

RECORD VERSION

STATEMENT BY

DR. THOMAS P. RUSSELL

**DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH AND
TECHNOLOGY**

BEFORE THE

**SUBCOMMITTEE ON EMERGING THREATS AND CAPABILITIES
COMMITTEE ON ARMED SERVICES
UNITED STATES HOUSE OF REPRESENTATIVES**

ON

**A REVIEW AND ASSESSMENT OF THE FISCAL YEAR 2019 BUDGET REQUEST
FOR DEPARTMENT OF DEFENSE SCIENCE AND TECHNOLOGY PROGRAMS**

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Chairwoman Stefanik, Ranking Member Langevin, and distinguished members of the Subcommittee, I would like to thank you for the opportunity to discuss the United States Army's program for Science and Technology (S&T) for Fiscal Year (FY) 2019. The committee plays a vital role in supporting Army S&T as the program seeks to ensure that the U.S. Army modernizes to meet future readiness requirements.

The Army's and future operational environment will demand land power dominance with increased flexibility, adaptability, and speed of responsiveness; mechanisms to mitigate or eliminate tactical surprise; improved joint interoperability and compatibility; an ability to effectively accommodate evolving alliances and partnerships; and seamless Soldier proficiencies across functional domains.

As a means to address current capability shortfalls and outpace anticipated threats, the Army S&T enterprise will pursue foundational technology developments for the future; leverage organic capacity and the capacity of our partners; mature technologies into innovative, affordable, and sustainable solutions; and make investments today in fundamental science and technology initiatives that will ensure breakthroughs that will yield affordable, decisive advantages for the future. The Army's S&T program supports the top modernization priorities established by the Secretary of the Army and the Chief of Staff of the Army (CSA).

Operating Challenges

Strategic land power dominance is critical to the U.S. Army for prompt, sustained, and synchronized operations with a force customized to the mission and poised to execute all its missions in all functional domains. Army S&T portfolio is focused on the Army's futures investment to allow it to fight tomorrow's wars with the right equipment.

The S&T enterprise faces a number of challenges, and is taking action to improve outcomes and efficiencies. Portfolio investments guide breakthrough research and technology innovation by creating, adapting, and developing leading edge technologies for future Army capabilities; innovating technical solutions to rapidly respond to urgent

Warfighter needs; and informing affordable and achievable requirements through experimental prototyping and demonstrations to leverage early Soldier input and drive down technical risk.

Over the past few years, the S&T Portfolio focused on near-term projects oriented on current requirements and improvements to current systems. After a critical review by Army stakeholders, the S&T Portfolio is being adjusted to meet the Army's needs to deter strategic competitors in the mid-and far-term, consistent with the Secretary of the Army and Chief of Staff of the Army and strategic planning guidance.

As a result, greater than \$1.0B in S&T funding was redirected from near-term to mid-term projects, reducing investments in counterinsurgency programs and increasing/accelerating investments to prepare for and deter strategic competitors. This adjustment is impacting FY19-23, which will allow S&T to maintain its investments to guide breakthrough research and technology innovation.

Science and Technology Development

The nation's landpower dominance will continue to rely on significant S&T advances to ensure competitive advantage to the U.S. Army and the joint force. As a safeguard against technological surprise, the Army's S&T portfolio is dedicated to futures investments that provide and inform technological options to our senior leadership and acquisition programs. These portfolio investments preserve S&T development continuity to maintain leading edge technologies; enable a broad technology outlook; and go beyond the limits of threat assessments to consider the "possible" and "unthinkable" to prevent tactical, operational, and strategic discontinuities.

Supporting Modernization

The Secretary of the Army and the Chief of Staff of the Army have established six top priorities to address the full spectrum from existing and emerging threats. Army S&T is fully involved with supporting the six key Army Modernization efforts:

Long Range Precision Fires

The Army's top modernization priority is to regain dominance in artillery and missile system range, lethality, and target acquisition with respect to strategic competitors. Army S&T has a multifaceted program to develop extended range capabilities for both cannon artillery and missile systems, as well as the supporting systems and technology necessary for their successful use in combat. A major change for FY 19 is an increased focus on engagement of multi-domain and moving ground and maritime targets with the initiation of the Land Based Anti-Ship Missile effort and the Extended Range Artillery Munition Suite.

Next Generation Combat Vehicle (NGCV)

The goal in this area is to provide an experimental prototype in FY 20 for Soldier evaluation. Several key technology efforts are scheduled to complete at end of FY19 including Modular Active Protection System (MAPS), Advanced Powertrain Demonstration, Vehicle Electronics Demonstrator, Advanced Running Gear, Combat Vehicle Survivability Underbody Blast Effort, and Vision Protection for Vehicles. A major focus area is robotics and autonomy enabled systems including artificial intelligence. This area includes developing purpose-built autonomy enabled systems and exploring upgrading current systems to be optionally-manned. There are significant challenges to overcome, but the potential increase in capability is worth the effort.

Future Vertical Lift (FVL)

The FVL effort is vital to ensure that Army Aviation can fly, fight, and survive in the future Anti-Access/Area Denial environment. The major focus areas of FVL S&T are Platform Design and Structures; Power; Unmanned Aircraft System Autonomy and Teaming; and Mission Systems. A major achievement occurred in one of the flight demonstrators under the Joint Multi-Role Technology Demonstrator project. Two successful flights demonstrated several revolutionary technologies, including advanced composites/low-cost manufacturing, active vibration control, and improved design and analysis tools.

Networks/C3I

The goal of S&T's Network/C3I investments is to provide the Soldier with assured communications in contested environments through situationally aware, intelligent networks, and autonomously routing of information over resilient communications links. Significant changes for FY19 are increased investments in tactical network and communications, and quantum computing for assured position, navigation, and timing (PNT) in Zero-GPS environments. A major effort is work on Modular Radio Frequency Communications to provide connectivity in contested and congested environments.

Air and Missile Defense (AMD)

The goal of S&T's effort in AMD is to develop and demonstrate technologies to defend against enemy air attack at extended range. A major change in FY19 is increasing focus on developing and demonstrating technologies to counter Maneuver Short Range Air Defense Missile Threats. To enable a layered defense, there are four major focus areas: Missiles, Directed Energy, Gun-based Air Defense, and Battlefield Sensors and Force Protection. The Army's High Energy Laser efforts are showing a great deal of promise. During FY17, the Army's 58 kilowatt Robust Electric Laser Initiative laser was successfully fired multiple times and achieved an electrical-optical efficiency of 43%, a record for solid state lasers. This laser was delivered to U.S. Army Space and Missile Defense Command for integration for the High Energy Laser Tactical Vehicle Demonstrator risk reduction demonstration scheduled for 4th Quarter of FY18.

Soldier Lethality

The Soldier Lethality modernization priority is focused on improving Soldier performance through increased mobility, enhanced lethality, and improved situational awareness. A major challenge to Soldier Lethality is how incorporating improved technologies can drive up the weight a Soldier must carry during a mission. The major focus areas for Soldier Lethality S&T are weapons and ammunition technologies, protection technologies, cognitive and physical performance measures, training to include the Synthetic Training Environment, and mission support capabilities such as

situational awareness sensors and displays, dismantled power and energy technologies, and Soldier and Small Unit sustainment capabilities.

The technologies that support these priorities are: Artificial Intelligence, ultra-secure communications, robotics, virtual reality, internet of things, energetics, Directed Energy, and ultra-designed materials. This list is not limiting but rather focusing, and as research proceeds, it is subject to review and revision.

- I. Artificial Intelligence (AI) – The artificial intelligence and machine learning effort extends commercial sector advances to solve military challenges. Reliance of the Warfighter on AI at the tactical edge requires the AI to be multi-faceted. Research in AI involves the development of a suite of AI-inspired and machine learning techniques and systems to assist Soldiers in dynamic, uncertain, complex operational conditions.
- II. Ultra-Secure Communications – The ultra-secure communications effort is two-fold. It seeks to develop short-haul hybrid communication networks with automated and intelligent switching capabilities and long-haul, distributed quantum communication networks that are tamper-evident and can provide more efficient processing of information for data-to-decisive actions.
- III. Robotics – The Robotics program is developing ground and air capabilities to advance the state of the art in military robotics and autonomous systems (RAS). It involves understanding capabilities, strengths, and limitations of RAS systems providing iterative feedback to both the S&T and Combat Developer communities. One example in the area of robotics is the combat vehicle robotics (CoVeR) – which builds on Wingman Joint Capability Test Demonstration capability to expand autonomous vehicle mobility to tracked platforms in operational environments at tactically relevant speeds.
- IV. Virtual Reality – The virtual reality effort will bring improvements to both Soldier training and to operational situational awareness. Training using virtual reality, along with constructive and live environments, is known as the Synthetic Training Environment, and will allow responsive and reconfigurable

- environments that immerse human senses in mixed-reality environments including physical elements, and providing touch and feel to simulate objects, such as obstacles and walls.
- V. Internet of Things (IoT) – We are using an internet of things approach for networking the battlefield of the future – converging and integrating various sources of information, communication systems, and analytical resources for faster, optimal decisions. The key difference between industry and military IoT is the deceptive and adversarial nature of the battlefield, its large scale and extreme heterogeneity.
 - VI. Energetic Materials – The energetic materials effort is opening insights into new ways to store energy and synthesize energetic compounds and approaches for releasing the stored energy at the desired time scales to achieve a substantially enhanced energetic output. The potential benefits are a class of energetic materials with 10 times the energetic release level of current explosives that will lead to increased lethality, smaller and lighter munitions, and higher performance gun and missile propellants.
 - VII. Directed Energy – In the past few years, diode-laser technology advances have made solid state High Energy Laser (HEL) systems feasible which may provide cost effective, lightweight, mobile HEL technology that affords protection against RAM, UAS, and cruise missiles in the future. Other key technology areas for Army S&T include non-traditional laser cooling systems and methods to mitigate adverse atmospheric effects and track targets in high clutter environments. These efforts are done in collaboration with the Joint community and the Directed Energy Joint Technology Office.
 - VIII. Ultra-Design Materials – All of the areas highlighted above benefits from the development of new materials with unique properties not available in nature. We are developing a materials-by-design approach to create transformational protection, energetic, electronic, and bio/bio-enabled materials.

Infrastructure Modernization

State-of-the-art technical facilities are essential to ensuring that the Army's S&T enterprise is positioned for discovery and maturation of technologies critical to Army and joint force operations into the deep future. Due to a myriad of contributing factors, many technical facilities that are leveraged by the S&T enterprise have become obsolete and would greatly benefit from revitalization and recapitalization. Upgrades made to existing facilities and/or minor construction of new facilities would improve safety, innovation efficiencies, and enterprise-wide poise for exploration of emerging scientific fields that would be difficult, if not impossible, to pursue using current facilities.

An enterprise-wide approach to technical infrastructure modernization, centered on four primary areas, is expected to lead to an integrated system of facilities accessible to technical personnel from across the S&T enterprise. This approach is focused on:

- Modernizing the Army's organic technical infrastructure.
- Informing technical construction of partner facilities.
- Engaging in Public-Public and Public-Private infrastructure collaborations.
- Imbedding Army Scientists and Engineers, using the Army Research Lab (ARL) open campus business model.

S&T Community

The Army S&T Strategy provides a unifying framework through which Army S&T laboratories and our industrial and academic partners are postured and empowered to mature disruptive technologies that ensure the operational overmatch for the Army and joint force. Demands of recent operations have required the Army's S&T Workforce to, in part, position itself to focus on near-term solutions. This dynamic, combined with emerging S&T developments, underscores the exigency that the Army's S&T Workforce, more routinely, consider the possible as well as the unthinkable to outpace unforeseen threats.

In particular, it is clear that the imperative to innovate and mature new technologies to meet capability needs has become even more critical to enabling the Army and joint

force than ever before. Efforts to evolve the technical workforce, are expected to facilitate critical technological developments for the future. The S&T enterprise must develop and retain a talented and high performing S&T workforce through:

- Developing senior S&T leaders to enable effective execution of S&T programs.
- Reshaping the existing technical workforce to meet emerging S&T challenges, dedicated to retraining current Army S&T professionals to prepare them to perform work in higher demand technical areas.
- Recruiting new personnel, and timely onboarding of S&T employees.
- Leveraging the best-and-brightest from across the Army S&T Enterprise, bringing together scientific professionals – Government, academic, and industrial – to address technical problems; these novel public-private partnerships are expected to enable rapid technology developments necessary to outpace emerging threats.

In addition to the roughly 12,000 scientists and engineers in the S&T enterprise, the Army Labs and Research, Development and Engineering Centers (RDECs) located throughout the United States are critical assets for the Army. With the committee's support, Army Labs and RDECs have been engaged with continual process improvements for years. Army Labs and RDECs have delivered key capabilities to the field in support of Operation Iraqi Freedom and Operation Enduring Freedom (Armor Kits for HMMWVs, Strykers, and MRAPs, IED solutions, Overwatch solutions).

Conclusion

For the imaginable future, the nation's landpower dominance will continue to heavily rely on significant S&T advances to ensure competitive advantage to the U.S. Army and the joint force. The Army S&T Strategy establishes a robust framework to efficiently pursue S&T advances that are essential to meeting the CSA's priorities concomitant with Joint Force operational goals articulated by the Secretary of Defense, thereby overcoming enduring technological challenges as well as emerging threats to agile and high-tempo land operations.