



POSITION STATEMENT

DEPARTMENT OF DEFENSE SCIENCE AND TECHNOLOGY

*Adopted by the IEEE-USA
Board of Directors, 23 November 2013*

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 Department of Defense's S&T program helps sustain U.S. military superiority through technological superiority. DoD supports research in U.S. universities that is the bridge between fundamental science and future military applications. It trains future engineers and scientists in critical disciplines, such as electrical engineering, computer science and mathematics. Further, DoD research funding builds and sustains the S&T workforce of U.S. citizens working in defense and security. The S&T program also funds research in federal, academic and industrial laboratories that focuses on technologies to promote defense innovations. This emphasis on long-term research leads to revolutionary advances in military capability, and it also has resulted in civilian applications with major benefit to the general public.

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

- Provide a minimum of 2% percent annual real funding growth increase each year for Basic Research (6.1) and assure at least 70 percent of it is expended at the nation's universities
- Maintain funding for the combination of Applied Research (6.2) and Advanced Technology (6.3)
- 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 the IEEE-USA Research & 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 more than 205,000 engineers, scientists and allied professionals who are U.S. members of 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 science and technology (S&T) program of the Department of Defense. 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 more cost effective weapons and processes, which requires the application of new science and technologies to defense. As envisioned by DOD, future network-centric warfare requires building and training a future workforce, and at the same time investing in basic and applied research to support technologies, and develop systems, products, solutions and tools for modern warfare.

DOD research has produced a steady stream of game-changing innovations, and contributed to many significant military capabilities, including lasers, atomic clocks, and the Kalman filter 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; gallium arsenide electronics and high efficiency jet engine compressor blades in the 1980s; chemical agent decontamination, quantum cascade lasers, and the Joint Precision Air Drop System in the 1990s; and physically constrained image deconvolution, and flexible electronics in the 2000s. The same research that produced these results also contributed to the education of many hundreds of thousands of engineers and scientists, and many of these DOD-sponsored discoveries have led to private sector commercial products. Currently, 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; in turn, paving the way for recruiting some of them as well-qualified future employees and consultants.

IMPORTANCE OF THE DOD S&T PROGRAM

DOD sponsors and conducts scientific and engineering research to generate new knowledge and technical capabilities relevant to national defense, often in areas not emphasized by other agencies. Doing so creates “future affordable options for new defense systems and helps the Nation avoid technological surprise.”¹ 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 DOD to access the entire world’s scientific advances, not merely those advances that it (or other federal agencies) funds. Describing science and technology as a priority, the Secretary of Defense stated “that accelerating trends in both technology development and a dynamic threat environment dictate that we must maintain our edge by protecting our investments in development of future capabilities.”²

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. As articulated by the president, “maintaining

¹ White House Office of Science and Technology Policy: **Innovation for America’s Economy, America’s Energy, and American Skills**, 2012.

² Office of the Secretary of Defense: **Defense Budget Priorities and Choices**, 2012.

our leadership in research and technology is crucial to America's success.”³ 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, and consequently, its economic leader as well. Maintaining these positions will require dedicated effort.

Today's federal budget environment brings immense pressure to decrease federal budgets. Federally funded research and development that has both military and economic value has the highest chance of surviving budget cuts. DARPA and some other DOD research funding organizations have a long and successful history of developing technologies that have both military and economic value. Expanding this practice to all groups conducting DOD sponsored research and development will increase the likelihood that DOD R&D will continue to benefit the nation greatly.

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

The 2005 National Academies report, *Rising above the Gathering Storm*, recommended:⁴

- “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.”
- “Provide new research grants of \$500,000 each annually, payable over five years, to 200 of the nation's most outstanding early career researchers. The grants would be made through existing federal research agencies, such as the National Institutes of Health, the National Science Foundations, the Department of Energy, the DOD and NASA, to underwrite new research opportunities at universities and government laboratories.”

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.⁵

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 knowledge of the DDR&E. 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.”⁶ It reaffirmed this recommendation in a 2012 report.⁷

³ President Barack Obama, **2011 State of the Union Address to Congress**.

⁴ Norman Augustine, et al, **Rising above the Gathering Storm**, National Academies Press, 2007.

⁵ Norman Augustine, et al, **Rising above the Gathering Storm Revisited**, National Academies Press, 2011.

⁶ Defense Science Board: **The Roles and Authorities of the Director of Defense Research and Engineering (DDR&E)**, 2006.

⁷ Defense Science Board: **Basic Research**, 2012.

Yet, despite this broad advocacy, DOD research funding has declined dramatically over the past decade--as a fraction of total federal research support. Because 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 DOD strongly impacts the viability of U.S. engineering research.⁸

In this time of restricted budgets, DOD must also resist the temptation to divert research funds to other, seemingly more urgent, requirements. Basic research is particularly vulnerable in this regard and must be protected diligently. To sacrifice future military superiority through technology research, to pay current operating expenses (including those of in-house laboratories), would be a serious mistake.

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. Almost a third of DOD civilian science and technology workers were then eligible to retire, and nearly 70 percent would become eligible within the next seven years. 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 basic 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.⁹ The National Academies made similar points in 2012, observing:¹⁰

- 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 work is no longer being conducted within the Department of Defense, or its contractor community.

The 2012 Defense Science Board report cited above⁷ also emphasized the importance of DOD STEM education and research grant programs, stating that “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 “DOD supports a substantial number of undergraduate and graduate students, primarily through research assistantships and DOD's research awards, as well as through a number of science, technology, engineering, and mathematics programs ... the task force recommends that DOD's programs be expanded.” Further, “DOD basic research funding

⁸ Stephen Merrill, “A Perpetual Imbalance,” **Issues in Science and Technology**, Winter 2013.

⁹ Task Force on the Future of American Innovation: **Measuring the Moment: Innovation, National Security, and Economic Competitiveness**, 2007.

¹⁰ 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.

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 DOD would like to solve, the researchers offer a potential pool of fresh new ideas to help solve DOD problems.”

IMPROVED BUSINESS PRACTICES

According to the same Defense Science Board report, “The unnecessary and unproductive bureaucratic burden on basic researchers funded by DOD in effect equates to reduction of the DOD basic research budget. Reducing that burden, whether from legislation, administrative requirements imposed from outside or within DOD, and the Services, is perhaps the most important thing that might be done to improve the current DOD basic research program.” Although speaking here on basic research, the report makes clear that improved business practices would strengthen the entire DOD S&T enterprise.

Specific recommendations included:

- Identifying and eliminating inappropriate burdens on DOD-funded research, at both universities and federal laboratories (This is a topic of increasing concern throughout government, as evidenced by the recent National Science Board request for suggestions.)
- Streamlining DOD STEM hiring practices; expanding the use of visiting S&Es in DOD laboratories; and more effectively utilizing DOD STEM education programs as hiring tools
- Expanding international S&T outreach.