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STATEMENT TESTIMONY OF

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SUBCOMMITTEE ON DEFENSE

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Chairman Durbin, Vice Chairman Cochran, members of the Committee, I am pleased to come before you today to testify about the state of the Department of Defense's science and technology (S&T) program. I am proud to be here representing the roughly 100,000 scientists and engineers in the science and engineering (S&E) workforce, a workforce that has had remarkable achievements in the past, but is now a workforce showing the early stages of stress due to downsizing and the budget challenges of the last year. This past year has been unlike previous years in our community; the collective impact of the sequester-forced civilian furlough and program curtailment, the October 2013 government shutdown, and the indirect impacts of the sequester, such as restrictions on our young scientists and engineers attending technical conferences, has impacted the health of our workforce and the programs they execute in ways that we are just beginning to understand. We have begun to address these challenges but they remain a concern for us.

INTRODUCTION

The FY 2015 budget request for science and technology (S&T)[1] is relatively stable, when compared to the overall DoD top line[2] and modernization accounts. The DoD FY 2015 S&T request is $11.51 billion, compared to an FY 2014 appropriation of $12.01 billion. This request represents a 4.1% decrease (5.8% in real buying power) in the Department's S&T compared to Research, Development, Test and Evaluation (RDT&E) account that was virtually unchanged. While we continue to execute a balanced program overall, there are factors that led Secretary Hagel to conclude in his February 24, 2014 FY 2015 budget rollout that "we are entering an era where American dominance on the seas, in the skies, and in space can no longer be taken for granted".[3]

Simultaneous with the challenges of balancing a reduced budget and continuing to engage the total defense workforce in meaningful research and engineering (R&E), the capability challenges to our R&E program are also increasing. This is attributable to changes in the global S&T landscape and the acceleration globally of development of advanced military capabilities that could impact the superiority of US systems. The convergence of declining budgets, in real terms, and increased risk is not a comfortable place to be. However, as I will highlight in the latter sections of my statement, the Department has begun to reshape the focus of our technical programs to address some of our new challenges. We are also beginning to shift our programs to better position the Department to meet our national security challenges. Finally, we have some areas where we need your help in order to be successful executing our FY 2015 budget. I will cover these areas at the end of my statement.

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[1] Science and Technology is defined as program 6, budget activities 1, 2, and 3; frequently called 6.1, 6.2, and 6.3 (basic research, applied research, and advanced technology development); Research and Engineering adds Advanced Capability Development and Prototyping (6.4).

[2] Top line refers to the total funds appropriated by Congress to include "supplemental" or Oversees Contingency Operations funds

[3] Remarks by Secretary Hagel on the FY 2015 budget preview in the Pentagon Briefing Room on 24 February 2014.

FY 2015 PRESIDENT'S BUDGET REQUEST

The current fiscal environment presents significant challenges to the DoD budget. The Department is in the third year of a protracted overall topline and RDT&E budget drawdown. As highlighted by Secretary Hagel, there are three major areas that comprise the Department's budget: force size, readiness, and modernization. The current budget is driving a force reduction, but this reduction will take several years to yield significant savings. In the FY 2015 budget, readiness and/or modernization will pay a larger percentage of the "bill". As a former airman who entered service in the 1970's, I am very well aware of what happens when savings are gleaned from readiness – the hollow force is not acceptable. Over the next several years of the budget we expect modernization accounts (Procurement and RDT&E) to pay a large portion of the Department's fiscal reduction bill. At the same time, Secretary Hagel's strategy is to protect advanced technologies and capabilities. The FY 2015 budget must balance all of these drivers; we believe we have done well, but do acknowledge there is increased risk.

The last several budgets have been characterized by instability and rapid decline of the modernization accounts. The FY 2013 sequestration reduced all accounts by 8.7%; for S&T, this amounted to a loss of about $1 billion. The December 2013 Bipartisan Budget Act increased the discretionary caps in FY 2014 and FY 2015 to provide some relief, but less in FY 2015 than FY 2014. From FY 2013 to 2015, the S&T program operated with reductions of $1.4 billion compared to what had been planned in the FY 2013 budget.

One of the key points for S&T of the FY 2015 budget is a shift in focus at the macro scale from basic research to advanced technology development and a shift from the Services to DARPA to develop advanced capabilities. In FY 2015, we funded DARPA at the same level, after inflation, as was planned in FY 2014 PBR. These numbers are shown in Tables 1 and 2.

	FY 2014 Appropriated ($M)	**PBR 2015 (FY 14 CY $M)**	**% Real Change from FY 2014 Appropriated (FY 14 CY $)**
Basic Research (BA 1)	2,167	2,018 (1,982)	-8.55%
Applied Research (BA 2)	4,641	4,457 (4,378)	-5.66%
Advanced Technology Development (BA 3)	5,201	5,040 (4,951)	-4.81%
DoD S&T	**12,009**	**11,515 (11,311)**	**-5.81%**
Advanced Component Development and Prototypes (BA 4)	11,635	12,334 (12,116)	4.14%
DoD R&E (BAs 1 – 4)	**23,644**	**23,849 (23,427)**	**-0.92%**
DoD Topline	496,000	495,604 (486,841)	-1.85%

Table 1— Defense Budget for Science &Technology; Research & Engineering; and DoD Top Line Budget (FY 2014 Appropriated and PBR 2015).

	FY 2014 Appropriated ($M)	PBR 2015 (FY 14 CY $M)	% Real Change from FY 2014 Appropriated (FY 14 CY $)
Army	2,455	2,205 (2,166)	-11.77%
Navy	2,102	1,992 (1,957)	-6.91%
Air Force	2,308	2,129 (2,091)	-9.39%
DARPA	2,707	2,843 (2,793)	3.17%
Missile Defense Agency (MDA)	255	176 (173)	-32.20%
Defense Threat Reduction Agency (DTRA)	476	473 (465)	-2.39%
Chem Bio Defense Program (CBDP)	393	407 (400)	1.73%
Other Defense Agencies	1,313	1,290 (1,267)	-3.49%
DoD S&T	**12,009**	**11,515 (11,311)**	**-5.81%**

Table 2 - Service and Agencies S&T Budgets (FY 2014 Appropriated and PBR 2015)

Research and Development is not a Variable Cost

Over the past decade, the R&D accounts have been quite variable, but this counters one of the key tenets of R&D investment made by the Honorable Frank Kendall in discussing the FY 2015 budget. There has been a tendency in the past to reduce research and development more or less proportionately to other budget reductions. This tendency, if acted upon, can be detrimental because research and development costs are not directly related to the size of our force or the size of the inventory we intend to support. The cost of developing a new weapons system is the same no matter how many units are produced. In a recent speech, Secretary Kendall explained the invariant nature of research and development this way:

> R&D is not a variable cost. R&D drives our rate of modernization. It has nothing to do with the size of the force structure. So, when you cut R&D, you are cutting your ability to modernize on a certain time scale, period -- no matter how big your force structure is.[4]

If we don't do the research and development for a new system than the number of systems of that type we will have is zero. It is not variable.

Secretary Kendall said it this way:

> [T]he investments we're making now in technology are going to give us the forces that we're going to have in the future. The forces we have now came out of investments that were made, to some extent, in the 80s and 90s…if you give up the time it takes for lead time to get…a capability, you are not going to get that back."[5]

[4] Honorable Frank Kendall presentation to McAleese/Credit Suisse FY 2015 Defense Programs Conference on 25 February 2014.
[5] Kendall, 25 February 2014.

There is another trend impacting the Department's ability to deliver advanced capabilities. Recent data from the Nation Science Foundation shows an upward trend in industry R&D spending compared to a downward trend in federal government R&D spending (Figure 1). Industry in the United States performs roughly 70% of the Nation's R&D with the federal government and academia making up the remaining 30%. Figure 1 also shows the dependence of academic researchers on federal government funding, as noted by the National Science Board:

Most of U.S. basic research is conducted at universities and colleges and funded by the federal government. However, the largest share of U.S. total R&D is development, which is largely performed by the business sector. The business sector also performs the majority of applied research. [6]

This implies that DoD needs to be more cognizant of industry R&D as part of our overall capability development and remain sensitive to the importance of federally funded academic research. We continue to push in these areas through our continued support of the university research portfolio and our recent emphasis on Independent Research and Development (IR&D).

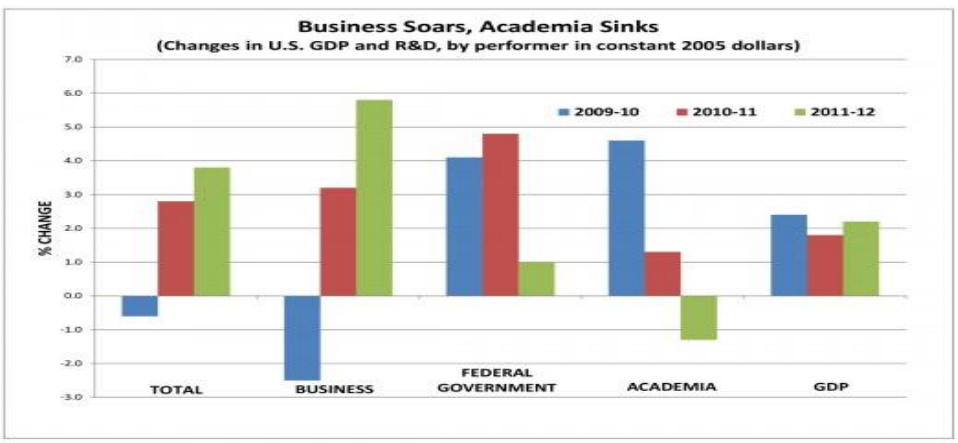

Figure 1 - Changes in US GDP and R&D by Performer[7]

SCIENCE AND ENGINEERING WORKFORCE

The Department's scientist and engineering (S&E) workforce consists of in-house labs, engineering centers, test ranges, acquisition program offices and so forth, and is augmented by our partners in the federally funded research and development centers (FFRDCs) and University Affiliated Research Centers (UARCs). The talented scientists and engineers working within these organizations form the foundation of the Department's technology base and are responsible for conceiving and executing programs from basic research through demilitarization of weapon systems. The technical health of this workforce is a priority for me and the Department.

[6] National Science Board. 2014. *Science and Engineering Indicators 2014*. Arlington VA: National Science Foundation (NSB 14-01).
[7] Science magazine. 13 January 2014. Retrieved from http://news.sciencemag.org.

Our in-house labs have been designated by Congress as Science & Technology Reinvention Laboratories (STRL) providing the directors of these facilities special authorities to manage their workforce via pay-for-performance personnel systems. Each director is granted flexibility to create workforce policies unique to his/her lab with new personnel initiatives being transferable to other STRLs if proven to be effective in the hiring, retention and training of S&Es. Each year my office works with the Services and their labs to ensure they have the authorities our lab directors need. Recent accomplishments include direct hiring authority for bachelors, masters and doctoral level graduates, increase in the number of technical senior executive billets, and authority for lab directors to manage their workforce based upon available budgets.

Data from the Strategic Human Capital Workforce Plan published in September 2013 indicates that our lab workforce is getting older. From 2011 to 2013, the average age of our scientists and engineers in our labs has grown from 45.6 years to 45.7 years for scientists and from 43.2 years to 43.9 years for our engineers. Although the change seems minimal over the past two years, it reverses the trend over the past decade when we had been driving the average age down. Data from the Science and Technology Functional Community indicate that the combination of fewer new hires and retirement-eligible employees working longer both contribute to the increase in average age. In 2013, there were only 731 new hires in the S&T Functional Community, whereas in 2010 there were 1,884. In 2010, retiring workers were retirement-eligible for an average of only 4.1 years. From 2011-2013, that average grew to 4.5 years. The trend indicates that we may not be replacing our seasoned employees with enough young scientists and engineers who will shape our future. This could be an indicator of older employees working longer because of a down economy or it could be an indicator that we are not hiring or retaining enough young scientists and engineers.

Although anecdotal, we are seeing a trend in why younger workers may be leaving. We saw a number of young scientists and engineers leave in 2013, early in their career. In conducting exit interviews, our laboratory directors reported that these young workers consistently cited travel and conference restrictions, as well as perceived instability of a long term career as motivating factors for their departure. This information, although anecdotal, is of concern; consequently, we are attempting to gather data to see if we can discern a definite signal.

Another area of significant Department and national interest is building a robust science and engineering workforce through various Science, Technology, Engineering, and Mathematics (STEM) initiatives. My office recently created the STEM Executive Board who has the authority and continues to provide strategic leadership for the Department's STEM initiatives.

Significant change to the Federal portfolio of STEM programs has occurred over the past year. In response to the requirements of the America Competes Reauthorization Act of 2010, Federal STEM-education programs were reorganized with the goals of greater coherence, efficiency, ease of evaluation, and focus on the highest priorities. This resulted in the Federal STEM Education 5-Year Strategic Plan designating the Smithsonian, Department of Education and National Science Foundation as lead agencies in implementing this plan. The DoD STEM Strategic plan is aligned with the federal plan to achieve Federal and Departmental STEM education goals.

We are also developing department-wide guidance on STEM program evaluation, coordinating within the Department and across the Federal government to improve effectiveness and efficiencies in these investments in future workforce needs. A DoD STEM Annual Report, expected to be delivered in FY 2015 based on FY 2014 data, will communicate the activities and results in achieving Departmental goals.

In summary, budget constraints, furloughs, and conference and travel restrictions have contributed to a drain on our most valuable resource – people. To replace our losses and rebuild our workforce for the future, we are working on bringing stability back to our S&E programs, give our people challenging while enriching environments in which to work.

CHALLENGES TO MAINTAINING TECHNOLOGICAL SUPERORITY

The United States has relied on a DoD that has had technological superiority for the better part of the post-World War II era. There are factors that are converging such that the DoD maintaining technological superiority is now being challenged. These challenges come from both changes in the way technology matures and in advanced capabilities being developed in the rest of the world. The Department is emerging from over a decade of focusing on countering terrorism and insurgency. While the challenges of counter terrorism remain, new national security challenges are emerging. Other nations are developing advanced capabilities in areas such as: cyber operations, advanced electronic warfare, proliferation of ballistic missiles for strategic and tactical intent, contested space, networked integrated air defenses, and a host of other capabilities stressing the Department's capability advantages. The Department's S&T program is being re-vectored to meet these new challenges. In addition, the Department is shifting to a focus on the Asia-Pacific region, a region with unique and challenging geographic and cultural features. Most notably, the geographic extent of the Asia Pacific region adds new challenges in terms of fuel efficiency and logistics.

In short, the Department and Nation are at a strategic crossroads—the funds available to the Department (and national security infrastructure in general) are decreasing, while the complexity and depth of the national security challenges are growing. The world we live in is an uncertain place. Secretary Hagel said it best in his recent roll out of the FY 2015 budget:

> "The development and proliferation of more advanced military technologies by other nations that means that we are entering an era where American dominance on the seas, in the skies, and in space can no longer be taken for granted." [8]

Secretary Hagel went on to say:

> "To fulfill this strategy DoD will continue to shift its operational focus and forces to the Asia-Pacific, sustain commitments to key allies and partners in the Middle East and

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[8] Remarks by Secretary Hagel on the FY 2015 budget preview in the Pentagon Briefing Room on 24 February 2014.

> Europe, maintain engagement in other regions, and continue to aggressively pursue global terrorist networks." [9]

Global Changes in S&T Impact Technology Development. The nature of the international technology landscape is much different than it was even 20 years ago in two fundamental ways:

1) Many technologies of importance to the Department's capability developments are driven by the commercial sector, and have become a global commodity.

2) The pace of maturation of technology is accelerating; that is, technology maturation occurs on a more rapid scale than in the past.

Our DoD S&T community needs to identify areas where technology has become a global commodity and not expend resources working to develop the same capability. We must track global technology developments, harness them and apply the technology to our needs. This year, we have initiated a project at the Defense Technical Information Center to improve our ability understand global technology development, and are in pilot phase to use automated tools to assess technology advances.

We already know that industry drives most microelectronics and semiconductors development; older infrared focal planes, routine communications, computers. The technology coming from these sectors is sufficient to meet most DoD capability needs. The DoD should be an adopter, not a leader in these areas while addressing the unique security concerns of these technologies used in our military, cyber and IT systems. The DoD should focus our research in technology integration or in developing technologies into products at performance levels beyond those commercially available or planned. Examples would include electronic travelling wave tubes (led by Naval Research Lab), which provide higher frequency and higher power output than is needed in commercial applications; and infra-red (IR) "super lattice" semiconductors (led by the Army's Night Vision Laboratory), which give high enough resolution in IR to make "movies" out of simple data and images. The DoD should monitor and apply these technologies to meet our needs.

At the same time, we know that the time to mature many technologies is decreasing. We have seen the time from invention to market penetration decrease by a factor of two over the past half century. Consequently, I would like to cite comments made by Mr. Frank Kendall, Under Secretary of Defense for Acquisition, Technology, and Logistics, who states that one of the key factors to maintaining technological superiority is to maintain a steady investment in technology.

"The effects of time (lost) cannot be reversed. It is well understood in the R&D community, and most particularly in the S&T community, that the investments we make today may not result in capability for a generation. It takes upwards of 5, 10, even 20 years to develop a new system, test it, and put it into production. By taking higher risks and accepting inefficiencies and higher costs we can reduce the "time to market" of new weapon systems; in fact, we have reduced this time … with reforms put in place in recent years."

[9] Hagel, 24 February 2014.

Even during World War II we fought with the systems that had been in development for years before the war began. We can shorten, but not eliminate the time required to field new cutting edge weapons systems. But one thing is for sure, if we do not make R&D investments today, we will not have the capability in the future.

Capability Changes to DoD Technology Superiority. More significant than the changes in how technology is developed and delivered globally are changes in military capabilities being developed by other nations.

I will cite just one example; there are many more. The convergence of advanced digital signals and computer processing has given rise to proliferation of a new class of system—the digital radio frequency memory (DRFM) jammer. DRFM jammers are fairly inexpensive electronic systems that ingest the radar (or communications) signal, analyze the digital waveform, and then generate random signals, with the same waveform, back to the transmitting radar receiver. The result is the radar system sees a large number of "electronic" targets. If the US employed conventional weapons systems using the traditional methods, we could shoot at or chase a lot of false targets. The consequence is that the US needs to develop a counter to DRFM jammers.

The convergence of computer processing, digital signal processing, digital electronics, optical fibers, and precise timekeeping are giving rise to inexpensive enablers that can improve the ability to counter conventional weapons platforms. We are starting to see other nations advance technologies to counter US overmatch by combining the components listed above to enhance capabilities in electronic warfare, longer range air-to-air missiles, radars operating in non-conventional bandwidths, counter-space capabilities, longer range and more accurate ballistic and cruise missiles, improved undersea warfare capabilities, as well as cyber and information operations. We see these types of new capabilities emerging from many countries; to include China, Iran, Russia and North Korea. This has led to a situation where, in the next five to ten years, US superiority in many warfare domains will be at risk. Accordingly, the following section highlights some of the areas where we are watching.

Proliferation of Weapons of Mass Destruction (WMD). The 2013 National Security Interests published by the Chairman of the Joint Chiefs of Staff lists as the top priority interest "Survival of the Homeland". The one existential threat to the United States comes from Weapons of Mass Destruction. Traditionally, WMD has included nuclear, chemical and biological weapons and their delivery systems. The emergence of new countries with nuclear ambitions, such as North Korea and Iran, make today's world much more dangerous. Chemical and biological weapons, used in both World Wars, have been resurgent in the past two decades. Perhaps the gravest danger for the United States and the rest of the world is the possibility of WMD falling into the hands of terrorist groups and other groups in the midst of instability. We must continue our vigilance in this area and continue to develop ways to deal with their use.

The United States is currently rebalancing to the Asia Pacific region. As we do so, the Department is faced with a host of new challenges. I will discuss some of the challenges over the next several paragraphs.

Vulnerability of the US Surface Fleet and Forward Bases in the Western Pacific. US Navy ships and Western Pacific bases are vulnerable to missile strikes from ballistic and cruise missiles already in the inventory. China has prioritized land-based ballistic and cruise missile programs to extend their strike warfare capabilities further from its borders. Chinese military analysts have concluded that logistics and power projection are potential vulnerabilities in modern warfare, given the requirements for precision in coordinating transportation, communications, and logistics networks. China is fielding an array of conventionally armed ballistic missiles, ground- and air-launched land-attack cruise missiles, special operations forces, and cyber-warfare capabilities to hold targets at risk throughout the region. The most mature theater missiles are the DF-21 C/D, which both have 1,500 km radius. They are also developing a longer range missile that would be able to strike as far as Guam. These ballistic missiles are coupled with advanced cruise missiles that could threaten any surface warfare fleet by 2020.

The People's Liberation Army (PLA) Navy has the largest force of major combatants, submarines, and amphibious warfare ships in Asia. China's naval forces include some 79 principal surface combatants[10], more than 55 submarines, 55 medium and large amphibious ships, and roughly 85 missile-equipped small combatants. The first Chinese-built carrier will likely be operational sometime in the second half of this decade. In the next decade, China will likely construct the Type 095 guided-missile attack submarine (SSGN), which may enable a submarine-based land-attack capability. In addition to likely incorporating better quieting technologies, the Type 095 will likely fulfill traditional anti-ship roles with the incorporation of torpedoes and anti-ship cruise missiles (ASCMs). Since 2008, the PLA Navy has also embarked on a robust surface combatant construction program of various classes of ships, including guided missile destroyers (DDG) and guided missile frigates in addition to more modern diesel powered attack submarines.

US Air Dominance. We see the same trend—development of systems to push US freedom of movement further from the Asia mainland. China is developing an integrated air defense system that could challenge US air dominance and in some regions, air superiority is challenged by 2020. The challenge to our air dominance comes primarily through the aggregation of capabilities starting with an extensive integrated air defense system (IADS), moving to development of advanced combat aircraft, to enabling technologies, primarily electronic warfare capabilities. China is demonstrating a systems approach through advanced aircraft design of 5th generation fighters, advanced combat systems, and advanced dense long range, networked air defense systems. It should be noted that others (such as Iran, Syria, and North Korea) are developing well integrated air defense systems. The PLA Air Force is continuing a modernization effort to improve its capability to conduct offensive and defensive off-shore operations such as strike, air and missile defense, strategic mobility, and early warning and reconnaissance missions. China continues its development of stealth aircraft technology, with the appearance of a second stealth fighter following on the heels of the maiden flight of the J-20 in January 2011, a 5th generation fighter scheduled to enter the operational inventory in 2018.

Vulnerability of US Satellites in Space. China has been rapidly expanding both the number, and quality of space capabilities; expanding its space-based intelligence, surveillance,

[10] As of 2013

reconnaissance, navigation, meteorological, and communications satellite constellations. In parallel, China is developing a multi-dimensional program to rapidly improve its capabilities to limit or prevent the use of space-based assets by others during times of crisis or conflict.

China continues to develop the Long March 5 (LM-5) rocket, intended to lift heavy payloads into space, doubling the size of the Low Earth Orbit (LEO) and Geosynchronous Orbit (GEO) payloads China can place into orbit. During 2012, China launched six Beidou navigation satellites completing a regional network and the in-orbit validation phase for the global network, expected to be completed by 2020. From 2012-2013 China launched 15 new remote sensing satellites, which can perform both civil and military applications. China will likely continue to increase its on-orbit constellation with the planned launch of 100 satellites through 2015. These launches include imaging, remote sensing, navigation, communication, and scientific satellites, as well as manned spacecraft.

Research and Engineering Strategy

To address the challenges of an accelerating, globalized research and development environment coupled with pressurized DoD budgets and the rapid growth of capabilities in other nations, we needed to examine the strategy we are using to focus the DoD investment on high priority areas.[11] To develop the research and engineering strategy, we had to go back to first principals. Why does the Department conduct research and engineering? What does the Department expect the DoD R&E program to deliver? After examination, we contend the Department conducts research and engineering for three reasons, in priority order:

1) ***Mitigate new and emerging threat capabilities***—the Department must defend the homeland and overseas forces and national interests against threats that exist today, and threats that are still in development.

2) ***Affordably enable new or extended capabilities in existing military systems***--Coincident with a tighter budget, and the fact that time is not recoverable, the DoD R&E program should focus on controlling costs, both in existing and future weapons systems.

3) ***Develop technology surprise***—Finally, throughout the past century, the nation and the Department have looked to the Department's R&E program to continually develop and mature new capabilities that surprise potential adversaries.

Priority 1: Mitigating or Eliminating New and Emerging Threats to National Security

The Department must be prepared to meet its current and future national security missions, which include defending the homeland, securing freedom of navigation, and being able to project power. The research and engineering priorities inherent in this principal also include protecting the nation against nuclear, chemical, and biological weapons, from both state and non-

[11] While the priorities listed below capture the cross-DoD priorities, there are still individual Service priorities they must address. These priorities do not address Naval responsibilities for the Ocean, Army responsibilities for the ground or Air Force for the Air. Rather, they comprise a set of areas that must be addressed across component. It is interesting to note the large efforts in the Services and DARPA largely align with the strategy.

state actors. This principal also includes protecting the nation against new threats, such as cyber operations and the proliferation of cruise missiles and UAVs. The final emerging vector in this area is to find solutions to the new capabilities that would prevent the US armed forces from fulfilling our global mission, such as electronic warfare and maintaining space capabilities.

Countering Weapons of Mass Destruction (C-WMD). The Department's investment in countering weapons of mass destruction is made primarily by the Defense Threat Reduction Agency and the Chemical Biological Defense Program, as well as the Army. All totaled, the Department's investment in C-WMD is about $800 million per year. Countering weapons of mass destruction poses some unique challenges because of the urgency and immediacy of the threats, the fact that threats present low probability but high consequence events, and that there is a need for on-call, comprehensive expertise. The Defense Threat Reduction Agency emphasis for FY 2015 include kinetic and non-kinetic means to counter and defeat WMD in non-permissive environments, low visibility search (and identification) for all threats (nuclear and chemical/biological), global situational awareness through mining large, diverse datasets, application of autonomy to reduce risk to the human, persistent intelligence, surveillance and reconnaissance (ISR) for WMD, WMD modelling and simulation, and operating in a high electromagnetic pulse environment. To date, we have not identified the "silver bullet" solution, so a sizable portion of the C-WMD program involves international and interagency partnership.

Emerging trends over the last year includes the need to counter threats as far "upstream" or left of event as possible. Therefore, the entire C-WMD community is strengthening their program to interdict / render safe WMD before they are used.

Missile Defense. In FY 2015, the investment in missile defense S&T dropped from roughly $350M in FY 2014 to $176M in FY 2015. Yet, missile defense remains a priority. The reduction in missile defense is more than offset the Navy and by the Office of the Secretary of Defense efforts in electromagnetic rail gun technology; a nearly $200M investment in FY 2015. This push in rail gun is being made to determine if the technology is mature enough to field an inexpensive, kinetic kill system to intercept theater ballistic missiles in terminal and mid-course. The current investment supports demonstration of an advanced rail gun against a missile surrogate in 2015.

Although not a capability that will be fielded soon, the Missile Defense Agency continues to look at Directed Energy for missile defense. They are the primary investor in both hybrid (diode pumped alkaline laser) and fiber lasers. Significant demonstrations for both of these directed energy capabilities will occur in 2015 to 2016.

A strategy based on only kinetic defense which requires a high-end US missile intercept against this proliferation of missiles is cost-imposing on the United States. Our research and engineering program is also working on developing non-kinetic capabilities and less expensive kinetic capability to reduce the effectiveness of potential adversaries' missiles; we are making strides in this area.

Cyber and information operations. The Department's investment in Cyber S&T in FY 2015 is $510M. With the growing reliance of modern military forces on information technology, cyber operations will play an increasingly important role in ensuring continuity of missions in the physical domains. Having effective technologies to support those cyber operations makes cyber security research an essential element in our long-term abilities to defend the nation.

This year, the Department rebuilt the cyber S&T investment around warfighting capability requirements. We have then built a strong integrated technical foundation across the Cyber research and engineering enterprise through our Cyber Community of Interest, a group made up of Senior Executive Service representatives from the Services, NSA, and my organization. Our cyber S&T investments are guided by an S&T Capabilities Framework that captures new and emerging mission requirements including improved situation awareness and course of action analysis. The framework has been developed with participation of all the Services as well as the Intelligence Community, National Laboratories, and our Federally Funded Research and Development Centers. We are placing emphasis on broadening the research beyond standard computing systems to include defending against cyber threats to tactical and embedded systems. Our cyber research includes investments in providing a testing and evaluation environment for the experimentation and testing of cyber technology across the full spectrum of capabilities to help validate and accelerate research. Additionally, and very importantly, it is a priority for the DoD to be an early adopter of emerging technologies in cyber defense and to ensure the transition of those products to our warfighters and the programs supporting them.

Though challenges remain in all areas, Cyber S&T is making progress and having significant impacts. Over the past few years, our cyber investments, from fundamental research through advanced technology demonstrations have resulted in many successes that directly benefit our warfighters and the broader defense enterprise. Some highlights are:

- Securing our telecommunications infrastructure through vulnerability assessment, tool development, and best practice dissemination;
- Developing technologies to accurately geo-locate illicit commercial wireless devices to protect our networks;
- Producing a game-changing approach to signature-free malware detection capable of defending against zero-day attacks;
- Designing a flexible, mission-based interoperability framework enabling rapid, low-cost capability integration for our cyber operation forces; and
- Developing tools and techniques that assure the secure operation of microprocessors within our weapons platforms and systems.

This year, in concert with White House Priorities[12], we created the Cyber Transition to Practice (CTP) Initiative. The goal of this initiative is to mature and ultimately transition S&T products to operational use. The development of cyber tools frequently happens on a time scale much less than the traditional acquisition process. The CTP initiative is intended to accelerate fielding of cyber tools.

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[12] This is in direct response to the NSS Cybersecurity FY2014 Budget Priority of September 11, 2012 (section 4.a of the annex).

Loss of Assured Space. Other nations have developed both kinetic and non-kinetic means to degrade or deny the US space layer. Consequently, the DoD S&T program is working on developing the space capabilities our forces rely on whether or not the space layer exists. The capability may be degraded, but will also not be vulnerable. Other nations are seeking to asymmetrically disrupt our military capabilities that depend upon assured satellite communications; global systems for positioning, navigation, and timing; and on-demand ISR, even in denied areas. The US will respond to these actions through increasing the resilience of our space assets so they are free from interference as well as develop alternative means to deliver the capabilities we currently obtain from our space assets.

Current technologies in development include, but are not limited to the following: improving our space situational awareness capabilities employing improved ground- and space-based systems (such as the Air Force Research Lab's 2006 demonstration of on-orbit, localized Space Situational Awareness), enhanced terrestrial and airborne communications or jam resistant communications (such as laser communications); novel timing devices decoupled from continuous access to GPS (like the Tactical Grade Atomic Clock, projected for transition to the acquisition community in 2017); high performance Inertial Measurement Units (like DARPA's High Dynamic Range Atom Sensor (HiDRA), projected for 2016, and small-form-factor anti-jam GPS antennas); and alternative ISR capabilities (which may incorporate advanced electro-optic coatings and thermal protections measures under development at the Air Force Research Lab). Finally, we have several Joint Capability Technology Demonstrations (JCTDs) to determine the viability of capabilities delivered from very small satellites. Kestrel Eye and Vector JCTDs will demonstrate the viability of small satellite tactical communications and ISR by 2016.

Electronic warfare (both attack and protection). The Department's investment in electronic warfare (EW) S&T is about $500 million per year. This is an area that is evolving rapidly because of technology advances. The two key parameters in EW are the frequency the system operates and how complex is the signal. The concept behind electronic warfare is simple—the goal is to control your electronic signature or confuse an opponent's system if you are defending and to simplify the overall situation (reject false targets and clutter) if you are attempting to use your own electronic systems (radar, communications and radio frequency).

Electronic warfare is becoming important and more critical because the enabling technologies underlying frequency and complexity are progressing very rapidly. To address the underlying technologies, the components have coalesced around a concept called Advanced Components for EW (ACE), which is focusing on Integrated Photonic Circuits, Millimeter Wave, Electro-Optical and Infrared (EO/IR), and Reconfigurable and Adaptive RF electronics. As a whole, these technologies should improve simultaneous transmit and receive; expand instantaneous bandwidth, and allow a huge leap ahead in complexity. ACE kicked off in FY 2013, with the components continuing to develop components.

In addition to the underlying technology, the Services are involved in building advanced electronic systems. We will cover two of them. The Navy's Integrated Topside program is just completing attempting to use multifunction transmitters on the top of a ship. This will reduce the number of individual systems with a unique electronic signature, and improve ship survivability.

The Home on GPS-Jam (HOG-J) is a small munition that will identify foreign GPS jammers and vector the munition into the jammer. HOG-J has had some preliminary successful tests, and could be ready to enter the inventory in 2-3 years. There are other EW systems that could be covered at the appropriate security level.

Priority 2: Affordably Enabling New or Extending Military Capabilities

The cost of Defense acquisition systems continues to be a challenge for the Department. Over the past three years, the Department introduced "Better Buying Power" initiatives to improve the cost effectiveness of the Defense acquisition system. Cost effectiveness and affordability of defense systems starts before the acquisition enterprise kicks in. There are two vectors to increasing affordability; technology to lower cost and extend life cycle, and research and engineering processes to address costs early in system development.

Systems engineering. The Department's systems engineering capability and capacity are critical to enabling affordability across the system life cycle of an acquisition program. The Department's systems engineers drive affordable designs, develop technical plans and specifications to support cost-effective procurement, and conduct trade-off analyses to meet program cost, schedule and performance requirements. Systems engineers are enabling strategies to identify opportunities to reduce life-cycle costs. My organization has taken a lead role in improving the Department's ability to achieve affordable programs through strong SE policy, guidance, dissemination of best practices, execution oversight and support for a healthy, qualified engineering workforce.

Through an emphasis on affordability in recently updated policy and guidance, the Department has established a clear role for systems engineers in defining, establishing, and achieving affordability goals and processes throughout the life cycle. Through required systems engineering trade space analyses, individual acquisition programs establish the cost, schedule and affordability drivers and can demonstrate the cost-effective design point for the program. These trade space analyses will be conducted across the program's lifecycle to continuously assess system affordability and technical feasibility to support requirements, investments, and acquisition decisions and depict the relationships between system life-cycle cost and the system's performance requirements, design parameters, and delivery schedules. Recent emphasis on better reliability engineering has focused the Department's acquisition programs on reducing overall lifecycle costs. My systems engineering staff maintains regular and frequent engagement with acquisition programs to support the planning and execution of effective technical risk management, as well as affordability considerations. They provide regular oversight and guidance to assist the programs as they mature through the lifecycle.

Developmental Test and Evaluation. Developmental Test and Evaluation (DT&E) efforts focus on engaging major acquisition programs early in their lifecycle to ensure efficient and effective test strategies, thereby ensuring a better understanding of program technical risks and opportunities before major milestone decisions. In 2013, the Deputy Assistant Secretary of Defense for Developmental Test and Engineering (DASD(DTE)) introduced the "shift left" concept—specifically to drive DT earlier in the acquisition process. Early DT&E engagement with programs not only reduces acquisition costs through efficient testing, but finding and fixing deficiencies early, well before production and operations, drastically reduces overall lifecycle costs. The DASD(DT&E) is focusing on a few key areas to improve the overall effectiveness of developmental test and evaluation; use of the Developmental Evaluation Framework, increased emphasis on testing in a mission context, earlier cyber security testing, and an increased emphasis on system reliability testing.

The Developmental Evaluation Framework is a disciplined process that results in a clear linkage between program decisions, capability evaluation, evaluation information needs, and test designs. Using the Developmental Evaluation Framework provides an efficient, yet rigorous T&E strategy to inform the program's decisions. Developmental Test and Evaluation is also moving beyond the traditional technical test focus to include testing in a mission context to characterize capabilities and limitations before production. Robust DT&E should also include early cyber security testing that previously was not tested until late in the acquisition life cycle, where deficiencies are costly to fix. Finally DT&E is focusing on increased system reliability testing. System reliability is a major driver in the affordability of future weapon systems. Improved reliability information early in the program allows acquisition leadership to understand the program technical and cost risks and take steps to improve system reliability and therefore the affordability of the system.

Prototyping. Another way to drive down costs of weapons systems is through the expanded use of prototypes, which we use to prove a concept or system prior to going to formal acquisition. Consequently, in FY 2015, we look to expand the use of developmental and operational prototyping to advance our strategic shift to a greater emphasis on future threats. In FY 2015, the Department's investment in prototypes or prototype like activities is around $900M. This includes activities that are not classical prototype efforts, but will demonstrate capabilities, such as the Navy's Future Naval Capabilities, Integrated Naval Prototypes, the Army's Joint Multi-role Helicopter and Future Fighting Vehicle, as well as Air Force Flagship programs, and the revamping of the Department's Joint Capability Technology Demonstrations and Emerging Capabilities Technology Development programs.

The RAND Corporation provides a good definition for prototyping, describing it as "a set of design and development activities to reduce technical uncertainty and to generate information to improve the quality of subsequent decision making."[13] We distinguish between two types of prototyping activities. Developmental prototyping demonstrates feasibility of promising emerging technologies and helps those technologies overcome technical risk barriers. Operational prototyping focuses on assessing military utility and integration of more mature technologies.

A recent example of an operational prototype is Instant Eye, a one pound quad-copter. We outfitted Instant Eye with an electro-optical camera and IR illuminator, bringing a field repairable, overhead surveillance capability to the soldier in the field at a unit cost of less than $1,000. Instant Eye would go on to provide targeting information for the neutralization of seven insurgents waiting to ambush a U.S. combat patrol.

[13] "From Marginal Adjustments to Meaningful Change",pg 64, Jeffrey Drezner and Meilinda Huang, RAND Corporation, 2010

Joint Multi-Effects Warhead System (JMEWS) is a good example of a higher-risk, higher reward developmental prototype. The JMEWS project took on the challenge of in-flight targeting and re-tasking of the Tomahawk Land Attack Missile (TLAM). JMEWS' flexible lethality increases the combat power of these expensive weapons by tailoring the TLAM flight profile for best effect, taking advantage of information often not available until after the weapon has launched. With the developmental prototyping effort demonstrating the essential technical aspects, all that remains for Navy is to integrate JMEWS into the TLAM program of record.

Throughout the history of the Department, periods of fiscal constraint have been marked by the use of prototypes to mature technology and keep design teams active in advancing the state of practice. We will use prototyping to demonstrate capability early in the acquisition process. Prototyping will also be used to improve capability development methods and manufacturing techniques, evaluate new concepts, and rapidly field initial quantities of new systems. Prototyping's ability to evaluate and reduce technical risk, and clarify the resource picture that drives costs makes it a critical piece of the larger research and engineering strategy. Put simply, by prototyping in research and engineering, we can focus on key knowledge points and burn down the risk before the risk reduction becomes expensive.

Energy and power. Energy and Power Technology has a strong focus of reducing DoD operational energy risks and costs. Power requirements of new DoD systems continue to grow every year, and energy is a major cost driver and logistic burden. The Department spends approximately $300M per year on Energy and Power science and technology. Some significant programs are:

Unmanned Underwater Vehicles – Air Independent Propulsion (UUV-AIP). The Navy program is developing and delivering long endurance, scalable air-independent propulsion solutions for UUVs. Highly efficient fuel cell technologies will provide extended mission duration in excess of 60 days, well beyond the current and projected capability of batteries. Fuel cells are also being assessed by other Services to extend duration of UAVs and UGVs. These systems are already spinning out to industry.

The Integrated Vehicle Energy Technology (INVENT). The Air Force INVENT program is developing power and thermal management technologies and architectures that not only address today's aircraft performance limits but also work with adaptive cycle engines to enable next generation game changing high power airborne capabilities. There are related Service initiatives to realize higher performance, more fuel efficient designs for rotorcraft and ground vehicles.

Advanced Vehicle Power Technology Alliance (AVPTA). The Army is working collaboratively with DoE (with secondary partners from the National Labs, industry and academia) to accelerate energy-related R&D initiatives into new vehicle designs. Current efforts include: (1) advanced combustion, engines and transmission with the help of Sandia National Laboratory; (2) examination of lightweight structures for vehicles (partnering with General Dynamics); (3) energy recovery and thermal management for improved efficiency and reduced emissions (industry partner, Gentherm); (4) advanced fuels and lubricants; (5) integrated starter-generators (ISGs) without rare earth permanent magnet materials (partners, Remy Intl and Oak

Ridge National Laboratory); and (6) computer-aided engineering for electric drive batteries (CAEBAT).

Engineered Resilient Systems. To address the need for more affordable and mission-resilient warfighting systems, we are developing an integrated suite of modern computational modeling and simulation (M&S) capabilities and engineering tools aligned with acquisition and operational business processes to transform engineering environments under the Engineered Resilient Systems (ERS) initiative. The ERS tool suite allows warfighters, engineers, and acquisition decision-makers to rapidly assess the cost and performance of potential system designs by providing many data-driven alternatives resulting in systems which are less sensitive to changes in external threats, mission needs, and program constraints. ERS has already demonstrated that the insertion of advanced S&T models, tools and techniques into early phases of engineering processes and decision-making will positively impact effectiveness, affordability and sustainability of defense systems, thus addressing these most critical challenges head on. These new M&S-based frameworks adopt the most advanced design and modeling approaches of government, industry and academia to enable our Nation to meet emergent threat, while insuring that we can do that affordably, today and in an uncertain future.

Priority 3: Creating Technology Surprise Through Science and Engineering

The third and final reason the Department conducts research and engineering is to create surprise to potential adversaries. Previous Department of Defense investment in basic and applied research has a long history of developing technologies that led to superior capabilities. The DoD research program led to stealth, the internet, synthetic aperture radar, precision weapons, infra-red focal planes and night vision devices, among others. Frequently, when investing in basic research, we don't know the specific application that will emerge; in fact, by definition, basic research is conducted without a specific product or system in mind.

The Department invests in a structured way to create surprise. Creation of surprise requires a robust basic research program coupled with a strong applied research. While it is not really possible to know where technology surprise will come from, there are several areas that highlight the possibility; we will discuss several of them in increasing level of maturity. The least mature is quantum science, followed by nanotechnology, autonomous systems, human systems, and then finally, directed energy systems.

Quantum Sciences: The discoveries a century ago of the quantum properties of the atom and the photon defined and propelled most of the new technology of the 20^{th} century – semiconductors, computers, materials, communication, lasers – the technological basis of much of our civilization. Now, the next quantum revolution may define new technological directions for the 21^{st} century, building upon the intersection of quantum science and information theory. Consequently, the DoD is increasing its basic research investment in Quantum Information Science (QIS). QIS exploits our expanded quantum capabilities in the laboratory to engineer new properties and states of matter and light literally at the atomic scale. We are already developing new capabilities in secure communication, ultra-sensitive and high signal to noise physical sensing of the environment, and a path to exponentially faster computing algorithms in special purpose computers. The DoD research funding has driven quantum sciences in the past decade. This funding has led to the demonstration to measure time through cold atom research at 1000 times more accurate than GPS. Using quantum sciences, the DoD is likely within 10 years of fielding an affordable timekeeping system that will cut our tether to GPS. We are building in the laboratory gravity sensors of unprecedented sensitivity, opening the possibility of remote detection of tunnels (or submarines). Other military applications are just being realized, but quantum science is a technology that will provide surprise.

Nanoengineering/Nanotechnology: QIS is based on the ability to control atoms. Nanoengineering also deals with the ability to develop and engineer systems at the molecular level. This will, in turn, lead to new system level capabilities. For instance, one of the limitations to systems like directed energy is thermal management. By designing systems at the molecular level, it is possible to increase thermal management by several orders of magnitude. Materials like "metamaterials" (engineered materials for specific properties) provide a promise of development of radars and electromagnetic systems that operate much more effectively at much broader frequency ranges. Metamaterials are especially intriguing because through clever design and dissimilar materials integration, properties that are never seen in nature's materials may be obtained. An example from the Navy's fundamental research realm is the investigation of a metamaterial suitable for antennas. This material system could become transparent to radio frequency waves when exposed to high power radio frequency radiation or pulses, preventing the coupling of this energy to an aircraft's electronic systems and, thereby, avoiding damage. Engineered nanomaterials and nanotechnology research remain very competitive in our research portfolio for their potential to provide capability advantage. Both the Navy and Army have explored coatings based on materials with nanometer dimensions that have wear and corrosion resistance superior to traditional and often hazardous metals. Most recently a nanocrystalline coating based on nickel-tungsten alloys has demonstrated properties exceeding hard chromium coatings without the potential environmental problems of chromium. One of the most exciting applications for engineered nanomaterials for defense and the whole economy is catalysts. The Air Force is supporting research on nanoparticle catalysts that are much more efficient in eliminating methane, a greenhouse gas, from exhausts while using the same quantity of the precious metal palladium and the rare earth element cerium. Energetic nanomaterials comprise one area of nanotechnology that is of interest primarily to defense at this time. The Army is examining highly reactive, energetic materials based on metals and metal oxides that are much less sensitive that traditional explosives. Because the DoD is committed to prudent development and application of new materials, we are studying the materials for any potentially unusual toxic properties based on their chemistry or extremely small particle size.

Autonomy: A major cost driver to the Department of Defense is the force structure but, technology is maturing to augment the human, possibly keeping the warfighter out of harm's way and reducing the numbers of warfighters needed to conduct operations. Autonomous capabilities range from software to aid the intelligence analyst in processing exploitation dissemination (PED) through very complex networked autonomous air systems working in tandem with unmanned ground or undersea vehicles. We could field simple autonomous systems within a couple of years, but true autonomy will take years to realize. Autonomous systems are truly multidisciplinary, in that they rely on technologies ranging from sensors that understand the environment, to software algorithms that aid decision making or decide to seek human assistance. Through autonomy, we seek to reduce the manpower required to conduct missions, while extending and complementing human capabilities. The Department has four technical areas of focus for investments in Autonomy: Human and Agent System Interaction and Collaboration; Scalable Teaming of Autonomous Systems; Machine perception, Reasoning and Intelligence; and Test, Evaluation, Validation, and Verification. Built around these four technical areas, we launched an experiment last year to develop an in-house capacity in autonomous systems. This experiment, called the Autonomy Research Pilot Initiative (ARPI), funded seven proposals to work on technologies in one of the four technical areas above. The awards were for three years, and had to be completed in DoD laboratories by DoD personnel. ARPI efforts include: Autonomous Squad Member--enabling robots to participate in squad-level missions alongside soldiers; and Realizing Autonomy via Intelligent Adaptive Hybrid Control--increasing robustness and transparency of autonomous control to improve teaming of unmanned vehicles with each other and with their human operators. Advancement of technologies from the successful Department investment in the four technical areas will result in autonomous systems that provide more capability to warfighters, reduce the cognitive load on operators/supervisors, and lower overall operational cost.

Human Systems: Previous wars were won by massing power through weapons systems. It is not clear that will be the case in future conflicts. With the proliferation of sensors and data, future conflicts may well be won by the person that can react quickest. Studies of human cognition suggest that cognitive response times can be reduced by using display systems that present information using multiple sensory modalities. Such a reduction would give the force that is enabled with these technologies the ability to process more information, faster than their adversaries. Additionally, we are learning how to tailor training to adapt to individual students' unique needs, leading to reductions in the time needed to acquire expertise. Reducing the time to train forces to an advanced level of competence offers another way to respond faster than our adversaries. Additionally, robots, unmanned vehicles and other advanced technologies continue to be deeply integrated with our warfighters. We are developing new methodologies and technologies to enable our warfighters to interact with these systems as naturally as they do with their human counterparts leading to faster and more accurate responses by these "hybrid teams". Lastly, we are optimizing warfighter physical and cognitive performance for long durations, in dynamic and unpredictable environments, through personalized conditioning and nutritional regimens.

Directed Energy: One of the most mature “game changing” technology areas is Directed Energy, and specifically, High Energy Lasers. High Energy Lasers have been promised for many years, but these lasers were always based on chemical lasers, which are difficult to support logistically, and the byproducts are toxic. Over the past several years, however, solid state (electric) lasers have matured, largely through the Joint High Power Solid State Laser, a cross DoD effort to develop a 100 kilowatt (KW) laser. At close range, 10-30 KW is lethal. The JHPSSL was demonstrated in 2009. Since then, the Services have worked on packaging a solid state laser that could be deployed. In Summer 2014, a 30 KW laser will be prototyped on the USS Ponce in the CENTCOM area of responsibility. In December 2013, the Army demonstrated the High Energy Laser Mobile Demonstrator at White Sands missile range. This 10 KW laser successfully engaged nearly 90% of the available targets. This system will be further demonstrated in a maritime environment at Eglin Air Force Base.

RELIANCE 21

The Department's Research and Engineering (R&E) Enterprise is wide-ranging, and is the foundation of the Department's technological strength. The enterprise includes DoD laboratories and product centers, other government laboratories, federally funded research and development centers (FFRDC's) and University affiliated research centers (UARCs), US and allied universities, our allied and partner government laboratories, as well as industry. Last year I took the opportunity to brief the members of this Committee as my impetus to develop a strategy for the R&E Enterprise; this strategy was discussed earlier. What is important this year is putting in place the structure to attempt to optimize the S&T investment. Consequently, the Department's S&T Executives and I have worked to put in place Reliance 21. Under Reliance 21, most of the Department's S&T program will be managed in one of 17 cross-cutting portfolios. Each of these portfolios will be made up of Senior Executive or Senior Leader from each Service and Agency with investment in the area. These teams are building integrated roadmaps, and beginning the process of integrating allied and industry efforts onto our roadmaps. Each year, about one third of the portfolios will be reviewed, in depth to the S&T Executives, who will approve or redirect the roadmaps. The roadmap will include the technical and operational objective, the critical technical efforts needed to meet the objective, the gaps to reaching the objectives, and an assessment of where the portfolio leads recommend changes. The 17 portfolios are all called Communities of Interest (COI). Done correctly, management of a large portion of the Department's S&T execution will be collaboratively achieved by the COIs.

What Congress can do for the Defense S&T Program

We are the most technologically advanced military in the world but, as Secretary Hagel so aptly stated in his remarks on the 24th of February of this year, "we must maintain our technological edge over potential adversaries"[14]. I have outlined what we are doing with the resources that we have been given and what we plan to do with the resources in the FY 2015 President's budget. Success, however, will depend on your support. In that regard I have two requests.

I ask that you enact the Research, Development, Test and Evaluation portion of the President's Budget as submitted. We spent a lot of time to balance the program to best meet DoD priorities.

The President's Budget seeks funding for FY 2016-2021 that is above the estimated sequestration levels under current law. As pointed out earlier, with no relief from the BCA in the out years, we expect modernization and readiness accounts to bear the brunt. This would heighten the increased risk we are already seeing. Simply, at that sequestration level, we expect continued erosion of the S&T and RDT&E accounts.

Second, I would ask that you support our efforts in prototyping. We are expanding the use of developmental and operational prototyping in lieu of formal acquisition programs. Throughout the history of the Department, during periods of fiscal constraint, the Department has used prototypes to mature technology and keep design teams intact and moving forward.

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[14] Hagel, 24 February 2014.

Prototyping has another advantage—it allows the Department to build a capability early in the acquisition process, before all the structure affiliated with the acquisition process begins. By prototyping in research and engineering, we can acquire valuable knowledge and buy down risk and lead time to production at relatively low cost.

CLOSING

In summary, the last year has been a challenge to the Department's S&T program. The risk to our force is growing, and the need for the S&T community is likewise increasing. We have shifted our focus to protecting the future by countering anti-access, area-denial threats, addressing the increasing complexity of adversary's weapons systems, shortening the maturation time of developing our own systems, and addressing the erosion of the United States' stature in international science markers. We need your help to remove the crippling uncertainty associated with sequestration so that we can transition to the balance of force structure, readiness and modernization the country needs and deserves from us.