Statement Testimony of

The Honorable Zachary J. Lemnios
Assistant Secretary of Defense for Research and Engineering (ASD(R&E))

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Mr. Chairman, Ranking Member Langevin, members of the committee, I am pleased to be here today on behalf of the dedicated men and women of the Department of Defense, who discover, develop, engineer, and field the critical technologies for our deployed troops and who are laying the foundation for a secure future. I would like to thank the members of Congress for your continued support of the Department's science and technology (S&T) program and our broader research and engineering (R&E) program[1]. Your steadfast support has allowed the Department to field technologically-based military capabilities that are unmatched anywhere in the world and provide the capability edge upon which our Soldiers, Sailors, Airmen and Marines rely.

I am also honored to be joined today by leaders of the Department's S&T organizations who will provide testimony in support of their individual S&T efforts: Dr. Marilyn Freeman from the Army, Rear Admiral Nevin Carr from the Navy, Dr. Steven Walker from the Air Force, and Dr. Regina Dugan from the Defense Advanced Research Projects Agency (DARPA). Their leadership of the DoD S&T community is critical to the ability of our forces to meet today's challenges and to prepare for the future. This team has worked closely over the past six months as part of the S&T leadership panel - the DoD Science and Technology Executive Committee (S&T EXCOM) - to ensure the Department's S&T investments are responsive to current and future warfighter needs. Together, we are keenly aware of the budget pressures facing the Nation and have made a collective commitment to ensure that the taxpayers' dollars provided to the Department's S&T enterprise are used wisely and efficiently.

FY 2011 Continuing Resolution Crisis

During the 17 February 2011 Congressional Budget hearings on the FY 2012 Defense Budget, Secretary of Defense Robert Gates said, "I want to start by making it clear that the Department of Defense will face a crisis if we end up with a year-long continuing resolution or a significant funding cut for FY 2011." This crisis would extend to the science and technology community. While much of the S&T program is planned and executed in a structured manner, the realities of a rapidly evolving and adaptable adversary in Afghanistan mean that we must conduct new starts in programs like the Joint Capability Technology Demonstration (JCTD) in a timely manner. We must also be able to reprogram available funds for higher priority needs. Operating under a year-long continuing resolution or with substantial reductions to the President's FY 2011 Budget request would allow neither, and would result in the loss of tools the Department needs to more rapidly adapt to emerging threats. One example is the delay in planned research efforts of the Systems Engineering Research Center (SERC) to advance the state of the art in Systems Engineering. The additional costs to the Department and uncertainly imposed on the defense industrial base, especially the small business community, hinder the innovative capabilities needed by the Combatant Commanders (COCOMs) for their area of operations. A long-term continuing resolution is also impacting the basic science community, especially academia, with the delay of previously authorized FY2011 initiatives.

FY 2012 Alignment to Department Budget Themes

In his recent State of the Union address, President Obama declared the following;

> "This is our generation's Sputnik moment. Two years ago, I said that we needed to reach a level of research and development we haven't seen since the height of the Space Race. And in a few weeks, I will be sending a budget to Congress that helps us meet that goal. We'll invest in biomedical research, information technology, and especially clean energy technology -– -- an investment that will strengthen our security, protect our planet, and create countless new jobs for our people".

We are here today to describe the FY 2012 President's Budget Request for the Department of Defense science and technology, to show how prior investments have maintained our technological edge and to show how the FY 2012 investment will continue to provide critical capabilities for our Nation's

[1] Science and Technology (S&T) is defined as the sum of basic research (6.1), applied research (6.2) and advanced technology development (6.3). Research and Engineering is S&T plus Advanced Component Development and Prototyping (6.4). Both S&T and R&E are activities that occur before initiation of formal acquisition programs.

security. The FY 2012 R&E budget of $25.88 billion supports the Department's FY 2012 budget themes and meets Secretary Gates' commitment to support the critical S&T needs of the Department[2].

The budget request contains 2.2 percent real growth in Basic Research (Budget Activity 6.1) and net 1.9 percent real growth across all S&T funding, compared to the FY 2011 President's Budget Request.

My testimony will provide an overview of the Department's S&T strategy and the key strategic initiatives in the FY 2012 budget and will outline recent accomplishments to integrate the Department's S&T and engineering activities. My colleagues will review their Component's projects in their respective testimony.

An Integrated Research and Engineering Enterprise

The Department's research and engineering enterprise encompasses a remarkable pool of talent and resources. Our footprint includes 67 DoD laboratories dispersed across 22 states with a total workforce of 60,000 employees; 35,400 of whom are degreed scientists and engineers, who conduct DoD-relevant research leading to key technology demonstrations and publish thousands of reports and peer-reviewed technical papers. In many cases, this community defines a technical field with seminal work and leads the industrial base in their respective areas.

We operate 10 Federally Funded Research and Development Centers (FFRDCs), 13 University Affiliated Research Centers (UARCs) and 10 Information Analysis Centers (IACs) across critical disciplines for the Department. These institutions enable the Department to connect with top technical talent across the Nation in fields ranging from cyber security to ballistic missile defense to advanced microelectronics and more. They provide objective systems engineering, objective red team assessments, gold standard test and evaluation, deep dive technical talent and innovative paths for rapid prototyping.

We also enjoy a strong relationship with industry and academia through a variety of programs designed to foster collaboration, including the Small Business Innovation Research (SBIR) program; Cooperative Research and Development Agreements (CRADA), and the DoD Reserve Officer Joint Reserve Unit (JRU) within ASD(R&E). In fact, in FY 2010, the Department issued approximately 2,000 SBIR Phase 1 awards (as a result of 12,000 proposals), and approximately 900 Phase 2 awards and engaged in approximately 2,500 CRADAs across a broad industrial base. Each of these is an avenue of innovation and a transition path to bring ideas into the Department and transition concepts developed in DoD Laboratories to commercial use.

Lastly, we continue to foster a strong relationship with future scientists and engineers. Our National Defense Education Program (NDEP) of DoD scientists and engineers in 26 states have engaged 180,000 students and 8,000 teachers. Our Science, Mathematics and Research for Transformation (SMART) program funds 670 undergraduate, graduate, and doctoral students in 19 DoD-relevant fields of study.

We are strategically shaping this enterprise to address a new set of technical and operational challenges for the Department. As described below, we have begun to focus our Laboratory, Basic Science, and Science, Technology, Engineering, and Mathematics (STEM) programs to address a common set of basic science emerging areas and S&T priorities. This will grow our technical talent pool in critical areas for the Department and provide industry and academia clear direction for future technical concepts and talent.

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[2] Office of the Under Secretary of Defense (Comptroller) / CFO, Fiscal Year 2012 Budget Request, February 2011.

Challenges for the Department's Research and Engineering Enterprise

We are in a period of remarkable change. Innovation, speed, and agility have taken on greater importance to our efforts given today's globalized access to knowledge and the rapid pace of technology development. For decades, the U.S. military's dominant operational capabilities were largely due to the continued development and delivery of superior technology by the defense research and engineering enterprise. In this environment, three factors have prominently shaped our thinking about the Department's S&T program:

1. **New technical capabilities for new Department missions**: The 2010 Quadrennial Defense Review (QDR) described the imperative to reshape America's military for today's wars while preparing for the most likely and lethal threats of the future.[3] It describes a complex and uncertain security landscape which requires new concepts and capabilities across the six key missions.[4] The Department's S&T enterprise has been successful in delivering capabilities to our Armed Forces to support the existing missions as well as emerging QDR missions, but there remain opportunities to create new capabilities that would provide utility across all mission areas.

2. **New approaches to overcome globalization of research and development:** The innovation environment that has been a hallmark of the United States since World War II, and the model for other nations, is evolving globally. The research and development (R&D) talent, financial resources, and manufacturing systems are integrated, but increasingly geographically dispersed.[5] The pool of experienced and talented researchers is increasingly globalized, led primarily by multi-national corporate R&D centers being established in new locations, many outside the United States. The recent acceleration in the development of research and development centers in Asia has been particularly rapid and far-reaching, as these economies grow.[6] This globalization has transformed technological innovation, lowered barriers across the globe for a wider range of actors to acquire advanced technologies, and potentially challenges the Department's ability to have assured access to leading-edge technologies.

   To mitigate this increased risk, we have strengthened collaboration efforts with our international partners to uncover and exploit potential scientific and technology breakthroughs, wherever they occur, and to contain whatever threats they may portend.[7] We have also launched a new initiative to develop the technical foundation for engineered resilient systems to mitigate supply chain vulnerabilities.

3. **Assuring the supply of Science, Technology, Engineering, and Mathematics talent for the Department:** Preparing for the future is a critical responsibility and our ability to provide future capabilities to our forces is contingent on our science and engineering talent. I am concerned about the future availability of science and engineering talent, particularly as we may see many of our exceptional scientists and engineers retire. By 2018, more than 60 percent of the federal workforce will be eligible to retire, and this figure includes many in our DoD laboratories.[8] I am also concerned that the defense industrial base, universities, and FFRDCs supporting the Department will also face science and engineering recruitment challenges. In our university, pipeline, the supply of qualified and interested U.S. students in the technical fields most relevant to defense is declining.[9] Today, over two-thirds of the engineers who receive PhDs from U.S. universities are not American citizens and recent data show many of these foreign-born

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[3] http://www.defense.gov/qdr/images/QDR_as_of_12Feb10_1000.pdf

[4] The six missions are: Defend the United States and support civil authorities at home; Succeed in counterinsurgency, stability, and counterterrorism operations; Build the security capacity of partner states; Deter and defeat aggression in anti-access environments; Prevent proliferation and counter weapons of mass destruction; and operate effectively in cyberspace.

[5] S&T Strategies of Six Countries: Implications for the United States (2010), The National Academy Press, 2010.

[6] Ibid, p.4: "Experienced researchers are becoming harder to find in the U.S. and Europe, as Asian emigrant scientists return to attractive opportunities at home." Also, "Most U.S. and European Fortune 1000 companies already have multiple R&D centers and manufacturing sites throughout Asia, and they direct increasing shares of R&D budgets accordingly."

[7] National Research Council, Op. Cit. Key Recommendation 9-1.

[8] U.S. Senate Special Commission on Aging, Kohl Hearing, Legislation to Improve Federal Government's Hiring, Retention of Older Workers. See http://aging.senate.gov/hearing_detail.cfm?id=297184&.

[9] From: "Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5", p8, See: http://www.nap.edu/catalog/12999.html

graduates leave the U.S. to pursue careers in their native countries, or in countries with strong economies.[10] Our Science, Technology, Engineering, and Math (STEM) program is critical to ensuring the Department's future workforce. I will report on our STEM efforts later in this testimony.

These three factors – cross-cut capabilities for QDR missions; the globalization of research and development; and the decline in the supply of science and engineering talent convinced me that we need improved management models and imperatives to coordinate and guide our science and technology investments across the Department.

Department Science and Technology Executive Committee (S&T EXCOM)

In FY 2010, we established the DoD Science and Technology Executive Committee, which I chair, to implement improved coordination and to ensure a healthy and robust S&T enterprise. The S&T EXCOM is comprised of leadership from the Department's largest S&T organizations plus Under Secretary of Defense for Policy (USD(P)), Assistant Secretary of Defense for Nuclear, Chemical, and Biological Research, the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (DASD(M&IBP)), and the Director, Joint Staff Force Structure, Resources, and Assessment Directorate (the J8). This body meets monthly to coordinate S&T strategic issues and to assure the Department's S&T investments are well-coordinated, focused on the highest-quality research efforts and responsive to current and future warfighter needs.

Inclusion of USD(P) has resulted in a close alignment of DoD S&T investments with Departmental policy. This has created opportunities for S&T to influence policy choices that in the past may not have had the benefit of wider options offered by emerging S&T concepts. Inclusion of the DASD(M&IBP) has opened opportunities for effective coordination of DoD S&T with defense industrial policy initiatives. Finally, the J8 has provided a key source for operational, warfighter input into the DoD research and engineering strategy.

Research and Engineering Imperatives

The Department's research and engineering enterprise is structured around the following four imperatives:

1. Accelerate the delivery of technical capabilities to win the current fight;
2. Prepare for an uncertain future;
3. Reduce the cost, acquisition time, and risk of major defense acquisition programs; and
4. Develop world class science, technology, engineering, and math capabilities for the DoD and the Nation.

Using these four imperatives as a framework, the remainder of this prepared testimony will give you information on our S&T activities over the past year and plans for FY 2012. The information provided focuses mainly on Departmental projects and initiatives funded by OSD program elements; information about Component activities is provided in the prepared remarks of my fellow witnesses at today's hearing.

[10] Ibid, p4, See: http://www.nap.edu/catalog/12999.html

Imperative 1: Accelerate the delivery of technical capabilities to win the current fight and develop the skills and processes to rapidly field capabilities in any future fight

The Department's research and engineering enterprise has undertaken a number of actions to improve the Department's ability to respond to COCOMs' needs, some which are urgent and needed immediately for current operations.

First, there has been a marked increase in the frequency and substance of connections to the COCOMs and their staffs. This is frequently done through personal visits to the Commander, in addition the OSD and component staffs conduct weekly and sometimes daily discussions with their counterpart COCOM staffs. These exchanges provide us with a front-line understanding of the operational challenges they face and the capability gaps they experience. Armed with this information we are better positioned to provide tailored solutions that address their highest priority concerns in a shorter period of time.

Second, we have strengthened connections with the COCOM Science and Technology Advisors. In Afghanistan, the Army's Research, Engineering and Development Command (RDECOM) leverages a network of Science & Technology Assistance Teams (STATs) and Science & Technology Acquisition Corps Advisors (STACAs) to gather and distribute first-hand knowledge of warfighter needs. RDECOM staff share what they learn with representatives across the Department. OSD is establishing a web portal to enable real-time direct exchange among the technical staffs, which better facilitates alignment of our investments with emerging COCOM needs. We also assist the COCOM staffs with analyses and field trials to refine the definition of capability needs and present candidate solutions. Several examples of delivered capabilities include the following.

Helicopter Alert and Threat Termination - Acoustic (HALTT-A) Program was discussed in testimony last year as an emerging capability.[11] The first two demonstrators have since been tested at the Army Aberdeen Proving Ground, sent to the 10th Combat Aviation Brigade at Ft. Drum for flight testing and has been deployed to theatre in Afghanistan protecting our troops. The systems have collectively logged more than 820 hours of mission time (351 missions) and are providing valuable operational data for future improvements. All of this was done in less than 12 months in close cooperation with Army Aviation and the Joint Staff.

Gunslinger Package for Advanced Convoy Security (GunPACS) provides enhanced situational awareness and cooperative engagement capabilities for ground and combat logistics elements in Afghanistan. Utilizing networked data fusion, such cooperative engagement enables more accurate and effective fire. In less than three months, four prototype systems were readied for operational deployment to the 1st Marine Division.

Mobile Modular Command and Control (M2C2) provides on-the-move, over-the-horizon communications and digital command and control (C2). The capability, delivered on an MRAP to Afghanistan, includes an integrated suite of tactical radios, broadband satellite communications, and staff kits with secure wireless network connectivity. This capability was fielded in seven months.

eXperimental Fuel Cell (XFC) Submerged Launch is a long endurance, stealthy (small and electric propulsion) unmanned aerial system (UAS) equipped with high quality real-time or stored video, capable of being launched from a submerged submarine or platform. Started in May 2010, this capability is being readied for delivery.

Low Collateral Damage Munitions is the work the Air Force is undertaking to develop munitions that minimize collateral damage – an important capability identified by the COCOMs. Munitions

[11] Prepared Statement of Zachary J. Lemnios, Testimony before the United States House of Representatives Committee on Armed Services Subcommittee on Terrorism, Unconventional Threats and Capabilities, 23 March 2010.

scientists from the Air Force Research Laboratory teamed with the Lawrence Livermore National Laboratory to design and test an advanced composite-case warhead that disintegrates during the explosion and minimizes fragmentation, thus decreasing damage and injury to nearby structures and personnel, including friendly forces and innocent civilians.

Third, the Department improved the Joint Concept Technology Demonstration (JCTD) program processes with a focus on speed and flexibility. Seventy seven percent of JCTD new starts are on track to rapidly develop and demonstrate new concepts, with two years set as the objective threshold. This is a marked improvement from 2009 where less than 20 percent of JCTD new start projects were completed in less than three years. Given the globalization of research and development it is important to accelerate the demonstration of innovative concepts and technologies, and field those that offer the most promise faster than our adversary. The JCTD program is instrumental in meeting that objective. Areas of increased emphasis for this program in FY 2012 include:

- COCOM and interagency data sharing for enhanced warning and control;
- Enhanced force protection through the use of unmanned/remotely piloted systems for troop resupply;
- Improvements in cyber infrastructure to protect classified networks;
- Improved Intelligence, Surveillance and Reconnaissance research, developmental, testing and evaluation (RDT&E) integration venues;
- Biometric and forensic S&T initiatives for both collection and rapid exploitation.

Fourth, we are leveraging our Small Business Innovation Research (SBIR) community to field capability to the warfighter faster. Within the Office of the Secretary of Defense, we have launched an SBIR Pilot Program to identify several SBIR projects which are addressing COCOM needs. We plan to support Phase II prototypes, including access to ranges to rapidly demonstrate their inventions in realistic warfighting conditions. Since we are working closely with COCOM representatives in this process, we expect this pilot to result in exciting, innovative capabilities from our Small Business community that directly address some of the most urgent needs of our warfighters.

Imperative 2: Prepare for an uncertain future

The Department's investments in basic research, S&T priority areas and joint service engineering concepts and testbeds are critical enablers of technological superiority, and by extension, operational advantage. Each of these efforts builds the technical capabilities for new Department missions**.**

The Department's Basic Research Program

The Department's basic research program paves the way for our technological future – the scientific discoveries it yields today provide the foundation for tomorrow's capabilities. Given the increased global emphasis on research and development, the U.S. cannot assume an assured technological superiority on the battlefield: to do so it must remain on the scientific cutting edge. The President's commitment to an appropriately funded basic research program is reflected in the Department's FY 2012 budget request. This represents a $79M increase to $2.078B, or 2.2 percent real growth in basic research accounts compared to the FY 2011 President's Budget Request. The increase has been inspired by recent basic research successes made possible by DoD funding. For example,

- The 2010 Nobel Prize was awarded for the discovery of graphene, which will likely lead to a new generation of electronic materials. DoD-funded research was instrumental in understanding the far-reaching implications of this research.[12]
- The microbial fuel cell, cited by Time Magazine as one of the 50 top inventions in 2009, can produce electricity at the ocean floor by bacteria-reactions and bacteria-nanowires.[13]

[12] Y. B. Zhang et. al ., Nature, 438, 201 (2005)

- Recently, quantum coherent processes have been demonstrated that have extremely long lifetimes at room temperature. This opens the door to new sensors, precision metrology and extremely secure communication over long distances without the need for extensive cryogenics.[14]
- DoD-supported researchers demonstrated a "spaser" (surface plasmon laser) that emitted 564nm light from a 44nm composite particle. The implication of this device is that it allows for faster electronics while avoiding current limitations due to heat generation.[15]
- New paradigms of information processing were developed, based on the spin of the electron in addition to or in place of the charge.[16]
- Over the past year, Human Social Cultural Behavior (HSCB) researchers have developed tools for joint analysts to rapidly and accurately understand the impact of crowd sentiments, and tools for planners to develop courses of action and assess their impact on a commander's objective.

Over the past year, the Department assessed the basic research areas for investments that represent future high potential/high opportunity. For example, advances in engineered materials that have unique properties not found in nature have the potential for launching a new generation of computer chips, for greatly accelerating signal processing for DoD needs and for achieving super-convergent optical beams not previously possible. A new field – quantum information and control – exploits the spectacular, recent advances in controlling matter in the laboratory at the level of the individual atom. The full capabilities of this emerging field are not yet fully known, but resulting technologies will likely show up in secure communications, ultra-precision sensing, navigation, materials simulation, and data manipulation. Those who explore and exploit these and other disruptive areas, including synthetic biology, nanotechnology, cognitive neuroscience, and modeling of human and societal behavior, will likely gain an important competitive edge in warfighting capabilities.

Basic Research is fundamentally about creating knowledge, and innovation occurs when that knowledge is used in creative ways. The Department believes sharing basic research information helps advance the progress of knowledge and in the past year reaffirmed and extended its policy towards removing restrictions on publication of fundamental research results.

The Department's S&T Priorities

In FY 2010 and early FY 2011, we gathered over 200 scientists, engineers, operators and subject matter experts from across the Department and launched a comprehensive study to derive a set of S&T priorities to support the six QDR mission areas. This effort built upon the important work accomplished during the QDR deliberations in 2009 and 2010 and was modeled after two recent Defense Science Board Studies.[17] [18] Our study outlined the operational architectures, critical capabilities, and enabling technologies to support each of the six missions. We identified a set of seven cross-cut capabilities that are critical to one or more of the mission areas.

The S&T EXCOM chartered a Priority Steering Council (PSC) for each area to develop research and engineering 'roadmaps' to inform and guide Department S&T investments over the Future Years Defense Program and beyond for each of these seven areas. Members of the PSCs include DoD S&T enterprise senior-level subject matter experts from all components with investment or interest in an area and experts from outside the Department.

The Department S&T Priorities are inclusive of the entire DoD S&T enterprise, and are meant to be in addition to Component specific priorities:

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[13] L. M. Tender et.al., Nature Biotechnology, 20, 821 (2002)
[14] M. Ledbetter et. al., Photonics Spectra, December 2010 pg 17
[15] M. A. Noginov et. al.,Nature, 460,1110 (2009)
[16] S. A. Wolf et. al., Proceedings of the IEEE, 98, 2155 (2010)
[17] Defense Science Board 2006 Summer Study on. 21st Century Strategic Technology Vectors
[18] Defense Science Board. 2008 Summer Study on Capability Surprise

- **Cyber Science and Technology -** science and technology for efficient, effective cyber capabilities across the spectrum of joint operations.

- **Electronic Warfare / Electronic Protection -** new concepts and technology to protect systems and extend capabilities across the electro-magnetic spectrum.

- **Data-to-Decisions -** science and applications to reduce the cycle time and manpower requirements for analysis and use of large data sets.

- **Engineered Resilient Systems** - engineering concepts, science, and design tools to protect against malicious compromise of weapon systems and to develop agile manufacturing for trusted and assured defense systems.

- **Counter Weapons of Mass Destruction** – science and technology to improve DoD's ability to locate, secure, monitor, tag, track, interdict, eliminate and attribute WMD and materials.

- **Autonomy** – science and technology to achieve autonomous systems that reliably and safely accomplish complex tasks, in all environments.

- **Human Systems** – science and technology to enhance human-machine interfaces to increase productivity and effectiveness across a broad range of missions.

Joint Engineering Concepts and Testbeds

The Department's investments in joint engineering concepts and testbeds are executed out of ASD(R&E) and include the Joint Capability Technology Demonstration (JCTD) program and other efforts that apply broadly across the Department.

Adaptive Versatile Engine Technology (ADVENT)

The ADVENT program is developing engine technologies that provide optimized fuel efficiency and performance capabilities that could yield 25 percent or greater increase in engine fuel efficiency. ADVENT should provide a suite of revolutionary technologies for a range of air vehicles, including future and legacy turbine engine propulsion systems supporting subsonic and supersonic long-range strike, tactical aircraft, strategic and tactical mobility, and intelligence, surveillance, and reconnaissance operations.

The ADVENT program is a cooperative funding effort between the U.S. Air Force and OSD and leverages industry independent research and development efforts. The program is making excellent progress with successful completion of an adaptive fan test, a key milestone, and is on track to conduct the prototype engine demonstrations in FY 2013..

Airborne Laser Test Bed (ALTB)

The Department terminated the Airborne Laser Program in 2009, and determined the best use for the existing aircraft was as a research and development test bed. As a result, the Missile Defense Agency established the Directed Energy Research (DER) Program, which includes the ALTB and other directed energy technology development programs. The ALTB beam control system is the most sophisticated beam control system built, and the only one integrated with an aircraft. As an S&T resource the ALTB offers risk-reduction opportunities for future airborne systems in the areas of target acquisition, tracking and pointing (ATP), jitter control, optical degradation from boundary-layer turbulence, lethality, adaptive optics, contamination control and mitigation, precision tracking/handover testing, and thermal blooming compensation. The Department conducted a study that confirmed ALTB is an important national test asset and should be kept to advance directed energy research and

development. We seek your support for the Fiscal Year $96M request for the MDA directed energy research.

Cyber Science and the National Cyber Range (NCR)
As a new operational domain, the Department included two new Defense-wide Program Elements (PEs) in the FY 2011 budget to extend the technical underpinnings for cyber operations. These program elements are in the FY 2012 budget request as well. The Department requests your support for the Defense-wide Cyber Security Applied Research and Cyber Security Advanced Technology Development new-start programs, which integrate and transition collaborative research across DoD. In the FY 2012 budget request, the Department is also seeking an increase in the DARPA cyber programs. We see these efforts as complimentary; the OSD program will address architectures while the DARPA program will address high-risk, high-payoff approaches.

The Department considers the ability to operate in cyberspace as essential.[19] Focused and innovative projects, from basic research to advanced development, remain a high priority for investment. Much work needs to be done to understand cyber and protect against capabilities being developed by a growing number of potential cyberspace adversaries. It is important to develop specialized active defenses that make it extremely difficult to impossible for cyberspace adversaries to attack or penetrate our systems.

We believe it is also necessary to strengthen the scientific basis, at the most fundamental level, for cyber security. Last year we commissioned a study by the JASONs, a panel of world-class scientists, to establish the scientific foundations of cyber security.[20] The report and the Air Force's new Multidisciplinary University Research Initiative on the Science of Cyber Security represent the beginnings of new approaches to determine better ways to the existing cycle of developing cyber security measures and countermeasures to dynamic cyber threats. More work will follow in this area.

An example of a successful transition is the adoption and use by various organizations across the Department of the award-winning Lightweight Portable Security capability, developed by the Air Force Research Laboratory, which creates a bootable, safe, self-contained environment on un-trusted commodity computers. The technology enables authenticated users to safely connect to trusted DoD servers and conduct DoD business securely without exposure to local malware.

The Department is leveraging its Small Business Innovation Research program for cyber security research; with 46 SBIR projects in 2011. Additionally, the Department, in partnership with the Department of Homeland Security (DHS), is hosting the 5th annual Cyber SBIR Workshop this summer to bring small businesses and commercial integrators together with DoD and DHS user organizations and accelerate transition of SBIR investments.

In keeping with the goals of President Obama's Cyberspace Policy Review, DARPA has created important enabling technologies under the National Cyber Range Program. These advanced technologies enable the emulation of networks at large scale, providing researchers with opportunities to experiment with new cyber security approaches, including network architectures; additionally, operators can test new concepts for cyber operations. Later this year, prototypes will be built and tested by DARPA and United States Cyber Command (US CYBERCOM) employing new use cases and technology. We have formed an interagency working group, comprising at its core OSTP, DoD, DHS, DoC (NIST), and NSF, to work with DARPA and US CYBERCOM to transition the prototypes across the U.S. Government.

[19] William J. Lynn, "Defending a New Domain". Foreign Affairs, 2010.
[20] JASON Report (JSR-10-102), *Science of Cyber-Security*, the MITRE Corporation, November 2010.

Joint Experimental Range Complex (JERC)
The Joint Experimentation Range Complex (JERC) at Yuma Proving Ground in Arizona is one of DoD's premiere sites for the assessment and evaluation of technologies for combating terrorism and fighting insurgencies. First built in 2003, the three separate JERC sites that make up the complex provide a comprehensive capability that represents many aspects of the tactical environment which U.S. forces currently operate. The JERC sites provide an open, accessible, and operationally representative environment in which companies can assess, evaluate, and mature their capabilities prior to fielding. In 2010 alone, more than 120 potential solutions from multiple developers were evaluated under the sponsorship of the Rapid Fielding Directorate (RFD).

A wide variety of technologies are routinely evaluated at the JERC sites to include counter-IED electronic warfare and detection systems, advanced Information, Surveillance, and Reconnaissance (ISR) Systems, and manned and unmanned vehicles. The RFD and the Joint IED Defeat Test Board manage the test efforts in a cooperative fashion to maximize utilization of the complex and to prevent duplication of investments. Employing a unique process to assess new technologies for further development or rapid deployment, the RFD canvasses the developmental communities for potential solutions to identified needs, and then assesses those solutions by facilitating and resourcing evaluation periods with an independent government test director. This process provides developers of novel solutions direct access to the JERC's capabilities, including small businesses that otherwise would not have access to these capabilities. RFD-sponsored testing is typically conducted on several technologies during one- to two-week blocks every seven weeks. The JERC is currently staffed to sustain 6-day-per-week/24-hour coverage. The range support contractor has approximately 80 temporary on-call employees to support surge operations during intensive test periods. Current staffing is approximately 28 government and 320 contractor personnel.

Two of the JERC sites replicate urban warfare sites in a desert environment, and the third replicates desert mountain roads typical of Afghanistan. The range is heavily instrumented to support counter-IED test activities; essentially all test data are acquired on a real-time basis, facilitating rapid analysis of test results. The physical terrain features provide a very challenging environment to stress materiel solutions prior to deployment. In addition to natural terrain, significant urban environments have been developed including over 400 buildings constructed from realistic methods including adobe brick, concrete, and wood. The road network was constructed based on intelligence information on roadways and replicates the enviroments that were used for some of the deadliest attacks against U.S. and coalition forces.

Representative threat systems, including complex cellular and wireless networks, are maintained to represent the measures used to defeat our countermeasures. To complete the representation of the environment, the JERC includes a robust representation of the radio frequency environment, which has proven invaluable in testing electronic warfare and threat detection systems. The JERC is equipped with modern instrumentation systems and fiber optic data networks that allow for efficient and rapid data collection.

Our efforts at the JERC expand existing test and technical infrastructure to develop an effective capability evaluation and fielding approach that anticipates and rapidly responds to emerging threats. Our adversaries have repeatedly demonstrated the ability to quickly neutralize U.S. or coalition capabilities with inexpensive, relatively inefficient weapons such as IEDs. This operational reality demands that the United States continue to accelerate the development and fielding of new capabilities in order to adapt faster than the enemy.

Trusted Defense Systems
To strengthen our trusted systems effort, the Department is implementing a Strategy for Systems Assurance and Trustworthiness, as reported to Congress in 2010. The Strategy

consists of activities in four key elements: mission criticality as a priority, comprehensive approach to program protection, industry engagement, and advanced detection of vulnerabilities. This strategy provides program and system managers tools to assure hardware and software. It also instills system security engineering as a fundamental discipline to manage risk commensurate with the criticality of, and threats to, the weapon system. The strategy will enable program and system managers to minimize the chance that system performance is impaired through supply chain risk management and secure system design.

Secure Microelectronics Supply Chain
Much of the world's accessible microelectronics is fabricated by and under the control of foreign companies; many foundries are located offshore. Offshore chip design and manufacture present adversaries with opportunities to introduce malicious code or to corrupt chip design, rendering our weapon systems vulnerable to non-kinetic attack.

The Strategy for Systems Assurance and Trustworthiness will enable program and system managers to conduct supply chain risk management (SCRM) throughout a weapon system's lifecycle. This strategy builds on past studies and programs to provide program and system managers with tools to manage risk in a manner commensurate with the criticality of, and threats to, the weapon system.

The Department Trusted Foundry Program (TFP) is part of this effort. The TFP ensures the defense industrial base has access to leading edge, and secure, foundry technology at IBM and more than 90 additional microchip-related services at 46 other trusted suppliers.

The Defense Microelectronics Activity (DMEA) ensures the TFP's viability. DMEA is responsible for the accreditation of the trusted suppliers and they are the trusted manufacturing source for replacement chips no longer available from commercial vendors. The FY 2012 budget equipment upgrades to DMEA's facility to manufacture 90nm chips – a needed capability to keep DMEA as a supplier of last resort for trusted components no longer available from commercial suppliers

High Performance Computing Modernization Program (HPCMP)
The Department funds the High Performance Computing Modernization Program (HPCMP) to provide super-computing services to DoD's scientists and engineers. It is instrumental to a number of DoD communities. For example, the Developmental Test community uses the HPCMP for a wide range of test activities to include augmenting or replacing expensive wind-tunnel testing and predictions for armor performance against improvised explosive devices. There are six DoD HPC Centers. Over the past 18 months the Department reviewed the capabilities, functions, and value of the existing HPC program. The study yielded a number of recommendations to increase efficiencies, and these recommendations are being implemented. For example, the study identified several HPC-linked software development projects had reached sufficient maturity and will transition to other programs. Additionally, the Maui Super Computing Center is to be designated as a "green computing" Energy Efficient Center of Excellence and will pursue research to reduce super-computing power consumption, an important goal not only for DoD, but for all national users of HPC equipment. A further recommendation is that the HPC program be linked more closely to Service acquisition programs. In FY 2012, the HPC program will transfer from OSD to Army program management.

Systems 2020
While the Department strives to improve its processes and workforce to reduce the cost, acquisition time, and risk of major defense acquisition programs, we are also starting a technology development effort, Systems 2020, with the objective of significantly advancing the state of engineering practice and productivity in delivering adaptable and trusted

systems. Systems 2020 is a part of an umbrella science and technology priority designated by the S&T EXCOM: Engineered Resilient Systems (ERS).

The Systems 2020 program will seek new concepts and tools for the design of adaptable systems. Systems complexity remains a key challenge – past and current research and development efforts resulted in highly capable, but individually complex, software and hardware components. As a result, overall system complexity has increased significantly resulting in design delays, reduced flexibility, and increased system delivery cycles. The Systems 2020 effort will explore new concepts to integrate advanced engineering models that result in systems that are inherently more adaptable across mission sets and environments. The key idea is investigating advanced digital design approaches that enable engineers and warfighters to rapidly model and iterate new ideas under various operational conditions and recommend design approaches for instilling adaptable capabilities into the platform. Since it is becoming increasingly difficult to predict missions and operational environments, tools that enable understanding and design of adaptability into our platforms will be of enormous benefit to our forces.

The program will also research new concepts for design tools that enable real-time assessment of the security risks involved in systems design when using components from un-trusted sources. Manufacturers use components sourced by a global supply chain which increases risks for compromise of our systems; design tools that enable the understanding of the tradeoffs among performance, risk, and cost are needed.

We cannot remain competitive and responsive with a sequential, fixed requirement focused engineering design and manufacturing capability. Model based and platform based technologies and tools offer game changing opportunity to transform engineering practice to efficiently create, field, and evolve trusted defense systems which can readily adapt to inevitable changes in threat, technology and mission environments.

Data-to-Decisions

Increased investments in Information, Surveillance, and Reconnaissance (ISR) capabilities have resulted in many new deployed sensors yielding data in terabyte amounts that many thought inconceivable just a few years ago. The increased number and type of sensors have been critical to support our troops' efforts in Afghanistan and Iraq, and wherever they conduct the war on terrorism. These threats are usually small groups of individuals who quickly adopt new concealment tactics to evade detection, including hiding among the indigenous population. While the Department has been very successful in delivering ISR capabilities, this accomplishment has resulted in what some senior military commanders are characterizing as 'data deluge.' There has been insufficient progress in building effective technology to exploit this exponential growth in data. As a result, our warfighters are not able to use the data to gain a situational awareness advantage against adversaries, many of whom operate from sanctuaries in complex, dynamic environments.

To address the difficult challenges of making rapid operational decisions in the face of overwhelming volumes of data, we have launched a joint Data-to-Decisions initiative that will advance military decision support systems. The key goal is to develop an open-source architecture system that enables rapid integration of existing and future data exploitation tools, no matter who delivers the tools. The program will create libraries of analytic and user-interaction modules that can be repurposed across a multitude of joint missions. It will achieve this using a proven "build-test-build" process that iteratively improves technical components by providing "real-world" data sets to a contractor and academic consortium with oversight from front-line operators. Through this program, the rapid development and maturation of new decision support systems will provide the necessary tools to mine important threats and relationships from massive data sets.

Investments in Data-to-Decisions research will enable operators and analysts to organize and assess vast amounts of data. Development of capabilities to understand the human, social, cultural, and behavior dimensions is equally important to understanding the data in context of diverse cultures, and employing these insights to successfully achieve objectives in joint operations.

Technology Forecasting

The rapid rise and progress of science and technology developments around the world have increased the risk for technology surprise to our forces. In response, the Department is launching a new effort to develop modern tools that will incorporate scientific, intelligence, and international community inputs into a modern technology watch and forecasting framework.

The program will use current advances in computational and analytic capabilities to identify science and technology areas of concern or opportunities where the Department should invest. It will start with an in-depth analysis of technology forecasting methods that have been used in the past and their successes in predicting trends. The knowledge gained will provide a baseline for comparison of novel methods, approaches for aligning both qualitative and quantitative approaches within a broader foresight program, and metrics and methods for understanding accuracy and establishing ground truth.

We work closely with both the Intelligence Community and our Allies to ensure we leverage expertise, are challenged by orthogonal approaches, and ensure broad and deep thought diversity in 'red-teaming' not only our results but also our foundational methodologies. The results from this program will be used to better connect our researchers with key research activities occurring around the world.

Imperative 3: Reduce the cost, acquisition time, and risk of major defense acquisition programs

To be successful today and in the future, the Department's research and engineering enterprise promotes innovation in process, design, and engineering while achieving productivity growth, and "to learn to do more without more." To improve our success in acquisition programs, the Department has worked to enhance our engineering and test and evaluation policy and guidance and to improve the capability and capacity of our engineering and test and evaluation workforce.

Last year, the Department continued to develop Systems Engineering (SE) policy and guidance to drive better technical performance through the application of SE principles and best practices for the Department's acquisition programs. For example, in a major effort to improve technical effectiveness and operational efficiency, the Department undertook a dramatic streamlining of the Systems Engineering Plan (SEP) to reduce duplication with other milestone document submissions. This revision to the SEP makes it more useful, more technically complete, and more pertinent. This year, the Department will oversee initial applications of the revised SEP outline as "expected business practice" and will adjust the format and content based on feedback from implementation on upcoming programs and new statute and policy.

In September, 2010, the Department issued Developmental Planning (DP) policy to establish elemental DP principles in support of defense acquisition. As a result of this policy, the Services are engaged in fostering technical analysis and planning much earlier in the acquisition life-cycle. These engagements promote identification of technical risk before the Department makes large resource commitments to the development of proposed materiel solutions, and have resulted in deeper understanding of capability gaps and the refinement of initial acquisition phase activities. We established a department-wide DP working group to assist the Components in implementing this new policy, to disseminate the most recent information on OSD guidance, to share Component DP policy and implementation strategies; and to share lessons learned across the Department.

An important part of the Developmental Planning initiative is to ensure Materiel Development Decisions are made with the full needs of the user capability in mind so the systems we acquire are engineered to work effectively as part of system of systems. Increasingly, capabilities both within and across the Services, require engineering attention at the capability level and systems engineering for systems of systems has become more important. We published a guide to Systems Engineering for Systems of Systems which is being used in a variety of capability areas, we have been working with the Services to support their efforts to apply systems engineering for systems of systems, and we are now looking at how we ensure that we consider the role new systems play in current and prospective systems of systems as we develop new system concepts

The Department has also assessed existing DoD reliability policy and proposed actions to improve effectiveness of the current DoD 5000.02 policy. This assessment resulted in a draft policy requiring early and continued emphasis on Reliability and Maintainability engineering and test activities throughout the lifecycle.

The Department's SE personnel are engaged throughout the acquisition lifecycle to help shape a program's technical and management processes, ensure positive outcomes, and increase the probability of program success. SE participates in technical reviews of MDAPs, particularly the Preliminary Design Review (PDR) and the Critical Design Review which help inform the Milestone Decision Authority. SE participation provides ground-truth for assessment of these reports, and, in the case of the PDR, informs the Milestone Decision Authority's 2366b certification activities. Other activities include:

(1) **Program Support Reviews** (PSRs) are conducted to support pending Overarching Integrated Product Team program reviews, requests by the USD(AT&L), and requests from Program Managers. Systemic root cause analysis performed on PSR findings shows that the adequacy of staffing is the most prevalent issue in program offices.

(2) **Nunn-McCurdy Reviews** assess SE and risk management in support of certification reviews following a Nunn-McCurdy breach.

The Department's Developmental Test and Evaluation (DT&E) personnel also engage throughout the acquisition lifecycle to provide an impartial evaluation of a program through T&E expertise to identify key issues and risks needing design resolution before production. The primary T&E product at technical reviews is credible knowledge of a system, a component, or technology maturity as well as the ability to provide the end-user with a characterization of a system's capabilities and limitations. DT&E has increased focus on support to Program Managers by reducing burdensome and manpower intensive oversight requirements. DT&E insight and influence comes from early and continuous engagement with programs.

As part of the Department's Trusted Defense Systems strategy SE made significant advancements during 2010 to streamline, update and apply program protection and supply chain risk management policy, guidance and methods. SE personnel have developed a criticality analysis methodology, engineering guidance for system security, and updated the reporting format for program protection plans required at every milestone review. We have engaged with acquisition programs, supporting identification of critical components and shaping the risk mitigation strategy for software, hardware, or firmware vulnerabilities and supply chain exploit. We have also reached out to industry in the development of best practices and to develop a new discipline for system security engineering.

A key focus within the Department's research and engineering enterprise is to ensure (1) that the Department's engineering workforce is trained and certified to meet the needs of complex SE efforts and (2) that the Department's T&E workforce is also trained and certified to conduct testing, verification and validation of program capabilities. We have launched a comprehensive survey of the Department's Systems Planning, Research, Development and Engineering (SPRDE)-certified engineering workforce. This survey will assess the current competencies and identify any skills gaps that may exist between the workforce's current capabilities and those needed to meet current and future mission requirements. This

assessment and resultant gap analysis will help shape future workforce development and human capital planning initiatives.

We have established several engineering workforce development initiatives to address the growing department and industry challenge of attracting and retaining the most qualified systems engineering technical leaders to address defense acquisition challenges. These initiatives include implementation of the engineering portion of the Key Leader Professional Development program, working with the defense industry and engineering professional organizations on education and training initiatives, and conducting national and international workshops that explore lessons learned in systems engineering education, training and experience development. We are also analyzing the T&E workforce to understand the breakdown of personnel performing the DT&E mission across the Components. We plan to launch a comprehensive competency assessment to identify the gaps in skills, education, and training of the T&E workforce. This assessment will be used to update the Defense Acquisition University curriculum in FY 2012. In addition, we are enhancing the T&E education certification criterion to include a technical or science degree.

Both the program Lead Systems Engineer and the program Lead Test and Evaluation were formally established in 2010 as mandatory Key Leader Positions. This will clarify organizational authority and responsibility for SE and T&E within program offices and will strengthen technical engagement in major defense acquisition programs.

Also important to the Department's efforts in this imperative is the Systems Engineering Research Center (SERC). The SERC is a DoD University Affiliated Research Center which brings together a broad consortium of universities from across the United States to advance the state of the art in Systems Engineering. In FY 2010, we sponsored SERC research tasks to explore future systems engineering workforce competency needs and to investigate new approaches to cultivate, educate, and prepare the future SE workforce. These tasks include research in support of the development of an authoritative SE body of knowledge, development of a graduate reference curriculum for systems engineering, and methods for incorporating systems thinking into undergraduate engineering capstone courses. The SERC has recently performed key work in developing tools to quickly and graphically define a concept of operations for our systems, so that as missions and environments change, our warfighters can quickly articulate their needs. Further SERC research efforts in 2011 are on hold pending release of funds under the continuing resolution, and we seek your support to provide funds in FY 2012 for this effort.

At the direction of the BETTER BUYING POWER memorandum[21], and to improve the efficiency and effectiveness of technology maturity assessments for Major Defense Acquisition Programs (MDAPs), the Department over the last year developed a revised Technology Readiness Assessment (TRA) process to replace the traditional TRA previously used. Compared to the prior TRA process, the new TRA process reduces the total number of required assessments and streamlines those assessments that are conducted. This increased efficiency is achieved by firmly affixing responsibility for technology maturity risk identification and mitigation on Service Acquisition Executives and Program Managers vice OSD staff.

This new TRA process is still in development and may be adjusted to reflect feedback during initial execution. However, I believe that it will result in clearer roles and responsibilities among OSD and the Services that will sharpen the focus on technology maturity while simultaneously increasing efficiency and reducing overhead burden.

During this migration to the new TRA process, the Department continues to conduct "traditional" TRAs and performed over twenty in the last year. These assessments sharpened the program managers' focus to effectively address the risks of technology insertion. For example, the TRA for the GPS IIIA program identified a technology maturity challenge for extremely accurate and stable atomic clocks. Subsequently, GPS IIIA conducted the recommended space qualification testing to demonstrate

[21] http://www.acq.osd.mil/docs/USD_ATL_Guidance_Memo_September_14_2010_FINAL.PDF?transcriptid=4648

adequate clock reliability. I expect that the new TRA process will also directly support programs while simultaneously providing Congressional and DoD leadership oversight

Imperative 4: Develop world class science, technology, engineering, and math capabilities for the DoD and the Nation

The final imperative addresses the goal of developing world class science, technology, engineering, and math capabilities for the DoD and the Nation. As President Obama said in the State of the Union address, "Maintaining our leadership in research and technology is crucial to America's success. But if we want to win the future – if we want innovation to produce jobs in America and not overseas – then we also have to win the race to educate our kids."

The Department depends on the technical skill and exceptional aptitude of its research and engineering workforce in its labs, in the defense industrial base, and in universities for innovation and success in the research and engineering initiatives designed to meet national security challenges. Ensuring our future workforce will possess the technical competencies necessary to meet future needs is an increasing challenge, and the FY 2012 budget requests funds for Science, Technology, Engineering, and Math (STEM) programs to ensure we meet the challenge.

In May 2010, the Department submitted to Congress its STEM Education and Outreach Strategic Plan. This plan, developed by 27 senior leaders from across the DoD, lays out our vision to develop a diverse, world-class STEM talent base by. The implementation strategy strengthens our STEM education and outreach portfolio and provides for specific processes and measurement criteria. The strategy includes a STEM governance architecture consisting of a DoD Executive Board, and links to the newly formed National Science and Technology Committee (NSTC) on Education and a defense industry forum.

Core to the strategy is the National Defense Education Program (NDEP). NDEP invests in inspiring, developing, and attracting the current and new generation of STEM talent. NDEP also enhances students and world-class researchers' interest in DoD by offering opportunities for direct engagement with DoD labs and Component technical staff.

NDEP's K-12 program enhances STEM education through public-private engagement between DoD and local schools and organizations. DoD research and engineering professionals serve as direct conduits for inspiring students to learn STEM and, in the process, motivate many to pursue STEM careers. Currently, 1,750 DoD scientists and engineers in 26 states have engaged 180,000 students and 8,000 teachers.

The Science, Mathematics and Research for Transformation (SMART) program funds 670 undergraduate, graduate, and doctoral students in 19 DoD-relevant fields of study. SMART is a scholarship-for-service program - participants commit to one year of DoD employment for each year of academic support received. Since 2006, nearly 300 students have transitioned into the DoD workforce. The program is popular – we received 2,800 applications earlier this year and selections will be made soon.

The National Security Science and Engineering Faculty Fellowship (NSSEFF) focuses on distinguished scholars and graduate students. The program awarded long-term funding to 29 distinguished university faculty members to conduct basic research on topics essential to national security. Connections to the faculty enable the program to leverage more than 150 students and postdoctoral scholars serving on research teams. The NSSEFF enables partnerships between the faculty and their research assistants with scientists and engineers in the DoD laboratories, providing us opportunities to identify and recruit top talent.

The Systems Engineering Capstone pilot program is designed to increase systems engineering skills in engineering students, and increase the pipeline of systems engineers available to DoD. The program inspires students to solve the types of system engineering challenges evident among DoD

programs. Three hundred undergraduate and graduate students at eight universities and six military institutions (Naval Postgraduate School, Air Force Institute of Technology, United State Military Academy, United States Naval Academy, United States Air Force Academy, and U.S. Coast Guard Academy) participate in the pilot program along with DoD civilian, military, and industry personnel who participate as mentors.

The President's Budget FY 2012 funds these NDEP programs, and we will look for more opportunities to further strengthen the Department's STEM activities.

Conclusion

Mr. Chairman, we are strategically shaping the Department's research and engineering enterprise to address a new set of technical and operational challenges for the Department. The QDR identified a series of missions where our forces must dominate, from irregular warfare to traditional conventional high-end warfare, where new challenges to access are emerging. The S&T EXCOM identified seven science and technology priority areas for investment that would provide dominant technical advantages across the mission space, for the near-term and the future. We now live in a world where research and development efforts are globalized, increasing the chance for technical surprise. Our basic research program and technology watch programs have been re-structured to ensure our scientists are involved early in potentially disruptive emerging science fields; history proves those who explore and exploit early advances will likely gain an important competitive edge in warfighting capabilities. We realize that our technical goals are only achievable with exceptional research and engineering talent and our STEM programs provide the resources and strategy to train and recruit the workforce we will need.

The President's budget addresses both important aspects – people and programs – and I ask for the Committee's support for the requested funds.

Secretary Gates testified last month that "We still live in a very dangerous and often unstable world. Our military must remain strong and agile enough to face a diverse range of threats…"[22] I want to give you my personal assurance that I will work tirelessly to ensure the Department's research and engineering enterprise is focused and properly resourced in people and programs to keep our military strong and agile. I look forward to working with you in the months ahead as we meet the challenges of winning the current fight and preparing for the future.

[22] Prepared Statement of Secretary of Defense Robert M.Gates to House Armed Services Committee, February 16, 2011; Pg. 8.