

Basic Research at DoD: A Status Report

As we reported in a previous article (Feb. 2011), pursuing research funding from the defense agencies is a very different process compared to applying to NSF or NIH. However, if your research happens to be relevant to the DoD's interests, they can be a good source of funding to support that research. (For readers who are new to the DoD, at the end of this article we include a recap of that article, which covered the basics of pursuing funding at DoD.) With the winding down of two wars and significant budget cuts, the research priorities of the Department of Defense (DoD) are changing significantly. If you plan to pursue DoD funding, it's critical to keep abreast of these changes in DoD's mission and priorities. A number of very useful documents posted on the [Defense Innovation Marketplace website](#) provide insight into these changes. We will summarize them below.

Science & Technology Areas of Investment

In [testimony to the US House Committee on Armed Services](#), Alan Shaffer, Assistant Secretary of Defense for Defense Research and Engineering provided an overview of DoD's shifting Science and Technology (S&T) priorities as reflected in the FY2015 budget request. Compared to the large overall DoD budget cuts, the FY2015 budget request for S&T is only 5.6% lower than FY2014 in real dollars. However, the DoD is shifting focus more to applied research and advanced technology development, away from basic research, and this is reflected in a 8.4% cut (in real dollars) for Basic Research. He also mentioned that funding to develop advanced capabilities is shifting from the Services (Army, Navy, Air Force) to DARPA. As a result S&T funding to the services has been cut (1.8% for the Army, 4% for the Navy and 7.9% for the Air Force) but DARPA's S&T funding has been kept constant in real dollars (which translates to a slight increase in actual dollars). Areas of emphasis (and increased investment) at the basic research level include:

- **Quantum Information Science (QIS):** DoD is increasing its basic research investment in QIS, which exploits expanded quantum capabilities in the laboratory to engineer new properties and states of matter and light at the atomic scale.
- **Nanoengineering/Nanotechnology:** While QIS is based on the ability to control atoms, nanoengineering/nanotechnology deals with the ability to develop and engineer systems at the molecular level. Shaffer mentioned several examples, including metamaterials, engineered nanomaterials such as coatings, and nanoparticle catalysts.
- **Autonomy:** The Department has four technical areas of focus for investments in Autonomy: Human and Agent System Interaction and Collaboration; Scalable Teaming of Autonomous Systems; Machine perception, Reasoning and Intelligence; and Test, Evaluation, Validation, and Verification. The Autonomy Research Pilot Initiative is an experiment to develop in-house capacity in autonomous systems and funded seven proposals last year.
- **Human Systems:** With the proliferation of sensors and data, future conflicts may well be won by the person that can react quickest. Studies of human cognition suggest that cognitive response times can be reduced by using display systems that present information using multiple sensory modalities. They are also interested in ways to optimize warfighter physical and cognitive performance for long durations through personalized conditioning

and nutritional regiments, and how to tailor training to adapt to individual students' unique needs. (This topic aligns with a general increase in DoD's interest in biologically oriented research – an area that might not immediately come to mind when considering DoD funding.)

In the [DoD Research and Engineering Enterprise](#) public statement released May 1, 2014, two high-level tenets that depend on continued technological superiority were identified: 1) The military will be smaller and leaner, but it will be agile, flexible, ready and technologically advanced; and 2) The Department will protect and prioritize key investments in technology and new capabilities, as well as our capacity to grow, adapt and mobilize as needed. This emphasis on affordability—finding ways to enable new or extended military capabilities while cutting costs—can be seen throughout the DoD's plans. They specifically identified interest in technologies to lower life cycle costs (e.g., embedded sensors to signal when maintenance is needed, improvements in modeling and simulation capabilities) and Research and Engineering processes to reduce the cost of transition from engineering to manufacturing development (e.g., model-based design, and expanded use of prototyping).

Research & Engineering Priorities and COIs

Interestingly, as a strategy to optimize R&E investment across all DoD components, they have reintroduced *Reliance 21*, a portfolio management approach that decomposes the S&T program into **17 distinct portfolios , or Community of Interest (COI)** composed of all the people working in the technical area, along with Basic Research, which is managed as a single program through the Defense Basic Research Advisory Group. As we've discussed in the past, if you plan to pursue research funding from DoD, it is extremely important to connect with intramural researchers working in your field. For that reason, if you identify a COI related to your research topic, you'll want to track the activities of the COI (including any meetings, reports, etc.) and get to know the people who comprise that COI. Those COIs are listed below. For more information, see the descriptions starting on page 9 of the [statement](#):

Seven Science and Technology Priorities

1. **Data to Decisions:** Human-computer interfaces, analytics and decision tools, information management, advanced computing and software development, and networks and communications, science and applications to reduce cycle time and manpower requirements for analysis and use of large data sets.
2. **Engineered Resilient Systems:** Engineering concept, science, and design tools to protect against malicious compromise of weapons systems and to develop agile manufacturing for trusted and assured defense systems.
3. **Cyber Science and Technology:** Science and Technology for efficient, effective cyber capabilities across the spectrum of joint operations.
4. **Electronic Warfare/Electronic Protection:** New concepts and technology to protect systems and extend capabilities across the electro-magnetic spectrum
5. **Counter Weapons of Mass Destruction:** Advances in DoDs ability to locate, secure, monitor, tag, track, interdict, eliminate and attribute WMD weapons and materials.
6. **Autonomy:** Science and technology to achieve autonomous systems that reliably and safely accomplish complex tasks, in all environments.

7. **Human Systems:** Science and technology to enhance human-machine interfaces to increase productivity and effectiveness across a broad range of missions.

Ten Other Significant Technology Areas

8. **Advanced Electronics:** Advancing scientific understanding of new materials and devices and S&T to enhance exploitation and insertion of advanced microelectronics and reduce microelectronics supply chain risk.

9. **Air Platforms:** Enables more efficient and effective platforms and future concepts including fixed rotary wing vehicles, unmanned aircraft systems, gas turbines, hypersonics, and aircraft power and thermal management.

10. **Biomedical:** Operates under the auspices of the Armed Services Biomedical Research Evaluation and Management Committee to develop a coordinated Defense biomedical Research, Development, Testing and Evaluation investment strategy.

11. **Counter-Improvised Explosive Devices:** Supports the objective of defeating IEDs and their threat to national security objectives and provide force-multiplying capability to address improvised explosive device threats of the future.

12. **Energy & Power Technologies:** Enhances operational effectiveness through power generation, energy storage, power control and distribution, electromechanical conversion, and thermal management technologies.

13. **Ground & Sea Platforms:** Enhances design and integration, survivability, mobility, modularity, and maintainability of manned and unmanned ground and sea platforms.

14. **Material and Manufacturing Processes:** Develops technology-based options for advanced materials for defense, and seeking excellence in materials technologies, processes and related research.

15. **Sensor & Processing:** Physics-based maritime, ground, air-borne, and space-borne sensing capabilities to include electro-optic and infrared sensors; radio frequency sensors; acoustic, magnetic, seismic sensors, and associated signal processing, fusion and modeling.

16. **Space:** Enhances effectiveness and affordability of space-based capabilities.

17. **Weapons:** Develop technology-based options for weapons, and seeking excellence in weapons technologies and related research, including guidance, navigation and control; ordnance; propulsion; undersea weapons; high energy lasers; radio frequency weapons; non-lethal weapons; modeling, simulation and test infrastructure.

Basic Research

Drilling down a bit more into the DoD's basic research interests, the DoD's Basic Research Directorate lists [six Emerging Scientific Research Areas: Synthetic Biology, Quantum Information Science; Cognitive Neuroscience; Understanding Human and Social Behavior; Novel Engineered Materials; and Nanoscience](#). The Army Research & Technology's [Basic Research Portfolio](#) lists five general investment categories along with their FY2015 budget (6.1) requests: **Human Centric** (\$77M), **Information Centric** (\$86M), **Material Centric** (\$172M), **Platform Centric** (\$55M) and **Enrichment Initiatives** (\$34M; these include education outreach and some university research programs). Within these categories, they list a number of investment areas such as "neuroscience" and "behavioral and cultural" under human centric. Remember that much of this funding will go to intramural research, but some will be available to support extramural research that supports these agency priorities.

As we mentioned earlier, DARPA is being given more responsibility for some types of research. In keeping with the increased emphasis across DoD on the life science and bio-inspired technologies, DARPA [established](#) a new [Biological Technologies Office \(BTO\)](#) this year, which has three focus areas: [restore and maintain warfighter abilities](#), [harness biological systems](#), and [apply biological complexity at scale](#). New opportunities include the [Hand Proprioception & Touch Interfaces \(HAPTIX\)](#) program. As we mention below, in contrast to the services, DARPA does not conduct intramural research but instead solely funds extramural research. However, their model and culture are fundamentally different from those of NSF and NIH (see the discussion in the recap below for more information if you're new to DARPA).

Other Resources

[DoD Basic Research Office portal](#)

[AFRL Basic Research](#)

[Testimony by DARPA Director to House Subcommittee on Intelligence, Emerging Threats and Capabilities](#)

[Disruptive Naval Technologies presentation](#)

[Air Force Research Lab Science & Technology Overview presentation](#)

[DARPA Strategic Plan](#)

Recap: Pursuing Funding from DoD

Overview of DoD agencies

The Department of Defense agencies that commonly fund external research are:

- Air Force Office of Sponsored Research (AFOSR)
- Office of Naval Research (ONR)
- Army Research Office (ARO)
- Defense Advance Research Projects Agency (DARPA)
- National Security Agency (NSA)
- US Army Medical Research & Materiel Command, which oversees the Congressionally Directed Medical Research Programs (CDMRP)

We will discuss the first four agencies together because of their similarities. Because CDMRP is varies significantly from the other DoD agencies in its culture, mission and procedures, we'll discuss it separately at the end of this article.

Culture and Mission (AFOSR, ONR, ARO, DARPA, NSA)

All of the Department of Defense agencies are highly mission-oriented. The missions of AFOSR, ONR and ARO are related to the management of research that supports the goals and operations of their respective services (Air Force, Navy and Army, respectively). DARPA's mission is to oversee high risk, high pay-off research that has the potential to significantly benefit any of the DoD's branches. These DoD agencies therefore are looking for research that has a close connection to defense, and particular technologies and problems of interest are identified by the various funding agencies in Broad Agency Announcements (BAAs).

Usually, time horizons for research to be translated into applications is relatively short. Program Officers in the various DoD agencies are given a large amount of discretion in making funding decisions, and having a relationship with the Program Officer is extremely important to potential applicants. Establishing a relationship with a Program Officer is not difficult; they are often receptive to phone calls and e-mails and are usually happy to discuss a potential applicants' research and whether it fits into the agency's needs; they also attend professional conferences on research topics of interest to their organizations. One caveat to this is that once a Request for Proposals (RFP) has been issued, Program Officers are usually not allowed to discuss the program in order to avoid the appearance of giving any of the applicants an unfair advantage. This is another reason that it is important to be engaged with the Program Officer early, before the RFP is issued.

Funding Opportunities

The Department of Defense classifies research according to how basic or applied it is.

- 6.1 - the most basic research and is usually the type of research that may be funded at a university
- 6.2 - applied research and may be a continuation of 6.1 research as it becomes closer to application in a defense system. This type of research is often funded at a defense company, which may partner with a university for the more basic aspects of the research.
- 6.3 - application research, where a new technology is applied to a defense system and tested. This type of research is usually performed by a defense company, perhaps in partnership with the potential user.

Like many mission agencies, ARO, AFOSR and ONR fund both intramural (internally conducted) and extramural (externally conducted) research. It's always a good idea for researchers aspiring to win funding from these agencies to get to know the internal DoD researchers who are working in their research areas. It's often expected that externally funded projects will be conducted in a collaborative fashion with DoD scientists; e.g., building on their results, utilizing specialized testing equipment at DoD labs, or designing components or systems based on criteria specified by DoD scientists. Furthermore, these DoD scientists are often involved in the proposal review process; therefore, having prior connections can enhance competitiveness of your proposal.

The defense agencies announce funding opportunities in a variety of ways, including Broad Agency Announcements (BAAs). Each agency typically issues a "**Long Range BAA**," which outlines technical research interests and priorities of the agency over a several-year range covered by the BAA, as well as **targeted BAAs**, which address more specific competitions, and **other targeted solicitations**. University research is often funded through unsolicited proposals based on the Long Range BAA. Web sites for the Long Range BAAs for each Research Office are given below by agency. Solicitations for programs targeted specifically or predominantly for University researchers are listed in the section on targeted programs below.

DARPA differs from ARO, AFOSR and ONR in that its mission benefits all areas of defense. DARPA's mission, according to its website, is "to maintain the technological superiority of the

U.S. military and prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research that bridges the gap between fundamental discoveries and their military use.” DARPA does not conduct intramural research, but each of its Program Managers is given an extraordinary amount of autonomy in setting research priorities and making funding decisions. The Program Managers are often well-known researchers in the technical field they are overseeing and very often rotate into and out of their position at DARPA from academia or industry. As with dealing with the other research offices, it is extremely important to develop a relationship with the DARPA Program Manager before submitting a proposal. Furthermore, since DARPA’s interests lie in transitioning new technology into military use as quickly as possible, faculty researchers are well-advised to team with defense industry or defense lab researchers when proposing new research.

Unsolicited Proposals

If you who would like to propose a research project addressing research priorities outlined in the Long Range BAA, you should typically contact the Program Officer to discuss your project idea. If the Program Officer is interested, she will request a white paper (also called a preliminary proposal). White papers are short summaries of the project idea, and rules for white paper length and format can be found in the agency long range BAA or will be designated by the Program Officer. If the Program Officer likes the white paper, she will request a full proposal.

Targeted Programs

DoD agencies periodically issue targeted BAAs or RFPs to address some specific need or priority pertaining to their service. As with unsolicited proposals, you will be in the best position if you have already talked to the program officer and were aware that the funding opportunity was coming before it was issued. You can accomplish this by getting to know the program officers and intramural researchers who conduct research in your field and talking to them about programs that they see coming down the pike. Often, the agency will hold a conference or workshop for potential applicants before the RFP or BAA is issued, and this can be a great opportunity to find partners as well as to learn more about the program. If the agency anticipates a large number of applicants, they may first require preliminary proposals or “quad charts.” Based on those submissions, they will invite full proposals from selected applicants. (We discussed how to develop quad charts and white papers in an article in the October issue.)

DoD also oversees programs that are aimed specifically or predominantly at university researchers or at partnerships that may include university researchers (listed below). In competing for most of these programs, it is extremely helpful to have already developed a relationship with a DoD program officer and preferably to have been funded by the DoD on a related research project.

Note: when looking at BAAs, check to see which services are participating. Some BAAs (particularly those for universities) are issued and administered by ONR but may also have participation by AFOSR and ARO.

Programs for Universities

[Minerva Initiative](#) (University-based Social Science Research Initiative)

[Programs for universities](#) (ONR list)

- [Multidisciplinary University Research Initiative](#) (MURI)
- [Defense University Research Instrumentation Program \(DURIP\)](#)
- Young Investigator Program
 - [ONR Young Investigator Program](#)
 - [AFOSR Young Investigator Program](#) (FY 2015 not announced yet)
- Faculty Exchanges and Summer Faculty Positions in DoD Labs
 - [Summer Faculty Research Program \(ONR\)](#)
 - [University Resident Research Program \(AFOSR\)](#)
- [Historically Black Colleges and Universities Program](#)

Other programs that may include industry/university partnerships:

- Small Business Innovations Research (SBIR)
- Small Business Technology Transfer (STTR)
- Targeted programs

All funding opportunities for DoD are included in the [Grants.gov](#) web page - select Department of Defense under "Agency" to see all recent funding opportunities issued by DoD agencies.

They are also announced on [FedBizOpps](#).

Positioning Yourself to Compete for DoD Funding

As we've already mentioned several times, if you plan to pursue DoD funding, you will need to find out who in DoD is likely to be interested in your research. Remember that DoD, unlike NSF, is not interested in funding research simply for the sake of advancing science. They have very specific needs and challenges arising from their defense missions, and they fund research that will help them meet those needs and challenges. You need to understand their needs as thoroughly possible so that you can describe how your research will help them address those needs. One excellent way to do this is by working in a DoD lab during the summer as part of their summer faculty positions program. To get one of these positions, you'll need a program officer or researcher within DoD to sponsor you, and you'll need an idea for a joint project that you will conduct with DoD lab researchers during the summer, so you'll need to have already engaged them. But if they are excited by your research they are often very happy to host you, and these summer positions typically lead to more funding after you return to your university.

Remember also that DoD funds research at universities not only for the research results, but also as a way to recruit graduate students into research positions at DoD. By involving your graduate students integrally in your DoD research projects and encouraging interaction of your graduate students with DoD scientists and the program officer, you'll be providing your graduate students with potential networking and employment opportunities, and you may be able to establish yourself as a good source of employees for the DoD lab. In that case, the DoD agency may see consistently funding one or two of the students your lab as an excellent investment.

If you expect to pursue DoD funding over the long term, you should consider developing collaborative relationships with defense companies and research corporations (?). These companies can provide you with insight into potential applications of your research, and they may look to you for basic research that they may not have the time or resources to conduct. Often, 6.2 type research (which tends to involve much higher funding levels) may include some basic research that a university can best conduct along with applied research that requires the capabilities of a defense company. If you have developed these collaborations, these companies are likely to seek you out for such opportunities.

Special Considerations

If you are considering pursuing DoD funding, remember that DoD culture is very different from academic culture. While many DoD program officers have worked extensively with universities, this is not always the case, and there is significant turnover among program officers. Make sure that you and your PO are on the same page regarding outcomes and expectations. Does the PO expect a “feelie” (DoD jargon for some piece of hardware) on his desk at the end of 18 months? If so, are you comfortable that you can provide one? Does your PO expect schedules with milestones down to the week, or does she understand that you’re working with graduate students and your schedule will be a bit more fluid? Are there any clearance issues or restrictions on foreign students participating in the research? This is not usually the case for 6.1 research, but it can be an issue for 6.2 research. What are the procedures for publication and presentation of research results? In most cases, the DoD sponsor requires that a draft of the article or presentation be sent to the sponsor so that it can be reviewed for restricted information, and several weeks must be allocated for that process.

Despite these concerns, many researchers have found working with DoD to be a very rewarding experience.

Useful links for AFOSR, ONR, ARO and DARPA

All DoD

[Defense Innovation Marketplace](#) - excellent website that brings together new solicitations, strategic documents, news, etc. for all of DoD Science and Technology) and includes RSS feed [DoD TechMatch](#)

Air Force Office of Scientific Research (AFOSR)

[Homepage](#)

[Organization](#)

[AFRL Research Areas](#)

Funding Opportunity Websites:

- [Broad Agency Announcements](#)
- [General Research Interests Broad Agency Announcement](#)

Office of Naval Research (ONR)

[Homepage](#)

Funding Opportunity Websites:

- [Current BAAs](#)

Army Research Office (ARO)

[Homepage](#)

[Organization](#)

Funding Opportunity Website:

- [Current BAAs](#)

Defense Advanced Research Projects Office (DARPA)

[Homepage](#)

[Organization](#)

[Funding Opportunity Websites](#)

[DARPA Biological Technologies BAA](#)

National Security Agency (NSA)

[Homepage](#)

[Unsolicited Proposals](#)

Congressionally Directed Medical Research Programs (CDMRP)

Culture and Organization

The culture and operating procedures of the CDMRP are closer to those of the basic research agencies such as NSF and NIH than those of DoD, with the exception that the priorities of the office are very closely tied to Congressional direction and can therefore change significantly from year to year.

According to the CDMRP's website, "dollars for the CDMRP are not considered part of the DoD's core mission, and are therefore not included in the DoD's requested budget. Rather, the dollars to fund CDMRP are added every year during the budget approval cycle by members of the House or Senate, in response to requests by consumer advocates and disease survivors." More information on the funding process can be found [here](#) . CDMRP's current research programs are listed [here](#).

Funding Opportunities

Funding opportunities are made public via Program Announcements, which can be found at the websites for each of the research programs or at the grants.gov site. The CDMRP uses a wide range of funding mechanisms, all of which are listed in the "Award Mechanisms" pull-down menu on the [award search site](#) . Not all award mechanisms are available for all research programs; each program has a web site describing awards available through that program.

Useful Links for CDMRP

[Home page](#)

[Mission](#)

[Organization](#)

[Awards Search](#)