IEEE-USA

POSITION STATEMENT

Department of Defense Science and Technology

Adopted by the IEEE-USA Board of Directors June 25, 2021

The Institute of Electrical and Electronics Engineers-United States of America (IEEE-USA) strongly supports the Department of Defense (DOD) Science and Technology (S&T) program, which includes Basic and Applied Research (6.1-6.2) and Advanced Technology Development (6.3).

The DOD's S&T program helps to sustain U.S. military superiority through science and technology leadership. The S&T program funds research and development in federal, academic, and industrial laboratories that promotes defense innovations. The technology revolution in the last few decades has transformed the national defense ecosphere. To be the world leader, the United States needs to outpace the competition with research and development in several key strategic and critical technologies, including: robust and resilient communications; space systems including GPS; cyber defense and infrastructure protection; reliable electricity in the environment, in space, and in moving vehicles; internet connectivity; artificial intelligence; and robotics. An emphasis on long-term research leads to revolutionary advances in military capability, and results in civilian applications with major benefits to the public. Further, DOD-supported research in U.S. universities trains future scientists and engineers in such critical disciplines as electrical engineering, computer science, and mathematics. It builds and sustains the S&T workforce of U.S. citizens employed in the defense industrial base.

Despite Defense S&T's importance, DOD research funding has been allowed to plummet, by one-third, from three percent to two percent, of the overall DOD budget in the past 25 years. To protect our national security for the future, this dangerous decline must be reversed.

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IEEE-USA recommends that Congress and the Administration work together to:

- Increase the real budget for Basic Research (6.1), Applied Research (6.2) and Advanced Technology Development (6.3) in order to restore the percentage of the DOD budget dedicated to S&T Program to the widely recommended rate of 3.4%. Give special emphasis to basic research, which too often is sacrificed to fund near-term activities.

- Continue support for the best and brightest U.S. STEM students interested in science and technology careers through such competitive scholarship programs as the Science, Mathematics and Research for Transformation (SMART) program and the National Defense Science and Engineering Graduate Fellowship (NDSEG) program.

- Enable honorably discharged veterans, many of whom have received technical training while in the military, to pursue four-year degrees in S&T-related disciplines by extending GI Bill benefits from 36 months to 45 months.

This statement was developed by IEEE-USA's Research and Development Policy Committee and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the more than 150,000 engineering, computing and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of IEEE, or its other organizational units.

BACKGROUND

IEEE-USA strongly supports the Department of Defense (DOD) science and technology (S&T) program. DOD S&T is vital for building a stronger military force to preserve national security, guard against both conventional and non-conventional threats, and avoid technological surprise. A continuous need exists for innovative, cost-effective systems and processes. Meeting this need requires new science and technology. The DOD Third Offset Strategy[1] envisions future national security that requires investing in science and engineering research to support technologies and develop systems, products, solutions and tools, while at the same time educating a future workforce.

[1]Robert Work, Remarks by Deputy Secretary Work on Third Offset Strategy, https://www.defense.gov/Explore/News/Article/Article/991434/deputy-secretary-third-offset-strategy-bolsters-americas-military-deterrence/, 2016.

DOD research has produced a steady stream of game-changing innovations contributing to many militarily significant capabilities, including lasers, atomic clocks, and stealth technology in the 1950s; the Global Positioning System, computer mouse, Fast Fourier transform, and superconductivity in the 1960s; the Josephson junction and airborne laser in the 1970s; active noise reduction, gallium arsenide electronics, and high efficiency jet engine compressor blades in the 1980s; remotely piloted vehicles, chemical agent decontamination, quantum cascade lasers, and the Joint Precision Air Drop System in the 1990s; flexible electronics in the 2000s; and PFLOPS high-performance supercomputers and advanced microelectronics in the 2010s.

The same research that produced these results also contributed to the education of hundreds of thousands of engineers and scientists, and many of these DOD-sponsored discoveries have led to private-sector commercial products. Currently, the DOD supports some 5,000 undergraduate students, more than 5,000 graduate students, and a few thousand postdoctoral fellows annually. As an additional benefit, student involvement in DOD research acquaints them with DOD programs, which in turn paves the way for recruiting students, as well qualified employees and consultants.

Importance of the DOD S&T Program

The DOD sponsors scientific and engineering research to generate new knowledge and technical capabilities relevant to national defense, often in areas other agencies don't emphasize. Doing so creates future affordable options for new defense systems and helps the Nation avoid technological surprise. The best research creates new ways of thinking about the natural world. DOD research support also produces a cadre of creative engineers and scientists who understand fundamental science and are aware of defense issues. Having experts to call upon for advice enables the DOD to access the entire world's scientific advances, not merely those that it, or other federal agencies, fund. The former Undersecretary of Defense for Research and Engineering emphasized the need for ensuring "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."[1]

Although focused on national security, the DOD research program indirectly supports other U.S. priorities as well, including economic growth, education, national prestige, and international scientific collaborations that promote good will. Maintaining our leadership in research and technology is crucial to America's success. Technological advances contribute to as much as 85 percent of measured growth in U.S. per capita income. Since World War II, the United States has been the world's scientific and engineering leader. Consequently, it is the world's economic leader as well. Maintaining these positions will require dedicated effort.

Broad Support for a Strong DOD S&T Program

The 2005 National Academies report, *Rising above the Gathering Storm*, recommended that the United States: "Increase the federal investment in long-term basic research by 10 percent each year over the next seven years through reallocation of existing funds or, if necessary, through the investment of new funds. Special attention should go to the physical sciences, engineering, mathematics and information sciences, and to DOD basic research funding."[2]

In its 2010 follow-on report, the National Academies reaffirmed its recommendations, but noted (citing the Congressional Research Service) that little action had been taken on these two recommendations, at least insofar as DOD research was concerned.[3] Even as recently as 2020, the American Academy of Arts and Sciences emphasized that much remains to be done to maintain U.S. technical leadership.[4]

In 2018, the Under Secretary of Defense for Research and Engineering identified the top-10 list of technology focus areas from the 2018 National Defense Strategy (NDS), that the Defense Department must have to ensure its advantage over potential adversaries. The technology areas include hypersonics, directed energy, command, control and communications, space offense and defense, cybersecurity, artificial intelligence/ machine learning, missile defense, quantum science and computing, microelectronics, and autonomy.

The Defense Science Board (DSB) Task Force on Technology Strategy recommended objectives for each of the 10 priority technology areas, including the value to national defense, how achievable the technology is, what should be done most urgently, and an estimate of the broad timeline and investment needed to achieve the desired technical capability.[5] In December 2020, Joint Chiefs of Staff Chair General Mark Milley reaffirmed the 2018 NDS priorities and emphasized the importance of technology to military readiness and advantage[6]

Congress and other leaders have expressed concerns about the adequacy of funding for DOD's S&T Program (6.1-6.3). Many government leaders see the scientific and technological insights that emerge from this funding, often referred to as the

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[2] Norman Augustine, *et. al.*, **Rising above the Gathering Storm**, National Academies Press, 2007.

[3] Norman Augustine, *et. al.*, **Rising above the Gathering Storm Revisited**, National Academies Press, 2011.

[4] Norman Augustine, Neal Lane, et. al., **The Perils of Complacency: America at a Tipping Point in Science & Engineering**, American Academy of Arts and Sciences, 2020.

[5] Defense Science Board report on Technology Strategy, February 28, 2019.

https://dsb.cto.mil/reports/2010s/U_TechnologyStrategy_Executive Summary_2-2019.pdf

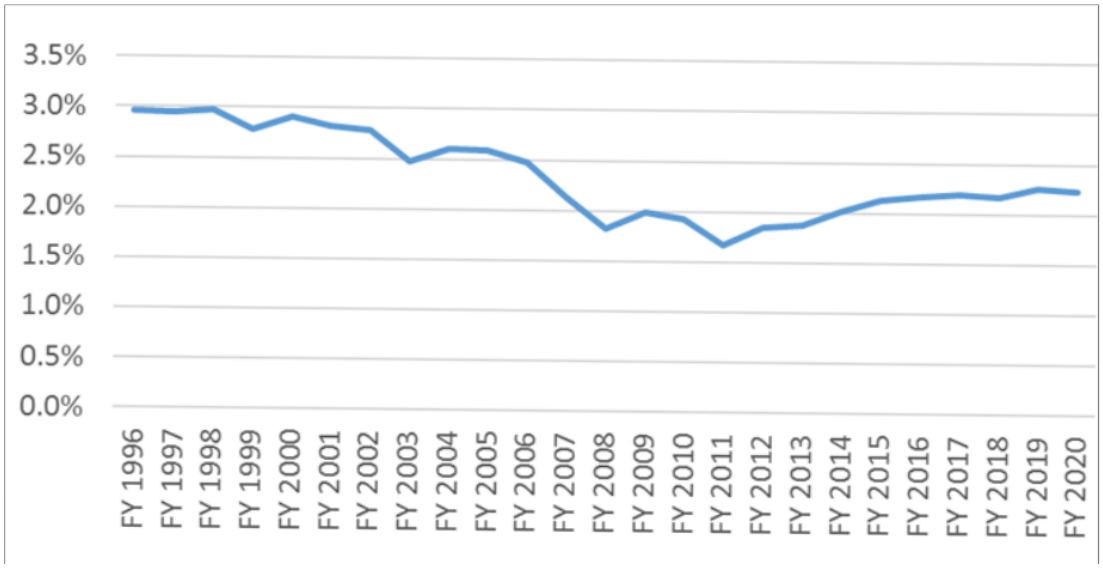
[6] "A conversation with Chairman of the Joint Chiefs of Staff General Mark Milley." The Brookings Institution, December 2, 2020. Transcript: https://www.brookings.edu/wp-content/uploads/2020/12/fp_20201202_milley_transcript.pdf.

department's "seed corn," as the available pool of knowledge to DOD and the industrial base for future defense technology development.

For this reason, Congress has often singled out defense S&T funding for attention, most recently by its Future of Defense Task Force. "To maintain its global preeminence in scientific and technological innovation and the associated economic and military advantage, the United States should increase its investment in foundational science and technology research." Specifically, "the Pentagon should increase funding for science and technology research programs to meet the 3.4 percent of the overall defense budget recommended by the Defense Science Board."[7]

Yet, viewed as a share of DOD's total obligation authority (TOA), S&T declined from about three percent in the late 1990s, to about 1.7% in 2011, recovering only to about 2.2% by FY2020. (See Figure 1.)

Figure 1. DOD Science and Technology Funding as a Percentage of DOD Total Obligational Authorities[8]



As just mentioned, the Defense Science Board, using industrial practice as a guide, proposed setting S&T funding at 3.4% of total DOD funding.[9] Increasing the S&T portion of the DOD budget to the recommended 3.4% over the next decade will require

[7] *Future of Defense Task Force Report 2020*, House Armed Services Committee, https://armedservices.house.gov/_cache/files/2/6/26129500-d208-47ba-a9f7-25a8f82828b0/6D5C75605DE8DDF0013712923B4388D7.future-of-defense-task-force-report.pdf.

[8] Congressional Research Services Report R44711, Department of Defense Research, Development, Test, and Evaluation (RDT&E): Appropriations Structure, October 7, 2020.

[9] Department of Defense, *Report of the Task Force on Basic Research,* Defense Science Board (Jan. 2012) (online at https://fas.org/irp/agency/dod/dsb/basic.pdf).

sustained real growth-per year of at least five percent. We should increase basic research even faster.

The public also strongly supports federal funding for research. "Americans overwhelmingly believe that science creates more opportunities for the next generation, that its benefits outweigh risks, and that the federal government should provide funds for scientific research."[10]

Because the DOD accounts for one-third of all federal investment in engineering research (as well as for 28 percent of federal math/computer science funding and 14 percent of federal physical science funding), the declining share of federal research funds flowing through the DOD strongly impacts the viability of U.S. engineering research.[11]

Sacrificing future military superiority through technology research to pay current operating expenses (including those of in-house laboratories) is a serious mistake. As the Deputy Secretary of Defense stated: "We're in a world of what we call 'fast followers.' … If adversaries try to copy us, we will always want to be ahead of what they're trying to do."[11] Failing to support defense S&T adequately is a sure route to sacrificing technical leadership in national security. The cost of Defense S&T is modest, but its impact is large.

DOD STEM Needs

In 2007, the Task Force on the Future of American Innovation, a group composed of organizations from academia and industry supporting research investment, called attention to the critical need for investment in the defense research workforce. This need continues, as the number of STEM educated U.S. students are not increasing.

Though many high-tech sectors have come to rely on foreign talent, the DOD requires U.S. citizens to carry out security-related research. The Task Force Report recommended expanding the focus of the American Competitiveness Initiative to include DOD research, and to place a greater priority on defense-related computer science research, as well as to encourage more collaboration between universities and federal defense research programs.

In 2012, the Defense Science Board emphasized the importance of DOD STEM education and research grant programs, stating that the "DOD must make a more concerted effort to ensure that the U.S. scientific human resources needed by the Department for global military competition will be available, and not assume that it will be so without such determined effort."

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[10] Pew Research Center, http://www.pewresearch.org/fact-tank/2018/07/03/americans-broadly-favor-government-funding-for-medical-and-science-research/.

[11] Stephen Merrill, "A Perpetual Imbalance?", **Issues in Science and Technology**, Winter 2013.

Recently, the Undersecretary of Defense for Research and Engineering emphasized that, “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.”[12] The DoD has developed a strategic plan[13] to secure sustainable STEM talent. Executing this plan remains a challenge the United States must rise to meet.

[12] Mike Griffin, Statement to the Emerging Threats and Capabilities Subcommittee of the Senate Armed Services Committee, 18 April 2018.
[13] Department of Defense STEM Strategic Plan, FY 2016-2020.