Guide to FY2016 Research Funding at the Department of Defense (DOD)

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Summary and Index

This document provides insights into the various DOD funding agency opportunities for University basic research (6.1) and for some applied research (6.2) efforts, with special attention to changes anticipated in FY2016. Additional information is available through the USC Mission Agency Program Summary (MAPS) website (more detail in Resources).

DOD funds research that is relevant to its mission, predominantly drawing on engineering, computer/information science, and physical sciences. The Department has identified seven priorities: Autonomy, Counter Weapons of Mass Destruction, Cyber Sciences, Data-to-Decisions, Electronic Warfare, Engineered Resilient Systems, and Human Systems.

The Service basic research budgets show increases compared to the President's budget request of last year, but Congressional action added to the Service research accounts significantly in 2015. So the 2016 requests for the Air Force and Navy are about 12% smaller than the funds available to them in 2015.

Appendix 2: FY2016 Selected Applied Programs with Significant Change

Overview

Since DOD relies heavily on technological advantage, contributions from research, development and engineering must be marshaled to meet tomorrow's defense challenges. DOD funds research and development (R&D) that is relevant to its mission, predominantly drawing on engineering, computer/information science, and physical sciences. However, DOD also funds limited social science, medical, and life science research.

The DOD has many different funding organizations that engage in Research, Development, Test and Evaluation (RDT&E), each with its own foci and idiosyncrasies. The better knowns are the three Services (Air Force, Army, and Naval) and the Defense Advanced Research Projects Agency. Information on the RDT&E budgets can be found in the annual DOD R-1 Document that summarizes the budget at a high level, and the R-2 documents (Research and Development Descriptive Summaries) that address each agency program in more detail. (http://comptroller.defense.gov/budgetmaterials.aspx)

As part of its investment in R&D, DOD funds basic research (labeled 6.1, or BA1), applied research (6.2, or BA2) and advanced technology development (6.3, or BA3). Taken together, these three budget lines are referred to as the S&T investment. The Department has identified seven Science and Technology (S&T) priorities: Autonomy, Counter Weapons of Mass Destruction, Cyber Science and Technology, Data-to-Decisions, Electronic Warfare / Electronic Protection, Engineered Resilient Systems, and Human Systems.

Universities get about 60% of the basic research, 10% of the 6.2, and 5% of the 6.3 funding. However, the 6.2 and 6.3 funding at Universities includes University Affiliated Research Centers (UARCs) and other entities that are structured to handle the greater deadline, security classification, and reporting requirements. On 6.2/6.3 projects, it is not unusual for a University professor to be a collaborator with industry, a university affiliated organization (such as the Information Sciences Institute (ISI) and the Institute for Creative Technologies (ICT) at USC), or a DOD laboratory/center.

Basic Research

DOD defines basic research as systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind. With very few exceptions, basic research will not be classified or restricted, with results to be reported in the open literature.

The Office of the Assistant Secretary of Defense (Research & Engineering) has identified high priority basic research topics: a) metamaterials and plasmonics, b) quantum information science, c) cognitive neuroscience, d) nanoscience and nanoengineering, e) synthetic biology, and f) computational modeling of human and social behavior. On occasion, the DOD Office of Basic Research sponsors workshops in emerging areas of science/engineering that it perceives as important to the DOD; these workshops are meant to guide research investment. In November 2014 the DOD released a solicitation through AFOSR that requested input on Future Direction Topics for basic research (solicitation #FDWRFI 0004).

Funding for basic research is available from several DOD agencies, each having its own particular focus:

- Army Research Office (ARO): www.arl.army.mil/www/default.cfm?page=29
  Focus: soldier, ground force mission (6.1 only)
- Air Force Office of Scientific Research (AFOSR): www.wpafb.af.mil/afrl/afosr/
  Focus: pilot, aerospace mission (6.1 only)
- Office of Naval Research (ONR): www.onr.navy.mil/
  Focus: sailor, marine, ship, ocean mission (6.1 - 6.3)
- Defense Advanced Research Projects Agency (DARPA): www.darpa.mil/
  Focus: defense-wide technology innovation (6.1 – 6.3)
- Defense Threat Reduction Agency (DTRA): www.dtra.mil/
  Focus: weapons of mass destruction (6.1 – 6.3)
- Chemical Biological Defense Program (CBDP): www.jpeocbd.osd.mil/
  Focus: chemical/biological warfare defense (6.1 - 6.3) – managed through DTRA
- Office Secretary of Defense (OSD): www.acq.osd.mil/rd/
  Focus: overarching Defense issues
- Defense Medical R&D Program (DMDRP): dmrdp.dhhq.health.mil/home.aspx
  Focus: military specific medical research (6.1 – 6.3)
- Congressional Directed Medical Research Program (CDMRP): cdmrp.army.mil/
  Focus: medical research of interest to a Congress person (6.1 only)

Generic Basic Research Broad Agency Announcements - Single Investigator Efforts

The majority of DOD basic research funding is invested in single investigator efforts and advertised through relatively generic Broad Area Announcements (BAAs). The funding for these efforts typically ranges between $100-200K/yr for three years; continuation is possible. Approximately 20% of the projects will be turned over annually.

While peer review is used to differing degrees by the various DOD agencies, the program officers have far greater latitude than do NSF program officers. So it is <u>essential</u> to contact a program officer and explore mutual interests. To identify the appropriate program officers, one can use the USC MAPS website keyword search engine, and/or contact Murday. A white paper is <u>very</u> useful (often required). The program officers don't want to waste your time writing, or their own time reading, an inappropriate proposal. Proposals to the long-range BAA programs may be submitted at any time, but late spring is when many tentative decisions are being made for new starts in the coming fiscal year (which starts 1 Oct). There is no standard DOD proposal format; each agency/office has its own requirements. Guides to interacting with the program officers and preparing proposals are in the MAPS web site, Tabs 2-4.

Special Program Announcements

During the year, DOD agencies can announce special program opportunities; DARPA, DTRA and CDMRP, in particular, use this approach predominantly. These opportunities range from large, center efforts [e.g., University Affiliated Research Centers (UARCs), Collaborative Technology Alliances (CTA), and Centers of Excellence (CoE)] to single investigator programs [e.g., DARPA/DTRA/CDMRP topic solicitations, and ONR's Basic Research Challenges]. These opportunities can be found by monitoring: 1) the funding agency sites, 2) the "grants.gov" website and/or 3) the "defenseinnovationmarketplace.mil" website. The DC Office of Res. Advancement does this and provides alerts to pertinent USC investigators.

Young Investigators
Each of the three services, DTRA, and DARPA has special announcements for young faculty programs (except ARO where it is part of the generic BAA). The eligibility typically is within five years of Ph.D. or equivalent degree, but DARPA and ONR are five years from initial tenure-track appointment. US Citizenship or "green card" status is required by the Services, but not by DARPA and DTRA. The available funding ranges from $50K/yr (Army) to $250K/yr (DARPA). Submission deadlines vary. For more information, see MAPS DOD Charts 156-161; a listing of prior awardees and their research topics is available from the DC office.

Senior Investigators - National Security Science and Engineering Faculty Fellowship
http://www.acq.osd.mil/rd/basic_research/program_info/nsseff.html
This is a special program to support outstanding faculty in topics-of-interest to DOD; it is competed intermittently as funding allows. Awardees are generally ~20 years post year of PhD and have impressive credentials. An NSSEFF awardee receives ~$600K/yr for five years. For more information see MAPS DOD Chart 165; a listing of the prior awardees/topics is available from the DC office.

Multidisciplinary Efforts – Multidisciplinary University Research Initiatives (MURIs)
http://www.onr.navy.mil/en/Science-Technology/Directorates/office-research-discovery-invention/Sponsored-Research/University-Research-Initiatives/MURI.aspx
As part of DOD's University Research Initiative budget line, the multidisciplinary university research initiative (MURI) program has topics announced in the Jul – Sept time frame each year, with white papers due about a month later, and proposals about three months later. These require multidisciplinary teaming efforts; the funding is up to $2.5M/yr for five years (presuming acceptable performance). Successful proposals have typically engaged 3-5 Universities, but single University efforts can be successful. For more information see MAPS DOD Charts 129-133; a listing of prior awardees/topics is available from the DC office.

University Centers of Excellence (COE)
Both the Army and Navy support University Affiliated Research Centers (UARCs) that, in addition to basic research, also address applied research and development (see MAPS DOD Chart 155). The Army also has University COE, Collaborative Technology Alliances (CTA), and Collaborative Research Alliances (CRA) that engage Universities. The Air Force supports University Centers of Excellence (~5yr lifetime) that are associated with specific Air Force Research Laboratory technical directorates. (see MAPS DOD Chart 178)

Human Social, Cultural, and Behavioral Modeling (HSCB)
http://minerva.dtic.mil/
In addition to Service core HSCB programs, the Office of the Secretary of Defense (OSD) funds S&T programs to address understanding and modeling of human behavior in social and cultural contexts. The basic research component is entitled the Minerva Initiative (see MAPS DOD Chart 128); it is presently administered by ONR.

Medical

Congressionally Directed Medical Research Program (CDMRP)

http://cdmrp.army.mil.

Congress typically adds funds to the DOD budget for support of medical basic research; these total ~$0.5-1B/yr in recent years. Each year the funds are inserted by a congressperson for specific topics for that year only. Those topics are openly competed through the Congressionally Directed Medical Research Program (CDMRP) solicitations. The Army's Medical Research and Materiel Command manages the CDMRP with a contractor (presently SAIC) providing the administrative functions. Since there is no certainty of continued funding, there are no program officers per se. For more information on the CDMRP, see MAPS DOD Charts 141-152 and/or visit the CDMRP website (which is very informative).

Agency

DOD has a relatively small extramural effort in medical basic research. In 2010 the DOD established a joint program, the Defense Medical Research and Development Program (DMRDP) with 6.1-6.3 funding (see MAPS DOD Charts 134-140). The Army Medical Research and Materiel Command (USAMRMC) issues a generic BAA for basic research, but generally without much available money. In addition, USAMRMC manages the Armed Forces Institute of Regenerative Medicine (AFIRM), which funds University-based consortia (see DOD Chart 55). DARPA has a Basic Operational Medical Science (6.1) effort (see MAPS DOD Charts 87-89). ONR has a Biological and Biomedical Division with interest in selected medical topics (see MAPS DOD Chart 69).

Instrumentation

http://www.onr.navy.mil/en/Science-Technology/Directorates/office-research-discovery-invention/Sponsored-Research/University-Research-Initiatives/DURIP.aspx

As part of the University Research Initiative (URI) budget line, the Defense University Research Instrumentation Program (DURIP) is competed each summer. The awards range from $50K to $1.5M; matching funds are not required, but are very useful for the high priced instruments. While anyone may submit, there is a strong preference for instrumentation in support of funded DOD research efforts. For more information, see MAPS DOD Charts 129-133. ARO also has its own research instrumentation program (see MAPS DOD Chart 51).

Education/Training/Sabbaticals

In addition to funding research itself, there are DOD programs in support of PhD education (the National Defense Science and Engineering Graduate (NDSEG) program - http://ndseg.asee.org/), and Undergraduate/graduate education (the National Defense Education Program (NDEP - http://www.ndep.us/). Each of the Services also has a STEM education effort. The DOD research laboratories fund postdoctoral positions through the National Research Council (NRC), the American Society for Engineering Education (ASEE), and the Oak Ridge Associated Universities (ORAU) programs. In addition there are many programs to support faculty working at the various DOD laboratories. For more information on these programs see MAPS DOD Charts 170-171).

Resources

Defense-wide central resource website: defenseinnovationmarketplace.mil

Office of the Secretary of Defense (OSD) Basic Research webite:
http://www.acq.osd.mil/rd/basic_research/

Assistant Secretary of Defense Research and Engineering, Strategic Guidance 2014
http://www.dtic.mil/dtic/pdf/success/ASD(R&E)_Strategic_Guidance_May_2014.pdf

Mission Agency Program Summaries (MAPS)
The DC Office of Research Advancement has created the Federal Mission Agency Program Summaries website to:

1. connect PIs with appropriate funding agency programs/program officers
2. assist in development of white papers/charts/elevator speeches

The website (http://web-app.usc.edu/web/ra_maps) can be accessed using one's USC NetID and Password.

MAPS will have the following resources:

1. *Search Tab* for a searchable database of programs/program officers
   One can do keyword searches to locate many of the associated mission agency (DHS, DOD, DOE, DOT, ED, EPA, NASA, NIST, NOAA and USDA) programs and program officers.
2. *Mission Agency Tab* (DHS, DHHS, DOD, DOE, DOJ, DOT, ED, EPA, INTEL, NASA, NIST, NOAA, and USDA)
   Guide to Agency Funding for FYXX
   Agency Research Program Charts
   Agency Planning Documents
   Chart numbers in the "Guides to Funding" reference the Agency Research Program Chart file.
3. *Presentation Tab* for charts from recent USC Center of Excellence in Research workshops
4. *Proposal Tab* for reports / guides on writing proposals
5. *Email Alerts Tab* for URLs at which one can arrange for automatic solicitation updates
6. *Grantee Tab* for URLs at which one can find previous agency/program officer awardees
7. *Visiting DC Tab* for information about DC Office services

Personal Assistance in Locating Funding and Preparing Proposals

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Table 1: FY2013 and FY2014 DOD Research Funding ($M)
Obligations at Universities/Colleges

	2013		2014	
	Basic	Applied	Basic	Applied
Total for DOD	**1862**	**4093**	**2094**	**4732**
Total at Universities	**974**	**507**	**1084**	**624**
Physical Sciences	**202**	**24**	**236**	**33**
Astronomy	0	-		
Chemistry	61	4		
Physics	125	10		
Other	15	10		
Environmental Sciences	**80**	**22**	**88**	**29**
Atmospheric	12	1		
Geological	3	-		
Oceanology	58	19		
Other	7	2		
Mathematics and Computer	**168**	**101**	**179**	**129**
Computer Sciences	57	87		
Mathematics	74	1		
Other	36	14		
Engineering	**321**	**204**	**355**	**247**
Aeronautical	54	18		
Astronautical	4	2		
Chemical	38	24		
Civil	2	5		
Electrical	65	46		
Mechanical	32	4		
Metal/Materials	58	13		
Other	69	92		
Life Sciences	**139**	**131**	**149**	**153**
Agriculture	0	0		
Biological	91	8		
Environmental	3	15		
Medical	38	104		
Other	7	5		
Psychological	**15**	**1**	**17**	**9**
Social Sciences	**23**	**9**	**30**	**8**
Other Sciences	**27**	**14**	**31**	**16**

From NSF "Federal Funds for Research and Development: FY2013-2015" NSF 15-324, July 2015
Because the entries for FY2015 are Budget Request only, they are not reported here.

Basic	2013	Tables 30, 77 and 80-86
Applied Research	2013	Tables 44, 88 and 91-97
Basic	2014	Table 31 and 78
Applied Research	2014	Table 45 and 89

Table 2: Projected DOD Basic Research Funding ($M) for FY2016: From the President's Budget Request Submitted to Congress.

Discipline / Agency	Army	AF	Navy	DARPA	DTRA	CBDP	DMRDP	OSD
Biology / Life Sciences	10			6				
Human Systems			17					
Biology / Medical			18					
Chemistry	10							
Propulsion		38						
Physics	16	34						
Electronics/Photonics	11	44	47	40				
Materials	7	64	58	70				
Mechanics	7							
Mechanics Structural								
Mechanics Fluid		31						
Environment								
Ocean			81					
Atmosphere and Space			25					
Environmental Science	2							
Computer, Information Sciences, Mathematics			46	132				
Mathematics	6	29						
Computing Sciences	8	17						
Information Sciences		20						
Networks	9	28						
Simulation and Training	2							
Cyber				54				
Air/Ground/Sea Vehicles			57					
Weapons			18					
Counter IED Devices			17					
Science Education Career and Outreach		24	48					
Transformative / Basic Research Challenge			21	30				
Chemical/Biological Warfare Defense						46		
Weapons of Mass Destruction Defeat					38			
Hi-Energy Laser Multidisciplinary Res Initiative		14						
Multidisciplinary Univ Research Initiatives	53	79	85					
Defense Univ Instrumentation Program	12	16	23					
National Defense S & E Graduate Program		47						
National Defense Educ Program (NDEP)								50
Social / Cultural / Human - MINERVA, HSCB	3							10
National Security S&E Faculty Fellow (NSSEFF)								35
Basic Operational Medical (in Defense Health)							7	
Total	155	484	559	333	38	46	7	94

The reported Army funding by discipline reflects only the ARO budget available for University single investigator proposal submission (budget line item HR 57), not the total Army basic research funding; from a different basic research budget line the Army also funds University Centers through special competitions. For the Navy, about 25% of the reported total basic research funding is provided to the Naval Research Laboratory. For the Air Force, about 30% is provided to the AF Research Laboratories.

Since the projected budgets in the table are parsed differently than most of the organization's program taxonomies, clear assignment of funds by academic taxonomies is not always possible. The Table should be considered a best estimate. In some cases the amount of funding in a discipline is included under other headings and is thereby unknown; physics and chemistry at ONR and DARPA are good examples.

Table 3: Summary of Basic Research Funding
(Taken from the President's Budget Requests to Congress)

Service		Actual* FY 14	Estimate* FY15	PBR FY15	PBR FY16	% inc PRB FY16-15
Air Force	Basic Research	511	551	454	485	7
	Defense Res Sciences	364	390	315	330	
Army	Basic Research	425	460	424	425	-
	Defense Res Sciences	217	248	238	239	
	ARO (H57)	78	81	81	87	7
	ICT (J08)	7.8	7.5	7.5	6.1	-20
Navy	Basic Research	604	650	576	587	2
	Defense Res Sciences	477	497	444	452	
DARPA	Basic Research	293	332	362	333	-8
	Basic Operational Medical Res Science	48	61	50	57	14
DTRA	Basic Research	45	38	38	38	-
CBDP	Basic Research	51	48	51	46	-10
OSD	NDEP	73	58	45	49	9
	MINERVA (0601110D8Z)	9.2	9.4	8.9	9.5	7
DHP	GDF-Basic Operational Med Res Sciences (0601117HP – 371A)	5.8	7.5	7.5	7.4	-

* The FY14-15 numbers may include Congressional changes and Congressional special adds (CA, sometimes labeled Congressional Special Interest, CSI) which do not appear in the President's Budget Request (PBR).

Note that Congress added funds to the Service research accounts in 2015, more than restoring the proposed reductions in the Presidential Budget request. While the 2016 PBR numbers grow over the 2015 PBR, it remains to be seen if Congress will again increase those accounts. If not, then AFOSR and ONR will experience significant reductions in 2016 compared to 2015,

Each of the Services has a strategic S&T plan which provides guidance into priorities; these can found at the USC MAPS DOD website. In addition to the opportunities elaborated in Appendix 1, approximately 20% of the projects in a DOD basic research program are turned over each year. So there are opportunities in many programs even in the absence of budget growth or modest decline.

Applied Research and Advanced Technology Development

DOD defines applied research (6.2 or BA2) as systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met. Advanced technology development (6.3 or BA3) includes all efforts that have moved into the development and integration of hardware for field experiments and tests.

Funding opportunities for applied research (6.2) and advanced technology development (6.3) are distributed among many DOD organizations, each having its own particular focus:

Organizations managing a 6.1-6.3 investment portfolio

- Office of Naval Research (ONR, Naval includes the Navy and Marine Corps)
  http://www.onr.navy.mil/Science-Technology/Directorates/Transition/
  Focus: develop/transition cutting-edge technology products to Naval acquisition managers
- Defense Advanced Research Projects Agency (DARPA)
  www.darpa.mil
  Focus: defense-wide technology innovation
- Defense Threat Reduction Agency (DTRA)
  http://www.dtra.mil/Research.aspx
  Focus: countering weapons of mass destruction – chem, bio, radiological, nuclear, explosive

Other S&T organizations (w/o basic research)

- Defense Forensics and Biometrics Agency (DFBA)
  http://biometrics.dod.mil/
  Focus: forensics and biometrics activities and operations in support of identity operations
- Defense Logistics Agency (DLA)
  http://www.dla.mil/Pages/default.aspx
  Focus: support the weapon system sustainment program
- Missile Defense Agency (MDA)
  http://www.mda.mil/business/advanced_research.html
  Focus: system to defend against ballistic missile attacks
- Special Operations Command (SOCOM)
  http://www.socom.mil/Sordac/Pages/Default.aspx
  Focus: development, acquisition, and fielding of critical items to enable the SOF Warfighter
- Strategic Environmental Research and Development Program (SERDP)
  Environmental Security Technology Certification Program (ESTCP)
  https://www.serdp-estcp.org/
  Focus: develop and demonstrate innovative, cost-effective, and sustainable solutions

Service Research Laboratories/Centers

- Army Research Laboratory (ARL, mostly 6.1 and 6.2)
  http://www.arl.army.mil/www/default.cfm?page=8
  Focus:
  - Computational and Information Sciences
  - Human Research and Engineering
  - Sensors and Electron Devices
  - Survivability/Lethality Analysis
  - Vehicle Technology
  - Weapons and Materials Research

- Army Research and Development Commands (RDECOM, mostly 6.2 - 6.4)
  http://www.army.mil/info/organization/unitsandcommands/commandstructure/rdecom/
  Focus:
    Edgewood Chemical Biological Center (ECBC)
    Soldier Research Development and Engineering Center (NSRDEC)
    Communication-Electronics RDE Center (CERDEC)
    Aviation & Missile RDE Center (AMRDEC)
    Tank-Automotive RDE Center (TARDEC)
    Armament RDE Center (ARDEC)
- Army Corps of Engineers, Engineering Research and Development Center (ERDC)
  http://www.usace.army.mil/Missions/ResearchandDevelopment.aspx
  Focus: solve nation's problems in geospatial sciences, water resources, and environmental
- Army Medical Research and Materiel Command (AMRMC)
  https://mrmc.amedd.army.mil/
  Focus: medical research, development, and acquisition and medical logistics management

- Air Force Research Laboratories (AFRL)
  http://www.wpafb.af.mil/afrl
  Focus:
    Aerospace Systems (RQ)
    Sensors (RY)
    Materials and Manufacturing (RX)
    Munitions (RW)
    Directed Energy (RD)
    Space Vehicles (RV)
    Information (RI)
    Human Effectiveness (711 HPC)

- Naval Warfare Centers
  Focus:
    Naval Surface Warfare Centers (NSWC)
    http://www.navsea.navy.mil/nswc/default.aspx
    Naval Air Warfare Centers (NAWC)
    www.navair.navy.mil/nawcwd Weapons
    www.navair.navy.mil/NAWCAD Aircraft
    www.navair.navy.mil/nawctsd Training Systems
    Naval Undersea Warfare Centers (NUSC)
    http://www.navsea.navy.mil/nuwc/default.aspx
    Space & Naval Warfare Sys Ctr (SPAWAR)
    http://www.public.navy.mil/spawar/Pages/default.aspx
- Navy Medical Research Center
  http://www.med.navy.mil/sites/nmrc/Pages/ott_main.htm
  Focus: battlefield medical problems and naturally occurring infectious diseases
- Naval Postgraduate School
  http://www.nps.edu/Research/rspa.html
  Focus: research and unique research laboratory facilities to support Fleet and OPNAV needs.

Technology Transition

- ManTech
  https://www.dodmantech.com/
  Focus: responsive, world-class manufacturing capability to affordably meet warfighters needs
- Small Business Innovative Research (SBIR and STTR)
  http://www.acq.osd.mil/osbp/sbir/about/
  Focus: cooperative research and development projects with small businesses
- Rapid Innovation Fund (RIF)
  http://www.acq.osd.mil/osbp/sb/opportunities.shtml
  Focus: transition technologies, mostly small business, resolving DOD operational challenges

For more information on these activities, see MAPS DOD Charts 175-206.

Office of Naval Research (ONR)

http://www.onr.navy.mil/Science-Technology/Directorates/Transition/Future-Naval-Capabilities-FNC.aspx

In addition to its Discovery and Invention program (most of the 6.1 and about half of the 6.2), ONR has a Future Naval Capabilities (FNC) program that invests about half of the Naval 6.2 and most of the 6.3 monies in the following areas:

- Capable Manpower: Intuitive systems and personnel tools for matching Sailors and Marines to the right jobs and training for mission-essential competencies
- Enterprise and Platform Enablers: Cross-cutting technologies to lower acquisition, operations, and maintenance costs
- Expeditionary Maneuver Warfare: Naval ground forces with special emphasis on regular and irregular warfare
- Force Health Protection: Medical equipment, supplies and procedures to reduce morbidity and mortality when casualties occur
- FORCEnet: C4ISR, networking, navigation, decision support and space technologies that provide an architectural framework for naval warfare in the information age
- Power and Energy: Energy security, efficient power and energy systems, high energy, pulse power
- Sea Basing: Logistics, shipping and at-sea transfer technologies that provide operational independence
- Sea Shield: Missile defense, antisubmarine warfare, mine warfare and fleet/force protection technologies that provide global defensive assurance
- Sea Strike: Weapons, aircraft and expeditionary warfare technologies that provide precise and persistent offensive power

ONR also has a Innovative Naval Prototypes program (INP) that explores high 6.2 and 6.3 technologies that can dramatically change the way naval forces fight. Programs in this category may be disruptive technologies, which for reasons of high risk or radical departure from established requirements and concepts of operation, are unlikely to survive without top leadership endorsement, and, unlike Future Naval Capabilities, are initially too high risk for a firm transition commitment from the acquisition community. For more information see MAPS DOD Charts 201-202)

Defense Advanced Research Projects Agency (DARPA)

http://www.darpa.mil/default.aspx

DARPA invests 6.1-6.3 monies through six offices: Defense Sciences, Biological Technologies, Information Innovation, Microsystems Technology, Strategic Technologies, and Tactical

Technologies. While all of the offices have this range of funding, DSO has the most emphasis on basic research and STO / TTO the most emphasis on advanced technology development. DARPA typically issues solicitations for larger scale, multi-participant efforts that are held to milestones and must deliver a prototype in a three-year time frame. The solicitations are frequently preceded by a proposer day where interested parties can gain more information on the effort, and/or by Requests for Information (RFI) that are used to shape a pending solicitation. For more information see MAPS DOD Charts 207-213.

Defense Threat Reduction Agency (DTRA)
http://www.dtra.mil/Research.aspx
DTRA is the combat support agency for countering weapons of mass destruction. It addresses the entire spectrum of chemical, biological, radiological, nuclear and high yield explosive threats. DTRA's programs include research and development, operational support to U.S. warfighters on the front line, and an in-house weapons-of-mass-destruction think tank that aims to anticipate and mitigate future threats. For more information see MAPS DOD Charts 214-222)

Defense Forensics and Biometrics Agency (DFBA)
http://biometrics.dod.mil/About/mission.aspx
Biometrics and forensics are critical to identifying known and unknown individuals by matching them with automated records (such as for access control) or with anonymous samples (such as crime scene investigations). This agency is responsible for applying biometrics and forensics capabilities through various tactics, techniques and processes. It has a generic BAA for research addressing its needs. For more information see MAPS DOD Chart 223.

Defense Logistics Agency (DLA)
http://www.dla.mil/SmallBusiness/Pages/default.aspx
The Defense Logistics Agency (DLA) Logistics Research & Development (R&D) Branch is charged with conducting research and development in all areas relevant to the DLA mission and across all DLA supply chains. White papers submitted to DLA may be based on fundamental R&D; concept formulation; assessment of system and subsystem requirements and processes; development, analysis and evaluation of concepts, systems and subsystems; development of associated industrial capabilities support techniques and processes; development of associated manufacturing techniques and processes; modeling and simulation; simulation-based acquisition; integrated data environments and product data managers; and development of operational systems. For more information see MAPS DOD Chart 224.

Missile Defense Agency (MDA)
http://www.mda.mil/business/advanced_research.html
The Ballistic Missile Defense System (BMDS) includes operational elements for sensing, monitoring, and intercepting ballistic missiles during all three phases of flight; boost, mid-course, and terminal. BMDS elements include a network of space, ground, and sea based sensors for detecting and tracking threat missiles; interceptor missiles launched from silos, trucks and ships; and tools for command and control. The BMDS must have the ability to detect, track, identify and kill ballistic missiles. The MDA has a University Research Program for advancing and solving complex technological problems, ultimately contributing to enhancing a more robust Ballistic Missile Defense System; these efforts are advanced research. For more information see MAPS DOD Chart 225.

US Army Corps of Engineers Engineering Research and Development Center (ERDC)
http://www.erdc.usace.army.mil/About/MissionandVision.aspx
The U.S. Army Corps of Engineers' (USACE) Engineer Research and Development Center (ERDC) helps solve our Nation's most challenging problems in civil and military engineering, geospatial sciences, water resources, and environmental sciences. ERDC R&D focuses on five primary technical areas to support the Army and the Corps:

- Warfighter Support – geospatial information; system development; operational support; force protection; and force projection and sustainment
- Installations – transformation; operations; and environmental issues
- Environment – remediation and restoration; land planning, stewardship and management; threatened and endangered species; and cultural resources
- Water Resources – infrastructure, water resources, environmental issues, and navigation; and flood control and storm damage reduction
- Information Technology – informatics; geospatial technologies; computational services; high-performance computing applications

For more information see MAPS DOD Chart 52.

Special Operations Command (SOCOM)
http://www.socom.mil/Sordac/Pages/Default.aspx
SOCOM has a long-term goal to develop technologies to meet Special Operations Forces (SOF) mission requirements. The intent is to accelerate the delivery of these innovative capabilities to the SOF warfighter. Prior studies and analyses have determined technical challenges to be: 1) trade space between weight, protection, power, and mobility; 2) cost; and 3) system component integration. SOCOM is interested in receiving white papers from all responsible sources from industry, academia, individuals, and Government laboratories capable of providing experiments and tests, feasibility studies, modeling and simulation, design, construction, and testing of SOF-related technologies. For more information see MAPS DOD Chart 226.

SERPD and ESTCP - Environmental Protection
https://www.serdp-estcp.org/
The DOD provides support for environmental efforts through the Strategic Environmental Research and Development Program (SERDP). It is a 6.3 (advanced development) budget line, but does fund 6.1 or 6.2 work, if the circumstances are right. In addition the DOD has the Environmental Security Technology Certification Program (ESTCP) that identifies and demonstrates the most promising innovative and cost-effective technologies and methods that address DOD's high-priority environmental requirements. (see MAPS DOD Charts 227-228)

DOD Laboratories, Centers, and Schools
The DOD has an extensive intramural research program distributed among various laboratories and centers (see above and MAPS DOD Charts 175-206 for more detail). Those entities do have some opportunities to fund University-based efforts, usually (but not always) involving applied research. Generic BAAs are published to announce the areas of interest, but contacting the institution prior to submitting a white paper / proposal is a good idea since there may be no interest in your ideas or no funding available. Especially for AFRL, there are also BAAs addressing specific topics.

Advanced Manufacturing
Small Business Innovative Research (SBIR and STTR)
http://www.acq.osd.mil/osbp/sbir/about/

The SBIR/STTR Programs are structured in three phases. Phase I (project feasibility) determines the scientific, technical and commercial merit and feasibility of the ideas submitted. Phase II (project development to prototype) is the major research and development effort, funding the prototyping and demonstration of the most promising Phase I projects. Phase III (commercialization) is the ultimate goal of each SBIR/STTR effort and statute requires that Phase III work be funded by sources outside the SBIR/STTR Program. (see MAPS DOD Charts 230-236)

Rapid Innovation Fund (RIF)

http://www.acq.osd.mil/osbp/sb/opportunities.shtml

The Rapid Innovation Fund provides a collaborative mechanism for small businesses to provide DOD with innovative technologies that can be rapidly inserted into acquisition programs that meet specific defense needs. The RIF is administered by the Office of the Secretary of Defense (OSD) Assistant Secretary of Defense for Research and Engineering (ASD R&E) and Office of Small Business Programs (OSBP). The RIF can be a source of the SBIR/STTR Phase III funding. (see MAPS DOD Chart 237)

Mantech

https://www.dodmantech.com/

All ManTech projects and initiatives are selected and executed through the Service and Agency ManTech Programs. The Army executes primarily through Army Research, Development and Engineering Centers and Army Laboratories; the Navy ManTech Program relies almost exclusively on Centers of Excellence; the Air Force partners with industry, other government agencies, and academia; DLA uses multi-contractor, 5 year competitive contracts; and the OSD's Defense Manufacturing S&T Program is executed through the Air Force primarily using Broad Area Announcements. (see MAPS DOD Charts 238)

NNMI

http://www.manufacturing.gov/nnmi.html

The National Network for Manufacturing Innovation (NNMI) consists of linked Institutes for Manufacturing Innovation (IMIs) with common goals, but unique concentrations. In an IMI, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization. Typically an IMI has ~$70-100M Federal monies over five years, with a requirement of at least an equivalent amount of matching funds. The IMIs have some limited funds available for University research.

DOD has reallocated fiscal resources to begin five IMIs.

FY2013:

(a) National Additive Manufacturing Innovation Inst (NAMII, now named America Makes)

FY2014:

(a) Digital Manufacturing and Design Innovation (DMDI)

(b) Lightweight and Modern Metals Manufacturing Innovation (LM3I, now named Lightweight Innovations for Tomorrow)

FY2015:

(a) Integrated Photonics

(b) Flexible Hybrid Electronics.

For more information see MAPS DOD Chart 239

Table 4: Summary of Applied Research Funding (Taken from the President's Budget Requests to Congress)

Service		Actual* FY 14	Estimate* FY15	PBR FY15	PBR FY16	% inc PRB FY16-15
Air Force		1124	1100	1081	1217	12
Army		931	981	863	880	2
Navy		844	870	821	865	5
DARPA						
	Biomedical	121	115	112	114	1
	Information & Comms	371	324	334	356	7
	Bio Warfare Defense	26	44	45	30	-25
	Tactical	218	300	305	315	3
	Materials and BioTech	159	150	160	220	40
	Electronics Tech	222	269	179	175	-2
DTRA		152	151	152	155	2
CBDP		195	226	226	208	-8
OSD	Cyber Security	12	15	15	14	-9
DHP	Applied Biomedical	60	73	74	58	-22

* The FY14-15 numbers may include Congressional changes and Congressional special adds (CA, sometimes labeled Congressional Special Interest, CSI) which do not appear in the President's Budget Request (PBR).

Appendix 1: FY2016 Basic Research Program Significant Changes

Army Research Office (ARO)

Life Sciences **from $7.8M in FY2015 to $9.8M**

Increase in funding and new directions identified

- Research and design neuro-cognitive computational models that detect a single-sound source (amongst multiple audible stimuli) to determine whether it is possible to link brain data to the segregated/isolated sound sources from noisy environments (may lead to new applications for effective auditory prostheses, automatic speech recognition, and other tools for enhanced Soldier auditory situational awareness in distracting environments);
- Screen analogs of cellular cyclic diguanylate to identify and characterize a key potential pathway that mediates the formation of bacterial persister cells, a unique state that is known to and other influences to human actions, and
- Auditory and signal processing research to map the cognitive implications of multisensory information integration.

Physics **from $13.6M in FY2015 to $16.3M**

Increase in funding and new directions identified

- Develop new imaging methods such as non-linear optical spectroscopies for detecting spin-orbit coupling in advanced materials (may lead to new electronic technologies for sensors and computational hardware);
- Investigate novel photon-photon interactions in a strongly-interacting cold atomic gas (may enable the first observation of the crystallization of a gas of strongly interacting photons, and in the long term, may lead to improvements in computation, measurement, and sensing);
- Develop robust techniques for quantum sensing and measurement to overcome the fragility of quantum information due to unwanted environmental interactions (may provide unprecedented computation and communication capabilities); and
- Characterize the unique electron dynamics of a particular class of magnetic materials known as ferroplasmons and develop theories to effectively model this behavior (may lead to lighter and smaller electronic components).

Office of Naval Research

Counter Improvised Explosive Device Sciences **from $14.6M in FY2015 to $16.5M**

Increase in funding and new directions identified

- Initiate research into the improved biomechanics and physiology of detection dogs for use in the detection of explosive hazards.
- Initiate research efforts to produce the knowledge and understanding necessary to detect and locate asymmetric explosive threats and their components by exploring combination of their unique passive and active characteristic responses at safe stand-off distances from various expeditionary platforms.
- Initiate research efforts to explore new lightweight multifunctional material design and techniques to optimize existing materials to improve protection from detonation effects.
- Initiate research efforts to neutralize or prevent explosive threats with or without direct knowledge of their locations.

- Initiate research efforts to provide understanding of the human and social elements and their relationships with asymmetric explosive threats to predict and prevent explosive events.

Medical/Biological **from $18.2M in FY2015 to $18.2M**

No change in the total funding, but some new directions identified

- Initiate research in partnership with the Army to study regenerative medicine (Armed Forces Institute for Regenerative Medicine II (AFIRM II)).
- Initiate research to investigate novel mechanisms to manage the mammalian circadian system for optimized health and performance.
- Initiate research to develop strategies for nerve cell regeneration.

Ocean Sciences **from $79M in FY2015 to $81M**

Minor increase in funding, but new directions identified

- Initiate research on extreme currents and highly variable flow generated by flow encountering abrupt topography in the Western Pacific.
- Initiate research on the structure and variability of the Northern Arabian Sea circulation using autonomous, unmanned sampling systems in order to provide critical basic understanding.
- Initiate geoacoustic inversion studies with an emphasis on the New Jersey and Arctic Shelves.

Weapons **from $17.9M in FY2015 to $18.2M**

Minor increase in funding, but one new direction identified

- Initiate hypersonic aerodynamics, aerothermodynamics and high temperature materials research focused on challenges resulting from unique Navy platform constraints.

DARPA

CCS-02 Math and Computer Sciences

Big Mechanism **from $16M in FY2015 to $24M**

- Demonstrate prototype technologies in production mode by identifying drug targets and drugs for one or more specific classes of cancer.
- Demonstrate automated testing of machine-generated hypotheses.
- Create new modes for visualizing and exploring models of huge scope that in their entirety exceed human cognitive capabilities.
- Formulate statistical approaches for uncovering causal relationships in numerical data/time series and categorical data/symbol sequences.
- Develop and implement scalable algorithms that reveal causality networks in large, complex, heterogeneous datasets.

Mining and Understanding Software Enclaves **from $8M in FY2015 to $12M**

- Implement scalable database technologies and mining algorithms that allow the ingestion and analysis of tens of millions of lines of open-source software.
- Integrate machine-learning algorithms that can direct and assimilate mining activities on analysis artifacts stored in the database.
- Evaluate component-level synthesis techniques that automatically construct implementations of complex protocols from discovered specifications.
- Identify key challenge problems in automated repair and security analysis, along with novel solutions that directly exploit the latent semantic content in the database.

Building Resource Adaptive Software from Specifications from $2.5M in FY2015 to $9.5M

- Integrate specifications within an operational environment to monitor resource changes and trigger signals when resource invariants are violated.
- Develop compile-time and runtime transformations that ensure survivable operation in the face of unexpected environment changes.
- Build validation tools that certify that transformed applications satisfy specification assumptions in the context of new operating environment guarantees.

CYS-01 Cyber Sciences

Transparent Computing from $10M in FY2015 to $15.4M

- Implement adaptive security policy schemes in software prototypes with flexibility and scalability suitable for use on distributed surveillance systems, autonomous systems, and enterprise information systems.
- Perform initial assessments of security policy prototypes in simulated laboratory and cloud environments.
- Develop and implement behavioral attestation techniques in software prototypes scalable to big data applications.
- Develop and implement causal dependency tracking across software/hardware abstraction layers.

ES-01 Electronic Sciences

Next Generation Atomic Clock from 0 in FY2015 to $4.6M

- Develop low-CSWaP application-specific laser devices, optical modulators, shutters, and isolators.
- Demonstrate integration of application-specific optical components into robust photonic integrated circuits.
- Develop techniques for alkali metal vapor pressure control over the full DoD temperature range.
- Develop low-CSWaP ultra-high vacuum technology operating without perturbative magnetic fields.
- Demonstrate clock operation with integrated enabling component devices.

Electronic Globalization from 0 in FY2015 to $3M

The Electronic Globalization program will examine various approaches for trusting circuits in an untrusted environment. It will develop the abilities to design circuits with functionality that is benign in an untrusted environment.

- Define the value proposition offered by the proposed material, identifying a specific Concepts of Operations.
- First pass intrinsic physics-level modeling and simulation of structures and materials.
- Design of proof-of-concept test sites.
- Fabricate test coupons and characterization of new morphological materials and structures.
- Characterization of experimental hardware.

MS-01 Materials Science

Nanoscale & Emergent Effects and Engn Devices from $13M in FY2015 to $20M

- Continue development of methods to stabilize extended solids at ambient temperatures and pressures.
- Demonstrate synthesis and stability to ambient temperature and pressure of high density extended carbon based materials (e.g., clathrates, allotropes, and oxides) at the multimilligram scale.
- Demonstrate methods to synthesize bulk cubic boron nitride at reduced pressure with purities of >50%.
- Refine and implement development of retrosynthetic pathways that are synthetically achievable for multistep reaction schemes to fabricate extended solids at reduced pressures based on computational analysis and stabilization results.
- Demonstrate the ability to assemble micron-scale, 3D, multiple material structures from nanoscale material constructs while preserving desirable nanoscale material properties.
- Demonstrate pick and place assembly of cm-scale materials from micron-scale constructs while preserving desirable nanoscale material properties.

TRS-01 Transformative Sciences

Applying Biological Complexity at Scale from 0 in FY2015 to $10M

Investigate dynamics and thresholds for transgene stability/instability in systems of infectious disease vectors.

- Study methods for achieving transient phenotypes in infectious disease vectors.
- Investigate predictive design rules and engineering approaches for integrated biosystems.
- Investigate microbial community evolution and communication as it applies to their application (e.g., microbiome impacts on health or catabolism).

MED-01 Basic Operational Medical Science

Harnessing Biological Systems from 0 in FY2015 to $10M

- Investigate predator effectiveness against pathogens of interest.
- Initiate basic science studies of the relevant underlying mechanisms of predation.
- Begin basic science studies to enhance understanding of biological adaptability in response to external pressures.
- Identify and understand fundamental mechanisms that control the transition between unicellular and multicellular function.
- Examine biological basis for naturally occurring evolutionary advances.
- Investigate novel methods to integrate evolved biological traits.
- Research basic science processes by which bacteria grow and spread throughout a community.

Appendix 2: FY2016 Selected Applied Research Program Significant Changes

Navy

Common Picture Applied Research

Appd Information Sciences For Decision Making **from $23M in FY2015 to $24M**

Minor increase in funding, but new directions identified

- Initiate efforts for reconstructing events from a loose network of heterogeneous cameras.
- Initiate Maritime domain awareness toolkit development for small vessel tracking.
- Initiate cyber information awareness decision tools for hull, mechanical and electrical security for Naval vessels.
- Initiate development for methods and tools for semi-/fully- automated software model extraction and online program execution monitoring toward achieving adaptive and resilient computing system.

Warfighter Sustainment Applied Research

Human Factors And Organizational Design **from $5.4M in FY2015 to $5.1M**

Decrease in funding, but new directions identified

- Initiate data collection activity using prototype panoramic camera aboard a sea vessel. Initiated research on integrating automated image processing technologies onboard the prototype panoramic camera.
- Initiate development of testbeds and tool chains for rapid disaster analysis and response.
- Initiate development of novel information feeds for Pacific Command.

Medical Technologies **from $6.2M in FY2015 to $5.8M**

Decrease in funding, but new directions identified

- Initiate research into improved cognitive agility for divers and diving supervisors
- Initiate research into diver Human Systems Integration (displays and biometric monitoring)

Warfighter Sustainment

Training Technologies **from $4.9M in FY2015 to $4.6M**

Decrease in funding, but new directions identified

- Initiate development of skill decay models for psychomotor, perceptual, and cognitive skills and refresher training strategies.
- Initiate development of intelligent avatars to interact with learners from different cultural, linguistic backgrounds, and preferences.
- Initiate development of scenarios generators that produce integrated training (e.g., individual and collective) training.

Electromagnetic Systems Applied Research

Electronic Warfare Technology **from $64M in FY2015 to $71M**

Increase due to adding new INP Electromagnetic Maneuver Warfare Command & Control (EMC2) EW EO/IR technology subprogram

- Initiate the development of SSDs leveraging multiband EO/IR components and sub-systems from prior DoD investments to demonstrate advanced ES and EA capabilities covering a broad range of EO/IR wavelengths in support of Navy and Marine Corps mission areas.

Electromagnetic Maneuver Warfare Command & Control (EMC2) subprogram

- Initiate Wideband Airborne Multifunction System design
- Initiate LowRIDR SubSystem build
- Initiate Electromagnetic Warfare Command and Control system design

Solid State Electronics **from $9.6M in FY2015 to $10M**

Solid State Transistors and Devices subprogram

- Initiate development of ultra-efficient mm-wave transistors.

High Efficiency, Highly Linear Amplifiers subprogram

- Initiate research into harmonic mm-wave amplifiers

Ocean Warfighting Environment Applied Res
Coastal Geosciences/Optics **from $6.6M in FY2015 to $6.3M**

Decrease in funding, but new directions identified

- Initiate studies to reduce uncertainties in data-assimilative littoral models in data-sparse environments
- Initiate analysis of historic remote sensing modalities to determine whether robust climatologies can be developed which provide utility for initialization of littoral geosciences forecast models in data-poor regions.

National Oceanographic Partnership Program (NOPP) **from $8.8M in FY2015 to $8.3M**

Decrease in funding, but new directions identified

- Initiate marine mammal tagging as a component of the marine arctic ecosystem dynamics study.
- Initiate development of coupled Arctic System Models to support improved forecasting and prediction of sea ice and other operational parameters
- Initiate efforts to seamlessly nest high-resolution regional ocean models into tide-resolving global HYCOM ocean forecasts
- Initiate project to understand the role of the ocean in providing skill in extended-range predictions of the environment through systematic model intercomparisons

Ocean Acoustics **from $3.5M in FY2015 to $2.6M**

Decrease in funding, but new directions identified

- Initiate marine mammal tagging as a component of the marine arctic ecosystem dynamics study.
- Initiate development of coupled Arctic System Models to support improved forecasting and prediction of sea ice and other operational parameters
- Initiate efforts to seamlessly nest high-resolution regional ocean models into tide-resolving global HYCOM ocean forecasts
- Initiate project to understand the role of the ocean in providing skill in extended-range predictions of the environment through systematic model inter-comparisons

Physical Oceanography **from $10.7M in FY2015 to $10.5M**

Decrease in funding, but new directions identified

- Initiate multi-scalable visualization tools using GPU's, tablets and remote sensing data.
- Initiate testing of Air-Deployed Ocean Profiler in research and fleet test.
- Initiate development of a coupled atmosphere-ocean-cryosphere-wave prediction system capable of forecasts from the submesoscale to decadal.
- Initiate development of a high resolution Arctic ice/ocean/weather/wave prediction system that can assimilate SAR data.

- Initiate Synthetic Aperture Radar Data Assimilation for Tropical Storm Forecasts
- Initiate Expendable Expeditionary Data Fusion Development

Joint Non-Lethal Weapons Applied Res from $5.9M in FY2015 to $6.1M

- Initiate evaluation of the susceptibility of targets to candidate vehicle and vessel stopping designs.

Undersea Warfare Applied Res

Anti-Submarine Warfare Distributed Search from $13.5M in FY2015 to $21.4M

Funding increase from FY 2015 to FY 2016 is due to 3 new programs funded in this PE: The Virtual Acoustic Sensing Array (VASA), Forward Deployed Energy & Communications Outpost (FDECO) (FY16-FY19) INP, and the Anti Submarine Warfare Mission Packages (ASW MP) (FY16-FY20).

- Initiate development of signal and information processing algorithms for improved ASW performance of high duty cycle active sonar systems.
- Initiate the Forward Deployed Energy & Communications Outpost (FDECO) Innovative Naval Prototype project.

Future Naval Capabilities (FNC) Applied Research

This FNC projects include announced new starts in FY2016 along with the program manager.

1. Capable Manpower (Cmp) from $8.3M in FY2015 to $9.3M

EC: CMP-FY16-01 Operational Planning Tool

Dr. William "Kip" Krebs, William.krebs@navy.mil

- Develop decision support analytic tools that enhance collaborative planning for generating and executing safe and effective navigation & operational plans.

2. Enterprise And Platform Enablers (EPE) from $12.4M in FY2015 to $11.7M

EC: EPE-FY16 Advanced Topcoat System

Mr. William (Bill) Nickerson, William.nickerson@navy.mil

Leverage commonality in current state-of-the-art topcoat systems for air and ground vehicle (topcoats ~80% common)

- Aviation: Type IV Polyurethane – Lower film thickness, focus on flexibility, erosion, color/gloss retention IH restrictions.
- Ground: Type IV/II Polyurea – Higher film thickness

3. Expeditionary Maneuver Warfare (EMW) from $6.7M in FY2015 to $6.3M

Emw-Fy16-01 Densified Propellant Fire From Enclosure - Confined Space Propulsion Technologies

Mr. Dan Simons, dan.simons@navy.mil

- Confined Space (FFE/CS) Propulsion Technologies
- Refine tungsten-propellant mix, grain dimensions and configuration, and the fabrication process to reach suitable rocket nozzle exit velocities and sound pressure levels.

4. Force Health Protection (FHP) from $9.2M in FY2015 to $8.7M

EC: FHP-FY16 Incapacitation Prediction for Readiness in Expeditionary Domains

Dr. Timothy (Tim) Bentley, timothy.b.bentley@navy.mil

- Integrated in-silico model of the human body and internal organs that includes physiologically-based injury prediction capabilities
- Quantitative validation method to ensure biofidelity

5. Forcenet (FNT) **from $28M in FY2015 to $32M**

EC: FNT-FY15-01 Advanced Airborne Early Warning Electronic Protection (AAEWEP)

- Initiate Advanced AEW Electronic Protection
- Develop techniques to improve E2-D electronic protection.

EC: FNT-FY15-02 Data Focused Naval Tactical Cloud

- Initiate Naval Tactical Cloud Analytics (formerly known as ASW Naval Tactical Cloud, EXW Naval Tactical Cloud, and IAMD Naval Tactical Cloud) - Perform the data science activities to ingest all relevant data (acoustic, IR, EO, magnetic, radar, SIGINT, METOC) into the Naval Tactical Cloud to enable efficient decision support analytics in support of effective ASW, EXW and IAMD mission execution based on Commander's Intent.

EC: FNT-FY16-02 Combined EO/IR Surveillance And Response System (Cesars)
Dr. Peter Craig, peter.craig@navy.mil

- Initiate Multispectral EO/IR Countermeasures against Advanced Threats (MEIRCAT) - Investigate multiband laser, window, and sensing technologies as well as advanced countermeasure techniques for shipboard defense.
- Shipboard Panoramic EO/IR Cueing and Surveillance System (SPECSS) - Investigate small pixel Mid-Wave Infrared (MWIR) Focal Plane Array (FPA) technologies and innovative approaches for seamless stitching of multiple FPAs to create large format, high pixel-count imagers.
- Combined EO/IR Surveillance and Response System

6. Sea Basing (BAS)

EC: BAS-FY16 Flexible Sea-based Force Projection
Dr. Geoff Main, Geoffrey.main@navy.mil

- Inflatable/fillable rigid structures deploy as wave mitigation barriers to reduce the local sea state near the Sea Base
- Systems utilize this new technology with existing sea base components to form interface platforms

7. Sea Shield (SHD) **from $46.5M in FY2015 to $52.8M**

EC: SHD-FY16-04 Ship-Launched Electronic Warfare Extended Endurance Decoy (SEWEED)
Mr. John Kinzer, john.kinzer@navy.mil

- Develop preliminary vehicle, payload,rocket, and launcher conceptual designs and sizing.

EC: SHD-FY16-05 Surface Ship Periscope Detection And Discrimination (SSPDD)
Mr. Mike Wardlaw, mike.wardlaw@navy.mil

- Develop specialized interface hardware for technology components.

EC: SHD-FY16-06 Next Generation Airborne Passive System (NGAPS)

- Develop an 'A-size' deep, long-duration, passive sonobuoy for area surveillance that takes advantage of Reliable Acoustic Path detection against modern quiet submarines and is tethered to a surface float containing a radio.

EC: SHD-FY16-07 Softkill Performance And Real-Time Assessment (SPARTA)
Col. Norman Eliasen, norman.eliasen@navy.mil

- Develop and establish design criteria, system requirements and software requirements.

EC: SHD-FY16-OSD Advanced Sea Mines

- Develop acoustic propagation modeling, algorithms for tracking and tracking, and algorithms to exploit the acoustic communications environment

8. Sea Strike (STK) from $34.4M in FY2015 to $43M

The FY 2015 to FY 2016 increase was due primarily to the planned ramp-up of STK-FY15-01, STK-FY15-02 and STK-FY15-03, and the initiation of STK-FY16-01 and STK-FY16-02.
EC: STK-FY16-02 REACTIVE ELECTRONIC ATTACK MEASURES (REAM)
Dr. Peter Craig, peter.craig@navy.mil

- Develop signal detection and classification techniques that can recognize new and agile radar threats.

Mine & Expeditionary Warfare Applied Res
Special Warfare/EOD from $11.8M in FY2015 to $11.1

Decrease in funding, but new directions identified

- Initiate development of technologies for ultra light-weight, low cost, highly capable autonomous robotic systems for complex dismounted operations.
- Initiate applied research into for autonomous ISR and mapping in canopied coastal and riverine environments
- Initiate 'through the sensor' in-stride mapping of coastal and riverine land and seascapes using operational EO/IR, radar and acoustic sensors
- Initiate investigation of techniques to detect deeply buried explosive threats and ordnance from a safe standoff distance
- Initiate investigation of techniques to neutralize or render safe explosive threats that result in low collateral damage to surrounding infrastructure.

Defense Advanced Research Projects Agency (DARPA)

BT-01 / Biomedical Technology
Neuro-Adaptive Technology from $22M in FY2015 to $31M

- Develop and apply data co-registration and fusion methods for neural activity, wiring and behavior.
- Generate and annotate first intact neural tissue volumes to elucidate microstructure and connections in three dimensions.
- Design algorithms for automatic cell identification and optical-signal estimation.
- Elucidate neural circuit dynamics using structurally-informed network models.
- Refine optical techniques for imaging large volumes of neural tissue.
- Expand data curation architecture, databases, and analytical tools to distribute generated data to the neuroscience community.
- Develop methods for automatically detecting and removing noise or contamination from datasets.
- Deliver a hierarchical computational model of key brain networks that captures features relevant for psychiatric illness and its treatment.
- Develop and refine neural state acquisition, classification and control algorithms to support closed-loop control in an implantable neural device.

- Characterize neural network plasticity during behavioral training.

Prosthetic Hand Proprioception & Touch Interfaces from $11M in FY2015 to $19M

- Integrate interface and electronic systems technology for use in human amputees to control and receive intuitive sensory feedback from a prosthetic device.
- Demonstrate closed-loop control of a government-furnished virtual prosthesis.
- Perform safety and efficacy testing of integrated HAPTIX system to capture motor control signals and provide electrical sensory stimulation through the peripheral nervous system.
- Demonstrate in vivo functionality of next-generation HAPTIX peripheral interface technology.
- Determine HAPTIX system prosthetic limb technology, complete sensorization, and begin manufacturing of devices.
- Implement draft version of outcome metrics for quantifying effects of HAPTIX technology and begin validation studies.

Performance Optimization in Complex Environments from 0 in FY2015 to $11.8M

- Begin development of new algorithms for sensing and modeling of physiological and cognitive state.
- Explore and identify primary sensing methods for reading biological signals.
- Begin research on biological interfaces for enabling input-output of information.
- Explore and study impact of various actuation mechanisms on physiological state and outcomes.

IT-02 / High Productivity, High-Performance Responsive Architectures
Complexity Management Hardware from $6M in FY2015 to $12.2M

- Design transistor level circuits implementing the complexity management algorithms.
- Demonstrate the ability to manage multiple data streams with interlaced information.

Scalable Optical Nodes for Networked Edge Traversal from 0 in FY2015 to $3.5M

- Identify common graph primitives that would accelerate the execution of DoD-specific applications.
- Explore the applications benefitting from the unique architecture and whether unique hardware design allows for processors for unique military applications.
- Design corresponding hardware, e.g. processor cores, to optimize performance for high bandwidth photonic networks.
- Design algorithms to execute DoD problems on a SONNET system and estimate system performance.

Electronic Globalization from 0 in FY2015 to $12M

- Develop a specific CONOP using the proposed structure, and identifying key enablers needed to realize it.
- Model designs such as encryption engines used to enable authorized chip operation.
- Create and model process module modifications for a standard fab gate recipe that result in desired behaviors.
- Demonstrate proof-of-concept of the ability of SHIELD-like devices to selectively authorize chip operation.
- Complete a high level design of piggyback chips, which can monitor and alter instruction execution of the host component.

IT-03 / INFORMATION ASSURANCE AND SURVIAVBILITY

Edge-Directed Cyber Technol for Reliable Mission Comms from $11M in FY2015 to $22M

- Initiate development of software prototypes suitable for laboratory experimentation with operational commands.
- Develop workarounds (fight-through strategies) that rapidly restore networked communication in the face of a wide variety of common network failure modes as well as cyber attacks against network infrastructure.
- Bring software prototypes to an initial field experiment in collaboration with an operational command.

Cyber Fault-tolerant Attack Recovery (CFAR) from $10M in FY2015 to $20M

- Demonstrate functionally replicated systems and novel variants that provide performance close to optimal and exhibit sufficient variability to guarantee differences in behavior under attack.
- Implement and test techniques for quickly detecting differences across replicated systems.
- Implement and evaluate alternative architectures for achieving cyber fault-tolerance for mission-critical military applications with commodity computing technologies.
- Work with potential transition sponsors to evaluate military computing systems as candidates for technology refresh with CFAR technologies.

Adaptable Information Access and Control (AIAC) from $7M in FY2015 to $17.6M

- Develop technologies to monitor heterogeneous distributed industrial control system networks, detect anomalies that require rapid assessment, and mitigate sensor spoofing and denial of service attacks.
- Extend simulation capabilities to understand the potential role of electric power markets in propagating or damping power grid anomalies.
- Develop techniques that use organic sensors, remote instrumentation, and other sources of cyber situation awareness information to continuously optimize cyber defenses.
- Explore defensive measures/counter-measures that can mitigate/thwart a coordinated cyber attack on national critical infrastructure.

Cyber Grand Challenge (CGC) from $6M in FY2015 to $11.3M

- Conduct world's first automated computer security contest: Cyber Grand Challenge Final Event.
- Release event results as cyber research corpus to measure and challenge future automated cyber capabilities.

IT-04 / Language Technology

Low Resource Languages for Emergent Incidents from $11M in FY2015 to $22M

- Develop algorithms to exploit the universal properties of languages when rapidly ramping up for a low-resource language.
- Collect, generate, and annotate data for an initial set of resources in typologically representative medium-resource languages.
- Create a baseline toolkit to rapidly develop an initial situational awareness capability given a new low-resource language document collection.

TT-03 / Naval Warfare Technology
Strategic Mobility from 0 in FY2015 to $8M

- Create time and cost model of brigade level deployment technologies and processes.
- Perform refined technology trade studies to identify critical component technology.
- Initiate development of select logistics technologies with high military payoff.

TT-04 / Advanced Land Systems Technology
Mobile Infantry from 0 in FY2015 to $6M

- Complete trades of mission/vignette-driven collaborative command and control of a MI unit composed of a warfighter team and semi-autonomous systems.
- Complete trade studies and initial estimates of perception and autonomous algorithms required to match vignettes.
- Complete trade studies of candidate platforms and options for conversion, system integration, interfaces (electrical, mechanical, software, etc.), and define preliminary warfighter architectures to leverage.
- Modify and demonstrate optionally manned configuration on an available all terrain vehicle.

Gremlin from 0 in FY2015 to $8M

- Conduct exploratory trade studies to establish feasibility of technical approaches.
- Initiate studies on integration with existing Service systems and systems architectures.
- Study platform design trades and approaches to best meet performance goals at minimum cost.

Quantitative Methods for Rapid Response (QMRR) from $8.6M in FY2015 to $15.6M

- Develop quantitative models to track the development of ISIL force structure, funding, and logistics.
- Develop quantitative models to track the spread of ISIL ideology with emphasis on the roles of social media and the dark web.
- Develop quantitative models to track the spread of Ebola with emphasis on social and economic factors.

TT-13 / Network Centric Enabling Technology
Understanding Machine Intelligence (UMI) from 0 in FY2105 to $12.7M

- Formulate approaches for AI systems to explain their behavior and clarify the basis for and reliability of outputs.
- Develop automated drill-down techniques that provide users with logic/data that drives AI system outputs/behaviors.
- Develop a mathematically rigorous virtual stability theory for AI-enabled systems analogous to the (conventional) stability theory developed for dynamical systems.

MBT-02 / Biologically Based Materials And Devices
Adaptive Immunomodulation-Based Therapeutics from $13M in FY2015 to $23M

- Develop novel interface technologies to monitor and stimulate peripheral nerves to selectively alter organ function.
- Demonstrate superior specificity of novel interface technologies compared to FDA-approved state of the art whole-nerve stimulation devices.
- Define input/output models of mammalian autonomic functions such as the immune

system and/or the autonomic stress response.
- Identify peripheral intervention points and modulation parameters for control of mammalian autonomic function for improving health or treating disease.
- Develop multi-site electrode array and stimulator to improve targeting of vagal nerve stimulation.
- Initiate testing of advanced interface technologies.

Biological-Computational Platforms from 0 in FY2015 to $10.5M
- Analyze architectures and systems for utilizing complex biological signals generalizable across users.
- Explore mechanisms for direct neural interfacing to receive and react to operationally relevant environmental, physiological and neural information.
- Begin researching scalable models and algorithms to derive actionable biological signals from multiple users.

Biological Robustness in Complex Settings (BRICS) from 0 in FY2015 to $8.1M
- Develop technologies to design and build biological pathways that will function in undomesticated microbial species from a wide range of phyla (prokaryotic or eukaryotic).
- Develop analytical tools that allow the simultaneous measurement of relevant parameters, such as gene transcription, protein synthesis, and small molecule communication, within a multi-species consortium.
- Fabricate generalizable culture substrates that provide control over community structure and composition and support the growth of both prokaryotic and eukaryotic cells.
- Integrate promising component technologies that may be readily adapted into a platform for engineering robust, stable, and safe biological communities.

ELT-01 Electronics Technology
Fast and Big Mixed-Signal Designs (FAB) from $4M in FY2015 to $10.8M
- Continue to investigate choices for the RF and digital technologies and the best methods of co-integration (monolithic, through silicon via (TSV)s, interposer, etc.) in order to achieve program objectives, along with identifying partner(s) for fabrication and/or integration.
- Continue circuit design activities to determine performance benefits of new processes enabled by the program.
- Continue to study the best technology for various RF functional blocks for optimal use of mixed technologies.

Direct On-Chip Digital Optical Synthesis (DODOS) from $3M in FY2015 to $8M
- Develop DODOS system architectures and integration approaches.
- Validate device-level performance requirements, such as the control-loop bandwidths and optical link budget, needed to reach the DODOS program metrics at the system level.
- Prototype critical photonic components in processes consistent with subsequent co-integration.

Hi power Amp using Vac Electronics for Overmatch Capab from 0 in FY2015 to $12M
- Initiate the design of a wide-bandwidth, high power microwave vacuum electronic amplifier and identify specific component performance parameters and engineering tradeoffs.
- Design, fabricate, and test high current-density cathodes capable of producing beam

current consistent with amplifier output power requirements.

Next Generation Atomic Clock (NGAC) from 0 in FY2015 to $8.4M

- Demonstrate prototype clock operation utilizing low-CSWaP component technology.
- Evaluate environmental sensitivity, particularly temperature and acceleration.
- Identify technology gaps and complete a roadmap for NGAC development.

Precise Robust Inertial Guidance for Munitions (PRIGM) from 0 in FY2015 to $10M

- Model and design architectures for chip-scale optical gyroscopes based on waveguide technologies
- Design and fabricate heterogeneously-integrated, chip-scale waveguide optical gyroscopes
- Demonstrate high-bandwidth (100,000 degrees/s) inertial sensors
- Model and design optically interrogated MEMS inertial sensors
- Develop co-fabrication processes to support MEMS optical interrogation
- Demonstrate shock survivability of sensors and component technologies

Near Zero Energy RF and Sensor Operations (N-ZERO) from 0 in FY2015 to $4.5M

- Initiate development of hardware components enabling passive or near zero energy collection, processing and detection of communications and sensor information.
- Initiate development of RF and physical sensor microsystems that collect, processes and detect the presence of desired signals while consuming near zero power.
- Identify government application spaces and transition paths that will make use of N-ZERO signal processing and detection.

Microwaves and Magnetics (M&M) from 0 in FY2015 to $5M

- Investigate recent advances in magnetic materials science to identify new processing, fabrication, and integration techniques that can enable microwave components with reduced loss, increased bandwidth, and enhanced tunability.
- Leverage new microwave component design and modeling techniques to assess the performance of advanced magnetic materials in microwave circuits and applications.
- Initiate the design and development of magnetic components using advanced magnetic materials with reduced loss, increased bandwidth, and enhanced tunability.

MultiPLEX from 0 in FY2015 to $8M

- Design and simulate the complete channelized receiver and generate flow down specifications to component technologies.
- Demonstrate the high risk photonic components in a high yield, repeatable fabrication process compatible with siliconmanufacturing.

Diamond Enhanced Devices (DiamEnD) from 0 in FY2015 to $6M

- Demonstrate that GaN epitaxy can be harvested from the SOA GaN on SiC epitaxy developed in the Wide Band Gap Semiconductors (WBGS)-RF program and mated with diamond substrates.
- Initiate effort to develop the diamond substrate materials and transistor technology to demonstrate GaN on Diamond devices with up to 25 W/mm.

Defense Threat Reduction Agency (DTRA)

Detection Technologies **from 0 in FY2015 to $26M**

- Discover/identify nuclear threat signatures, characteristics, and corresponding detection modalities and collection systems.
- Develop algorithms/tools for rapidly and effectively analyzing all-source intelligence to identify nuclear threats.
- Prototype systems to remotely monitor small and wide areas, which may produce or contain nuclear threats.
- Develop algorithms/tools to synthesize the collection and analysis of multiple nuclear threat signatures to improve assessment confidence and cuing of potential nuclear threat events.
- Execute robust and operationally relevant testing and evaluation of developmental radiation detection systems to determine and select the best performing technologies and techniques for further development and transition to user groups.
- Down select sensor materials for the most effective/efficient capability and integrate into detection systems.
- Down select detection system algorithms for most effective/efficient processing and integrate into detection systems to improve user capabilities.
- Research and develop advanced three-dimensional imaging technologies for high-resolution source characterization and identification to provide new and improved capabilities to detect, locate, identify, and characterize threat materials.
- Investigate viability of ultra-low-power, long-duration programmable remote radiation monitoring systems.

Chemical Biological Defense Program

CB2 / Chemical Biological Defense Applied Research

Percutaneous Protection **from 0 in FY2015 to $5M**

Develop both force protection and situational awareness through the improvement of multi-functional materials that exhibit broad reaching, crosscutting capabilities in chemical/biological sensing and detoxification. Validate response mechanisms of dynamic materials that conform to the challenge amount.

TM2 / Techbase Medical Defense Applied Research

Diagnostic Assays **from 0 in FY2015 to $1M**

Develop in-vitro assays for Western, Eastern, and Venezuelan Equine Encephalitis (VEE) virus vaccines. Develop in-vitro assays for VEE virus protease activity and structure based discovery of viral protease inhibitors.

Appendix 3: Abbreviated illustration of a Program Officer Datasheet

Dr. David M. Stepp
ARO, Chief, Materials Sciences Division
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Biosketch:
Dr. David Stepp serves as the Chief of the Materials Science Division of the U.S. Army Research Office. Also, he is Adjunct Assistant Professor in the Department of Mechanical Engineering & Materials Science, Pratt School of Engineering, Duke University.

Education
PhD in Mechanical Engineering and Materials Science from Duke University in 1998
MS in Mechanical Engineering and Materials Science from Duke University in 1995
BS in Engineering from Harvey Mudd College in 1993

Program: Mechanical Behavior of Materials
http://www.arl.army.mil/www/default.cfm?page=183
The Mechanical Behavior of Materials program seeks to establish the fundamental relationships between the structure of materials and their mechanical properties as influenced by composition, processing, environment, and loading conditions. The program emphasizes research to develop innovative new materials with unprecedented mechanical, and other complementary, properties. ……

Recent MURI Topics:
FY11 Flex-Activated Materials
FY10 Ion Transport in Complex Heterogeneous Organic Materials
FY09 Tailored Stress-Wave Mitigation
FY09 Disruptive Fibers for Flexible Armor

Illustrative Papers Reflecting Personal Research Interests:
A theory of amorphous viscoelastic solids undergoing finite deformations with application to hydrogels
Korchagin Vladimir; Dolbow John; Stepp David INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES 44(11-12), 3973-3997 JUN 1 2007

Damage mitigation in ceramics: Historical developments and future directions in army research
Stepp DM
CERAMIC TRANSACTIONS 134, 421-428 2002

High-resolution study of water trees grown in silver nitrate solution
Stepp, D.,King, J.A., Worrall, J., Thompson, A., and Cooper, D.E.
IEEE Transactions on Dielectrics and Electrical Insulation, 3(3), 392 - 398 1996

Appendix 4: Acronym and Abbreviation Glossary

Agency Specific

AFIRM	Armed Forces Institute for Regenerative Medicine
AFOSR	Air Force Office of Scientific Research
AFRL	Air Force Research Laboratories
AMRDEC	Aviation and Missile Research and Development Center (Army)
AMRMC	Army Medical Research and Materiel Command
ARDEC	Armament Research and Development Center (Army)
ARL	Army Research Laboratories
ARO	Army Research Office
BA	Budget Activity (new designation for the R&D accounts)
BMDS	Ballistic Missile Defense System
BSV	Bio Surveillance
BTO	Biological Technologies Office (DARPA)
C2	Command and Control
C2ISR	Command, Control, Intelligence, Surveillance and Reconnaissance
C4ISR	Command, Control, Communications, Computers,…
CBDP	Chemical/Biological Defense Program
CBRNE	Chemical, Biological, Radiological, Nuclear and High Explosive
CBWD	Chemical/Biological Warfare Defense
CCRI	Cross-cut Research Initiative
CDMRP	Congressionally Directed Medical Research Program
CERDEC	Communication-Electronics Research and Development Center
CM	Counter Measures
CNA	Computer Network Attack
CoE	Center of Excellence
CONOPS	Concepts of Operation
COTS	Commercial Off-the-Shelf (products)
CSI	Congressional Special Interest (also known as budget “adds”)
CTA	Collaborative Technology Alliance
CWMD	Combating Weapons of Mass Destruction
D2D	Data to Decisions
DARPA	Defense Advanced Research Projects Agency
DDR&E	Director, Defense Research and Engineering
DFBA	Defense Forensics and Biometrics Agency
DHP	Defense Health Program
DLA	Defense Logistics Agency
DMDI	Digital Manufacturing and Design Innovation (an IMI)
DMRDP	Defense Medical Research and Development Program
DMS&T	Defense Manufacturing Science and Technology
DTIC	Defense Technical Information Center
DTRA	Defense Threat Reduction Agency
DURIP	Defense University Research Instrumentation Program
ECBC	Edgewood Chemical and Biological Center
EM	Electromagnetic
ERDC	Engineering Research and Development Center, Army Corp of Engineers
ERS	Engineered Resilient Systems
ESTCP	Environmental Security Technology Certification Program
EW	Electronic Warfare
FDW	Federal District of Washington (DOD)
FPA	Focal Plane Array
GDF	Guidance for the Development of the Force

GPS	Global Positioning System
HEL	High Energy Laser
HSCB	Human Social Cultural and Behavior Modeling
IED	Improvised Explosive Devices
IMI	Institute for Manufacturing Innovation
ISR	Intelligence, Surveillance and Reconnaissance
LM3I	Modern Metals Manufacturing Innovation (an IMI)
LVC	Live, Virtual and Constructive (environments)
MDA	Missile Defense Agency
Minerva	Name of DOD program engaging the social science community
MOVINT	The ability to track moving things on land and sea (Movement Intelligence)
MTO	Microsystems Technology Office (DARPA)
MURI	Multidisciplinary University Research Initiative
NAMII	National Additive Manufacturing Innovation Institute (an IMI)
NAWC	Naval Air Warfare Centers (Patuxent River-Aircraft Div, China Lake–Weapons Div)
NDEP	National Defense Education Program
NDSEG	National Defense Science and Engineering Graduate Fellowships
NMRC	Naval Medi
NPGS	Naval Postgraduate School
NRL	Naval Research Laboratory
NSRDEC	Natick Soldier Research and Development Command
NSSEFF	National Security Science and Engineering Faculty Fellowship
NSWC	Naval Surface Warfare Center (Dahlgren and Carderock Divisions)
NUWC	Naval Undersea Warfare Center
ONR	Office of Naval Research
OSD	Office of the Secretary of Defense
PACOM	DOD U.S. Pacific Command
PE	Program Element – term from DOD budgeting
PM	Program Manager (same as PO)
PO	Program Officer (same as PM)
QIS	Quantum Information Science
R&E	Research and Engineering Enterprise (DOD Assistant Secretary)
R-1	RDT&E Program Budget Summary Document
RDDS	Research and Development Descriptive Summary (R-2 Budget Document)
RDECOM	Army Research and Development Commands
RIF	Rapid Innovation Fund
RF	Radiofrequency
SIGINT	Signals Intelligence
SERDP	Strategic Environmental Research and Development Program
SOCOM	Special Operations Command
SOF	Special Operations Forces
SPAWAR	Space and Naval Warfare Systems Center
STO	Strategic Technology Office (DARPA)
TARDEC	Tank-Automotive Research and Development Center (Army)
TBI	Traumatic Brain Injury
TTO	Tactical Technology Office (DARPA)
UARC	University Affiliated Research Center
UCAR	Unmanned Combat Air Rotor
UCAV	Unmanned Combat Air Vehicle
USAMRMC	United States Army Medical Research and Materiel Command
UXV	Unmanned (X for ground (G), air (A), sea (S),…) Vehicles
YIP	Young Investigator Program

General

BAA	Broad Agency Announcement
CA	Congressional add
CFDA	Catalog of Federal Domestic Assistance Number
CMOS	Complementary Metal Oxide Semiconductor (electronics)
CSI	Congressional Special Interest
DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DoEd	Department of Education
DoI	Department of Interior
ED	Department of Education (alternative)
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FFO	Federal Funding Opportunity
FFRDC	Federally Funded Research and Development Center
FY	Fiscal Year
HTM	Hierarchical Temporal Memory
IHE	Institutions of Higher Education
IMI	Institute for Manufacturing Innovation
MAPS	Mission Agency Program Summary (provided by USC Research Advancement)
MEMS/NEMS	Micro- Nano-ElectroMechanical Systems
NASA	National Aeronautics and Space Administration
NDI/E	Non-Destructive Inspection/Evaluation
NIST	National Institute for Standards and Technology (in DOC)
NNMI	National Network for Manufacturing Innovation
NOAA	National Oceanic and Atmospheric Administration (in DOC)
NSF	National Science Foundation
PBR	President's Budget Request (submitted to Congress)
PTSD	Post-traumatic Stress Syndrome
RDT&E	Research, Development, Test and Evaluation
RF	Radio-frequency
RFA	Request for Application
RFI	Request for Information
S&T	Science and Technology
SBIR	Small Business Innovative Research
STEM	Science, Technology, Engineering and Mathematics (education)
STTR	Small Business Technology Transfer
TBA	To be announced
TBI	Traumatic Brain Injury
USDA	US Department of Agriculture