



POSITION STATEMENT

Department of Defense Science and Technology

*Adopted by the IEEE-USA
Board of Directors (18 Oct. 2017)*

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 sustain U.S. military superiority through technological leadership. The S&T program funds research in federal, academic, and industrial laboratories that promotes defense innovations. This emphasis on long-term research leads to revolutionary advances in military capability, and has also resulted in civilian applications with major benefits to the general public. Further, DOD-supported research in U.S. universities trains future engineers and scientists 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 defense and security. Yet, despite Defense S&T's importance, DOD research funding has been allowed to plummet from five percent to two percent of the DOD budget, over the past 25 years. To protect our future, this dangerous decline must be reversed.

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 (6.3) in order to restore percentage of the DOD budget dedicated to research to its historic rate of 5%. 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 national security 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.

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 180,000 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 weapons and processes. Meeting this need requires new science and technology. The DOD Third Offset Strategy¹ 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.

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; and flexible electronics in the 2000s.

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."² The best research creates new ways of thinking about the natural world. DOD research support also produces a cadre of

¹ Robert Work, Remarks by Deputy Secretary Work on Third Offset Strategy, 2016.

² White House Office of Science and Technology Policy, **Innovation for America's Economy, America's Energy and American Skills**, 2012

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. Describing science and technology as a priority, a former Secretary of Defense stated: "...accelerating trends in both technology development and dynamic threat environments dictate that we must maintain our edge by protecting our investments in development of future capabilities."³ The current Undersecretary of Defense for Research and Engineering reemphasized this point, stating 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."⁴

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. Former President Obama emphasized that "maintaining our leadership in research and technology is crucial to America's success."⁵ As much as 85 percent of measured growth in U.S. per capita income can be attributed to technological advances. 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.

There is broad support for a strong DOD S&T program.

The 2005 National Academies report, *Rising above the Gathering Storm*, recommended that the U.S. "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."⁶ 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.⁷

In 2006, The Defense Science Board warned that the DOD "must keep abreast of the most rapidly changing and emerging technologies." It went on to recommend "that the Secretary of Defense direct the Under Secretary of Defense for Acquisition, Technology and Logistics to develop a strategic technology plan drawing on the experience and

³ Office of the Secretary of Defense, **Defense Budget Priorities and Choices**, 2012.

⁴ Mike Griffin, **Statement to the Emerging Threats and Capabilities Subcommittee of the Senate Armed Services Committee**, 18 April 2018, https://www.armed-services.senate.gov/imo/media/doc/Griffin_04-18-18.pdf.

⁵ President Barack Obama, **2011 State of the Union Address to Congress**.

⁶ Norman Augustine, *et. al.*, **Rising above the Gathering Storm**, National Academies Press, 2007.

⁷ Norman Augustine, *et. al.*, **Rising above the Gathering Storm Revisited**, National Academies Press, 2011.

knowledge of the Director of Defense Research and Engineering(DDR&E)⁸. The plan should identify the handful of technologies critical to enabling those mission capabilities; which in turn, are critical to supporting the strategies to achieve national security and national defense objectives.⁹ It reaffirmed this recommendation in a 2012 report.¹⁰ Its 2016 study recommended that the DOD pay special attention to the international developments in autonomous systems.¹¹ Even more recently, the Director of National Intelligence identified the importance of technological leadership in cybersecurity, artificial intelligence, chem-bio defense, and other critical areas.¹²

The public also strongly supports federal funding for research.¹³ “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.”¹⁴

Yet, despite this broad support, DOD research funding has been allowed to decline drastically over the past two and one-half decades.¹⁵

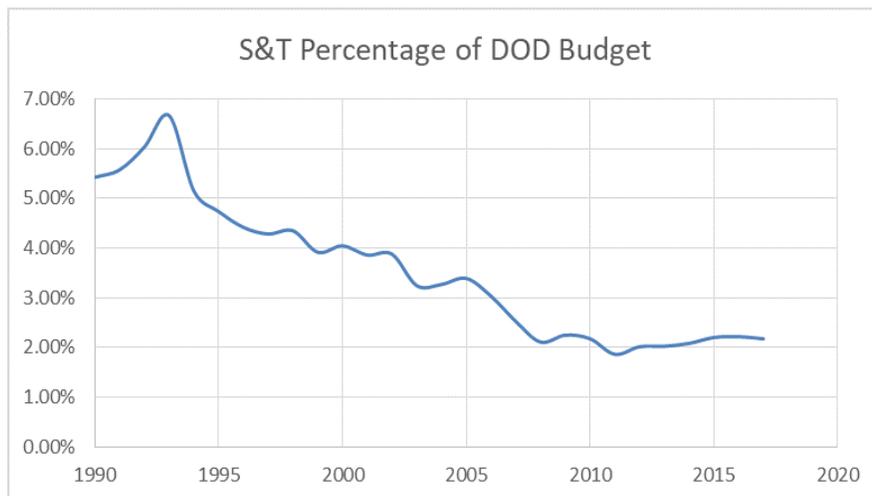


Figure 1. DOD S&T (6.1 – 6.3) as a percentage of total DOD budget.

⁸ Director of Defense Research and Engineering, now renamed the Assistant Secretary of Defense for Research and Engineering.

⁹ Defense Science Board, **The Roles and Authorities of the Director of Defense Research and Engineering (DDR&E)**, 2006.

¹⁰ Defense Science Board, **Basic Research**, 2012.

¹¹ Defense Science Board, **Autonomy**, 2016.

¹² Daniel Coates, “Worldwide Threat Assessment of the US Intelligence Community”, **Senate Select Committee on Intelligence**, 2017.

¹³ Pew Research Center, <http://www.pewresearch.org/fact-tank/2018/07/03/americans-broadly-favor-government-funding-for-medical-and-science-research/>.

¹⁴ National Science Board, **Science and Engineering Indicators 2018**, <https://www.nsf.gov/statistics/2018/nsb20181/digest/sections/public-attitudes-and-understanding-of-science-and-technology>.

¹⁵ Based on data aggregated by the American Association for the Advancement of Science, <http://www.aaas.org/sites/default/files/DODST%3B.xlsx>, and by the Office of Management and Budget, <https://www.whitehouse.gov/omb/budget/Historicals>, Table 5.2.

Restoring the S&T percentage of the DOD budget to five percent over the next two and one-half decades would require four percent real growth per year. Basic research should be increased even faster, because it will provide the foundation for a “Fourth Offset Strategy” that will be needed eventually. F

urther, because the DOD accounts for one-third of all federal investment in engineering (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.¹⁶

Sacrificing future military superiority through technology research to pay current operating expenses (including those of in-house laboratories) would be a serious mistake. A 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.”¹

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

The Task Force on the Future of American Innovation, a group composed of organizations from academia and industry supporting research investment, called attention in 2007 to the critical need for investment in the defense research workforce. 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.¹⁷

The National Academies made similar points in 2012:¹⁸

- New technological opportunities and threats are appearing with ever-increasing frequency.
- For many technologies, the most advanced work is no longer being conducted in the United States.
- For most technologies, the most advanced and innovative work is no longer being conducted within the Department of Defense or its contractor community.

¹⁶ Stephen Merrill, “A Perpetual Imbalance?” **Issues in Science and Technology**, Winter 2013.

¹⁷ Task Force on the Future of American Innovation, **Measuring the Moment: Innovation, National Security, and Economic Competitiveness**, 2007.

¹⁸ Norman Augustine, Dan Mote, *et. al.*, **STEM Workforce Needs for the U. S. Department of Defense and the U. S. Defense Industrial Base**, National Academies Press, 2012.

The 2012 Defense Science Board report cited above⁷ also 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.” Although the “DOD supports a substantial number of undergraduate and graduate students, primarily through research assistantships and the DOD’s research awards, as well as through a number of science, technology, engineering, and mathematics programs, ... the task force recommends that the DOD’s programs be expanded.” Further, the “DOD basic research funding agencies and services can and should do much better in capitalizing on the talent of the basic researchers that they fund. By systematically exposing these researchers to the ‘hard’ problems that the DOD would like to solve, the researchers offer a potential pool of fresh new ideas to help solve DOD problems.”

Most 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.”¹⁹

¹⁹ Mike Griffin, **Statement to the Emerging Threats and Capabilities Subcommittee of the Senate Armed Services Committee**, 18 April 2018, https://www.armed-services.senate.gov/imo/media/doc/Griffin_04-18-18.pdf.