rotor spars and cuffs. Commercial applications include the Boeing helicopter 609, Boeing 777, and Raytheon Premier components. Over 14 fiber placement machines, valued at $37 million, have been sold to several prime aerospace contractors.

Conclusion

Mr. Chairman, we wish to thank the Committee for this opportunity to give you a broad overview of our defense research and development posture. The future of our modernization efforts will rely on the partnerships we form in the development and execution of our R&D programs, which in turn will enable tomorrow's warfighting superiority. The Congress and the Department have worked hard—together—to achieve our global dominance and to maintain our strength. We urge your continued support of our common, overriding interest in keeping our combat forces the best equipped, the best supplied, and the best sustained in the world.