STATEMENT BY
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UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING

BEFORE THE

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Chairwoman Ernst, Ranking Member Heinrich, and distinguished members of the Subcommittee, thank you for the opportunity to discuss technology transition and what the Department of Defense can do to mitigate the infamous "Valley of Death".

The Department of Defense faces a continued challenge – balancing force structure, operational readiness and modernization in an increasingly complex environment. DoD needs to develop new ways to achieve innovation at what Secretary Mattis refers to as "the speed of relevance." This requires a need to move fast to wring out problems through experimentation and prototyping with a willingness to learn from failure rather than design to perfection.

In addition to an increased emphasis on prototyping and experimentation to both identify innovative solutions to our warfighting dilemmas and facilitate their development and transition to a fielded operational capability, we are developing tools that will identify promising, emerging technologies and capabilities to integrate current Department owned models and simulation environments to evaluate their potential, in conjunction with the Services, in Joint simulation environments. Our global technology watch/horizon scanning effort uses data analytics from a wide range of academic, research, and private and public investment data to identify current promising technologies, and forecast emerging technologies that the Department must be aware of to support innovative solutions to regain/maintain our technological edge in a highly competitive global environment. Additionally we are developing a capability to integrate validated Service and threat models into a Joint simulation environment so that we can conduct high fidelity evaluations of these potential capabilities in a mission level scenario so that the Department can gain a better understanding of how these capabilities will work in support of and improve the warfighting capability of existing service programs and force structure.

We are grateful to the members of this Committee for your sustained support of our warfighters, your support of our laboratories and research, development and engineering centers and your continued commitment to ensure that funding is available to provide our current and future warfighters with the technology that enables them to defend America's interests and those of our allies around the world.

Strategic Landscape

The United States still faces a complex and growing array of security challenges across the globe as described in the National Defense Strategy.

Many factors determine whether or not a technology transitions from the laboratory to the ultimate consumer – the warfighter. These factors include technology maturation, performance, affordability (of the technology and/or the system), manufacturability, available funding, schedule, continued need and/or support from program managers and perhaps most importantly, sustained priority for the technology/system for the Department.

The future force will be smaller, yet must remain capable of conducting the full range of operations on land, including prompt and sustained land combat as part of large, multi-phase joint and multinational operations. The future operational environment is likely to have several characteristics that will have a significant impact on land force operations in the future, including increased momentum of human interaction and events, potential for overmatch, proliferation of weapons of mass destruction, increasing importance of the space and cyberspace domains, and demographics and operations among populations in complex terrains. While the future force will become smaller and leaner, its great strength will lie in its increased agility, flexibility and ability to deploy quickly, while remaining technologically advanced.

While adversaries continue to invest in technology to counter or evade our strengths, insufficient resources and force modernization place at risk our ability to overmatch opponents. To mitigate these risks, the Department must maintain high levels of readiness while also investing in future force modernization. To maintain a decisive advantage over our enemies, the DoD emphasizes the integration of advanced technologies with skilled warfighters.

Despite these great pressures, the Department continues to protect its S&T investments critical to identifying, developing and demonstrating technology options that inform and enable affordable capabilities for the warfighter.

A Balanced Approach to Modernization

It is the Department's responsibility to address both current and emerging threats to ensure every warfighter deployed is equipped to achieve decisive overmatch regardless of the situation. As is often stated, we never want to send our Soldiers, sailors, airmen, or Marines into a fair fight. To ensure a balanced modernization strategy is paramount,

even under these austere fiscal conditions, to ensure we create long-term investment road maps across all our investment portfolios.

We must focus investments and develop concepts and technology to become more lethal, expeditionary, and agile, with greater capability to conduct decentralized, distributed, and integrated operations. The Department also focuses on decisions and priorities regarding current technology to maintain overmatch, while driving critical capability and technology needed for the future.

Innovation and technology continue to reshape the strategic environment, multiplying and intensifying the effects that even minor actors are able to achieve. Rapidly advancing technologies in many fields may become critical to military effectiveness; examples include autonomous systems, disruptive energetics, immersive training environments, quantum computing, synthetic biology, alternative power and energy solutions and unprecedented levels of networking capabilities. The Department will continue to develop countermeasures to future threat capabilities and pursue technological opportunities. However, enemies and adversaries will counter U.S. technological advantages through cover, concealment, camouflage, denial, deception, emulation, adaptation or evasion. Finally, understanding how humans apply technology to gain capabilities and train will become as important as the technologies themselves.

The technology playing field is changing. Important technology breakthroughs in many fields are now driven by commercial and international concerns. Our strategy acknowledges the imperative of a global, networked and full-spectrum joint force. It responds to the new fiscal environment and emphasizes new ways of operating and partnering. In a world where all have nearly equal access to open technology, innovation is a critical discriminator in assuring technology superiority.

The Department has identified enduring capability challenges that are necessary to conduct future operations to prevent, shape, and win conflicts, and are used to frame modernization.

The nature of research and engineering (R&E) is such that continuity and stability have great importance. Starting and stopping programs prevents momentum in research and lengthens the timelines for discovery and innovation. While the R&E enterprise gains valuable insight from the intelligence community, this only represents one input to the enterprise and likely describes the most probable future. To have a balanced outlook across all the possible futures requires that the portfolio also address the "possible" and "unthinkable."

Solving Current Problems

As noted before, it is the expertise resident within our R&E enterprise that enables our ability to respond to warfighter urgent needs in a timely and effective manner. The familiarity of our workforce to the operational environment helps them to quickly assess the ability for commercial solutions to meet the need (either with or without modifications) and/or identify developing capability that could address the immediate needs of the warfighter.

A strong organic research and engineering as well as technical workforce is critical to the Department's effort to retain the U.S.'s technical advantage over our adversaries. A major challenge facing the Department, as well as industry in general, is identification and recruitment of technical professionals with specific skills, experience, and knowledge in advanced technologies. In order to address technical workforce challenges and continue to close our capability gaps, we are leading many initiatives to enable the Department to hire people with critically needed technical skills as well as equip our current workforce with these skills.

Furthermore, DoD must build a human capital development program incorporating both traditional and non-traditional STEM careers paths that put the right technical talent and innovative talent in touch with the warfighter. This requires building tailored programs that create the necessary skills and social networks, develop the right risk taking culture and marries it with the opportunities to experiment. This is as simple as linking recipients of DoD STEM scholarship funding starting with undergraduate education to research laboratories and academic institutions through postdoctoral fellowships. To that end DoD increased STEM education funding beginning in FY19 to support DoD initiatives in Artificial Intelligence, Microelectronics, Hypersonics, and Biotechnology.

Driving Down Technical Risk

In this time of decreased modernization funds, it is incumbent upon the R&E enterprise to drive down the technical risks associated with developing new capabilities.

Congress has supported the Department over the last few years. One such way is by passing legislation in the Fiscal Year 2017 NDAA, Section 901 establishing the USD(R&E) with a focus on maintaining technology superiority. The USD(R&E) focus will drive down technical and integration risk through the extensive use of prototyping and experimentation, gain warfighter feedback to better inform requirements; to ensure that concepts going forward into acquisition not only provide the needed capability, but are timely and affordable.

Another was FY17 NDAA language to ensure that all major defense acquisition programs have a modular open design, to the maximum extent practicable, and a technology refresh strategy built in, prior to them being permitted to move forward into development. In response to the Acquisition Agility Act, the DoD employed a cross-functional team that developed policy changes, started establishing a body of practice,

and began training acquisition program staff to assist the workforce in implementing more rapid/agile acquisition of capability for the warfighter. Program-specific examples include:

- Blue Guardian (Air Force Research Laboratory (AFRL)-led program). Due to the adoption of Modular Open Systems Approach (MOSA) in the USAF Open Mission Systems (OMS) architecture, the Air Force was able to support the rapid acquisition of advanced C4ISR capabilities faster and cheaper than existing methods.
- Army Common Operating Environment (COE). The Army has adopted MOSA for its mission command systems, COE, to provide a common foundation of shared components and standards across key systems, allowing the Army to design, develop and deliver capabilities more effectively than the previous method (of using three different systems having different designs and standards).
- Navy Submarine Warfare Federated Tactical Systems (SWFTS). Due to the adoption of modularity and open business practices, Navy common submarine combat system programs, collectively known as SWFTS, were able to speed the delivery of advanced technologies and capabilities while driving down integration risks and life-cycle costs across multiple submarine classes.

By moving toward modular, open designs for architectures in this and other areas, we are creating systems that are easily upgradeable as new threats emerge. We are also making it easier for small, innovative businesses to contribute their technologies.

Identifying and Mitigating System Vulnerabilities

New theaters present new challenges – we anticipate facing future operations against technically savvy opponents who will challenge our military superiority. This effort looks at vulnerabilities in both individual technologies and systems, providing timely feedback to technology and materiel developers in order to increase awareness of potential risks (in context of future scenarios and threats) and to identify opportunities for technology and/or employment improvements. These efforts have the potential for significant cost savings, as vulnerabilities are mitigated before system designs are finalized and/or systems are fielded. A key aspect of this initiative is red teaming, challenging the systems with an emulated enemy – one who can use innovative and adaptive methods to disrupt the planned capability. This has proven to be an effective method to tease out inadvertent seams that result from the introduction of new technologies and systems into operational use.

One way we are accomplishing this is through Red Teaming activities, in which we provide technologists and systems developers with realistic and challenging scenarios where they can employ and assess their solutions prior to acquisition. These activities are envisioned to take emerging systems and prototypes out of the lab and into "messy" environments, incorporating varied operational and increasingly complex scenarios

against capable adversaries, as well as experienced warfighters and security forces that provide real-time user feedback on design and performance. In these settings, technology solutions are examined from multiple perspectives – including systems integration, logistics, training and adaptability risks – in order to expose potential employment vulnerabilities and identify needed improvements early on.

Understanding the Global Technology Environment

Understanding the current and projected threat environment is essential as we develop future capabilities. To foster greater innovation within the R&E enterprise, we are identifying concepts and conducting technology-based assessments about what S&T will look like in the deep future (the 2030-2040 timeframe) and how this will affect both the Department and our adversaries. We are taking a multipronged approach that includes brainstorming from government, industry and academia, and red teaming of potential technology concepts. At the heart of this initiative lies a commitment to solid analysis and a focus on bringing fresh ideas from a wide community, including innovative thinkers who haven't traditionally been a part of the planning process.

Our red teaming/vulnerability analysis activities are fostering closer ties between S&T and the intelligence community, a partnership that is increasingly important as we look beyond the recent wartime period into a more complex and unknown future.

Conclusion

As the Department's R&E enterprise continues to identify and harvest technologies suitable for transition to our force, we aim to remain ever vigilant of potential and emerging threats. We are implementing a strategic approach to modernization that includes an awareness of existing and potential gaps; an understanding of emerging threats; knowledge of state-of-the-art commercial, academic, and government research; as well as a clear understanding of competing needs for limited resources. The Department will sharpen its research efforts to focus upon those core capabilities it needs to sustain while identifying promising or disruptive technologies able to change the existing paradigms of understanding. Ultimately, the focus remains upon our warfighters; we consistently seeks new avenues to increase the warfighter's capability and ensure their technological superiority today, tomorrow, and decades from now. Our mission is not complete until the right technologies provide superior, yet affordable, overmatch capability for our Soldiers, sailors, airmen, and Marines.

All of the efforts described above would of course be impossible without the continued support of our partners in Congress. I would again like to thank the subcommittee for your long-standing support of the incredibly important work of the Department's R&E

enterprise. I am extremely proud to represent the men and women who have dedicated their lives to provide our warfighters with the capabilities to operate in any environment and situation. Thank you. I would be pleased to answer any questions you have.