Guide to FY2014 Basic 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 a few more salient applied research (6.2) efforts, with special attention to changes anticipated in FY2014. More extensive information is provided at the Central Desktop “Mission Agency Program Summary” (MAPS) website, including the charts cited in the text.

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.

Descriptive of DOD basic research funding opportunities pages 3-8
Brief descriptions of the agencies and funding mechanisms pertinent to Universities.
Table 1: FY10/12 basic and applied research funding at Universities (~$1.6B/yr) 7
Table 2: FY2014 requested basic research funding pertinent to Univ. (~$2.2B) 8

Appendix 1: FY2014 New Basic Research Programs and/or Significant Growth pages 9-15
Overall, the change in basic research investment relative to the FY13 President’s Budget Request is projected to be modest (essentially zero after inflation). Cyber and Information S&E grows.

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<td>Social Media in Strategic Communication</td>
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<td>Vanishing Programmable Resources</td>
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<td>Autonomous Diagnostics to Enable Prevention and Therapeutics</td>
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Office of the Secretary of Defense

Basic Research initiatives (includes MINERVA) from 19 to 11 15
NSSEFF from 26 to 35 15

Appendix 2: FY2014 Selected Applied New Programs and/or significant growth

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Appendix 3: Illustration (abbreviated) of a program officer data sheet 26

Appendix 4: Acronym Glossary 27
Overview
DOD funds research that is relevant to its mission, predominantly drawing on engineering, computer/information science, and physical sciences. However, DOD also funds some limited social science, medical, and life science basic research. In addition to basic research (labeled 6.1, or BA1), DOD funds applied research (6.2, or BA2) and advanced technology development (6.3, or BA3). Universities get about 50% of the 6.1, 15% of the 6.2, and 10% of the 6.3 funding. But the 6.2 and 6.3 funding at Universities is dominated by University Affiliated Research Centers (UARC) and other entities that are structured to handle 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 ISI and ICT at USC), or a DOD laboratory/center.

DOD relies heavily on technological advantage; research and engineering must be marshaled to meet tomorrow's defense challenges. Given today's globalized access to knowledge and the rapid pace of technology development, innovation, speed, and agility have taken on greater importance to DOD efforts. 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 major basic research funding opportunities originate in the three Service research offices, the Defense Advanced Research Project Agency (DARPA), the Defense Threat Reduction Agency (DTRA), and the Congressionally Directed Medical Research Program (CDMRP), which is managed by DOD. Large-scale opportunities arise from the annual Multidisciplinary University Research Initiatives and from periodic Center competitions. Applied research and development are also funded by the Services, DARPA, DTRA, and other DOD agencies.

Funding for basic research (6.1) is distributed among several DOD agencies, each having its own particular focus:

  Focus: soldier, ground force mission (6.1 only)
  Focus: pilot, aerospace mission (6.1 only)
  Focus: sailor, marine, ship, ocean mission (6.1 - 6.3)
  Focus: defense-wide technology innovation (6.1 - 6.3)
  Focus: weapons of mass destruction (6.1 - 6.3)
- **Chemical Biological Defense Program** (CBDP): www.jpeocbd.osd.mil/
  Focus: chem/bio warfare defense (6.1 - 6.3) – managed through DTRA
- **Congressional Directed Medical Research Program** (CDMRP): www.cdmrp.army.mil/
  Focus: medical research (6.1 only)
- **Office Secretary of Defense** (OSD): www.acq.osd.mil/rd/
  Focus: overarching Defense issues

For the Army and Air Force, the 6.2 and 6.3 funds are managed out of their Laboratories and Commands.
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. New programs occur periodically, e.g., the Navy has its Basic Research Challenges and the Air Force has its Basic Research Initiatives. For more information see the MAPS DOD Charts 36-81 that are parsed by agency and/or DOD Charts 22-35 that are parsed by academic discipline.

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 essential to contact a program officer and explore mutual interests (to identify the appropriate program officers one can use the discipline organized DOD Charts 22-35, the MAPS database, and/or contact Murday). A white paper is very useful (sometimes required). The program officers don’t want to waste your time writing, nor to waste their own time reading, an inappropriate full proposal. Proposals to the long-range BAA programs may be submitted at any time, but late spring is when many tentative decisions are 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 proposal requirements. Guides to interacting with the program officers and preparing proposals are in DOD Charts 168-171.

Special Announcement Programs
During the year, DOD agencies may announce special program opportunities; DARPA, in particular, mostly uses this approach. These range from large, center efforts (e.g., UARCs, Collaborative Technology Alliances (CTA), Centers of Excellence (CoE)) to single investigator programs (e.g., ONR’s Basic Research Challenges, AFOSR’s Discovery Challenge Thrusts, DARPA’s Mathematical Challenges). These opportunities can be found by monitoring the funding agency sites, “grants.gov” and/or “defenseinnovationmarketplace.mil” for new solicitations. The DC Office of Res. Advancement does this and provides alerts to pertinent USC investigators.

Teaming Efforts
The multidisciplinary university research initiative (MURI) program has topics announced in the June – Sept time frame each year, with white papers due about a month and proposals about three months later. These require multidisciplinary teaming efforts; the funding is up to $1.5M/yr for five years (presuming acceptable performance). A record of prior winners for the past seven years is available from the DC office, including the successful USC efforts. Successful proposals have typically engaged 2-4 Universities, but single University efforts can be successful. For more information see DOD Chart 120.

University Centers of Excellence (COE)
Both the Army and Navy support University Affiliated Research Centers that address more applied research and development (DOD chart 149). The Air Force supports University Centers of Excellence (~5yr lifetime) that are associated with a specific Air Force Research Laboratory technical directorates. These Centers are to: 1) perform research in a high priority AF interest area; 2) educate US students in critical technology areas; 3) frequent professional interchanges between AFRL and University personnel; and 4) strengthen AFRL in-house technical capabilities. (see DOD charts 63-64) The Army has similar University COE (see DOD charts 51-53).
Advanced Manufacturing Institutes
The National Network for Manufacturing Innovation (NNMI) will consist 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. DOD has reallocated fiscal resources to begin three of these Institutes. National Additive Manufacturing Innovation Institute (NAMII) was established in FY2013 with an initial federal investment of $30 million, using existing authorities in the Departments of Defense and Energy and other federal agencies. NAMII, a consortium that includes manufacturing firms, universities, community colleges, and non-profit organizations from the Ohio-Pennsylvania-West Virginia ‘Tech Belt,’ is led by the non-profit National Center for Defense Manufacturing and Machining (NCDMM). The NAMII partners more than matched the federal investment, contributing almost $40 million in support. Two DoD institutes to be established in FY2014 are (1) Digital Manufacturing and Design Innovation (DMDI) and (2) Lightweight and Modern Metals Manufacturing Innovation (LM3I).

Instrumentation
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 DOD Chart 121). ARO also has a research instrumentation program (see DOD Chart 43).

Environmental
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. (see DOD Charts 138-39) 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.

Young Investigators
Each of the three services, DTRA, and DARPA have young faculty programs. The eligibility typically is within five years of Ph.D. or equivalent degree; 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 $170K/yr (Navy). Submission deadlines vary. For more information see DOD Charts 150-158; a history of the awardees/topics is available from the DC office.

Human Social, Cultural, and Behavioral Modeling (HSCB)
In addition to the Service core HSCB programs, OSD created S&T programs to address understanding and modeling of human behavior in social and cultural contexts. The basic research component is entitled Minerva, HSCB itself had funding allocated from the 6.2 and 6.3 budget lines. In FY14, the HSCB budget amounts are zeroed, and the OSD MINERVA budget is reduced. The Army and ONR retain their programs. (See DOD Chart 147)

National Security Science and Engineering Faculty Fellowship (NSSEFF)
DOD has a special program to support faculty with a degree awarded in the last 25 years (awardees have averaged ~20 yrs) and an established outstanding research record in areas of interest to DOD. A new competition is projected for FY2014 (see DOD Chart 167).

Medical
Congress typically adds funds to the DOD budget for support of medical research; these total to ~$400M/yr in recent years. The funds are for specific topics and are competed openly through the Congressionally Directed Medical Research Program (CDMRP), which is managed by US Army Medical Research and Materials Command (USAMRMC). For more information see DOD Charts 122-23 and/or visit the website http://cdmrp.army.mil. USAMRMC has a generic BAA that lists its current interests (but it has little monies for extramural work). The Guidance for the Development of the Force (GDF) program has mostly applied monies (see DOD Chart 133). The Armed Forces Institute of Regenerative Medicine (AFIRM) periodically funds consortia (see DOD Chart 46). DARPA has a Basic Operational Medical Science (6.1) and Biomedical Technology (6.2) budget line (see DOD Charts 92-94).

DOD Laboratories, Centers, and Schools
The DOD has an extensive intramural research program at various laboratories and centers (see DOD Charts 53, 64, 81 for listings). Those entities do have limited opportunities to fund University-based efforts. One example is the Naval Postgraduate School, which annually solicits research initiatives in support of its efforts (DOD Chart 80).

Education/Training
In addition to funding research itself, there are DOD programs in support of PhD education (National Defense Science and Engineering Graduate) and K-12 education (National Defense Education Program). Each of the Services also has a STEM education effort. In addition there are many programs to support faculty working at the various DOD laboratories. For more information on these efforts see DOD Charts 159-166.

Non-DOD Security Related Opportunities
In addition to the DOD, the Intelligence Community and the Department of Homeland Security have some limited S&T opportunities. For more information see DOD Charts 3-15.

Resources
DARPA current solicitations:
OSD-wide solicitations:
defenseinnovationmarketplace.mil

For access to the information in the Research Advancement Mission Agency Program Summary (MAPS) on the Central Desktop website, contact NLWalker@usc.edu for user name and password.

The MAPS site has:
Under “Wiki” Tab - how to use the site
Under “Files/Discussion” Tab
Mission Agency (DHS, DOD, DOE, DoEd, EPA, NASA, NIST, NOAA, USDA and cross-agency programs in Adv Manuf, Sustainability, STEM education
Guide to Agency Funding for FYXX
Agency Research Program Charts
Agency Planning Documents
Program Officer Data sheets (with contact info, biosketch, program descriptive, personal pubs)
Program Officer presentations (when available)
Under “Database” Tab
USC MAPS - table of all program officers / programmatic interest

Chart numbers in the text above reference a file in the Agency Research Program Charts folder.

Assistance in Locating Funding and Preparing Proposals
Dr. James S. Murday    DC Office of Research Advancement
Tel: 202 824 5863    Email: Murday@usc.edu
Table 1: FY2010 and FY2012 DOD Research Funding ($M)
Obligations at Universities/Colleges

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From NSF "Federal Funds for Research and Development: FY2010-2012" NSF 13-326, July 2013
Basic 2010 Tables 27, 31 and 65-71
Applied Research 2010 Tables 38, 42 and 45-48
Basic 2012 Table 29, 33 and 67
Applied Research 2012 Table 40, 44 and 75
Table 2: Projected DOD Basic Research Funding ($M) for FY2014

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<td>364.5</td>
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Since the projected budgets in the table are parsed differently than the organization’s program taxonomies, clear assignment of funds 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 – indicated by “xx” in the cell.

The reported Army funding reflects only the ARO budget available for University proposal submission, not the total basic research funding. For the Navy, about 25% of the reported total basic research funding is provided to the Naval Research Laboratory and is not available for University proposal submission. For the Air Force, about 30% is provided to the AF Research Laboratories.
## Appendix 1: FY2014 DOD Basic Research (6.1) Programs

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<tr>
<th>Service</th>
<th>Actual* FY 12</th>
<th>Estimate* FY 13</th>
<th>PBR FY13</th>
<th>PBR FY14</th>
<th>% inc PRB FY13-14</th>
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* The FY12-13 numbers may include Congressional Adds (CA, sometimes labeled Congressional Special Interest, CSI) which do not appear in the President’s Budget Request (PBR).

The Office of the Assistant Secretary of Defense (R&E) has identified the following as high priority 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.

The DOD Office of Basic Research sponsors workshops in emerging areas of S&E that it perceives as important to the DOD; there is high probability those workshops will be used to guide research investment. In 2011 there was a workshop on “Neuroscience;” in 2012 there were workshops on “Basic Science and the Future of Warfighters” and “Mechanical and Civil Engineering;” no workshops are listed for 2013 (as of 5/1/2013). ([http://www.acq.osd.mil/rd/basic_research/references/workshops.html](http://www.acq.osd.mil/rd/basic_research/references/workshops.html))

Each of the Services has a strategic S&T plan which provides guidance into priorities; these can found at the Research Advancement’s MAPS Central Desktop website. In addition to the budget growth elaborated below, approximately 20-30% of the projects in a DOD program are turned over each year. So there are opportunities in most programs even in the absence of budget growth.
Air Force Office of Scientific Research
(www.wpafb.af.mil/library/factsheets/factsheet.asp?id=8976)

Aero Structure Interactions and Control  From $27M in FY2013 to $30M
Scientific focus areas are high temperature aerospace materials, hypersonics, aero thermodynamics and turbulence, and flow interactions and control. FY2014 Plans: Continue to investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, structures, and thermodynamics.

Energy, Power, and Propulsion  From $36M in FY2013 to $40M
Scientific focus areas are thermal control, theoretical chemistry, molecular dynamics, space power and propulsion, and combustion and diagnostics. FY 2014 Plans: Continue to exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, structures, and materials. Investigates processes associated with the generation, storage, and utilization of energy, specifically for Air Force systems. Includes developing novel energetic materials as well as understanding and optimizing combustion processes.

Decision Making  From $19M in FY2013 to $21M
Scientific focus areas are mathematical modeling of cognition and decision making, and collective behavior and socio-cultural modeling. FY 2014 Plans: Continue to investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human machine decision making to achieve accurate real-time projection of expertise and knowledge into and out of the battlespace. Includes efforts to advance the critical knowledge base in information sciences and information fusion, and to model individual and group cognitive processing and decision-making.

Natural Materials and Systems  From $24M in FY2013 to $26M
Scientific focus areas are renewable energy, natural materials and nature inspired systems. FY 2014 Plans: Continue to investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems accomplish their required tasks. Study how to adapt and mimic existing natural sensory systems and add existing capabilities to these organisms with the intent to gain more precise control over their material production.

Education and Outreach  From $10M in FY2013 to $13M
Outreach to International S&T Community
Foster international S&T cooperation by supporting direct interchanges with a broad range of key international researchers and communities. Identify and leverage international scientific advances when appropriate. Explore current foreign investments and influence world-class scientific research on specific topics of Air Force interest. Support international visits by scientists and high-level DoD S&T delegations, and provide primary interface to coordinate international S&T participation among DoD organizations.

**Basic Research in Computing Sciences**  
From $6M in FY2013 to $7.7M  
Provides the backbone for performing complex, multi-system analysis, modeling and simulation for understanding information systems. Advancements in computer sciences have a direct impact on enhancing the warfighters’ decision-making, situation awareness, command and control, as well as on the overall performance of weapon, intelligence, transportation and logistics systems.

**Basic Research In Network Sciences**  
From $6.7M in FY2013 to $8.3M  
Focuses on gaining an understanding of the fundamental aspects of how networks develop, function, and adapt to the environmental and the rate of information flow in manmade and naturally occurring networks. This understanding will have a direct impact on net-centric force operations, such as better communication system design and operations, and more efficient logistics or communications support.

**Army University and Industry Research Centers**

**Cyber Security Collaborative Research Alliance**  
From 0 in FY2013 to $3M  
The Cyber Security Collaborative Research Alliance (CRA), a competitively selected consortium, is formed to advance the theoretical foundations of cyber science in the context of Army networks. This CRA will consist of academia, industry and government researchers working jointly with the objective of developing a fundamental understanding of cyber phenomena so that fundamental laws, theories, and theoretically grounded and empirically validated models can be applied to a broad range of Army domains, applications, and environments. Overarching goals of cyber security are to significantly decrease the adversary’s return on investment when considering cyber attack on Army networks, and minimizing the impact on (Army) network performance related to implementing cyber security. The Cyber Security CRA focuses on three Research Areas (Risk, Detection, Agility), and on Cross Cutting Research Issue (CCRI) (Psychosocial Effects):

- Research in Risk will develop theories and models that relate fundamental properties and features of dynamic risk assessment algorithms to the fundamental properties of dynamic cyber threats, Army’s networks, and defensive mechanisms.
- Research in Detection will develop theories and models that relate properties and capabilities of cyber threat detection and recognition processes/mechanisms to properties of a malicious activity, and of properties of Army networks.
- Research in Agility will develop theories and models to support planning and controls of cyber maneuver (i.e., "maneuver" in the space of network characteristics and topologies) that would describe how control and end-state of the maneuver are influenced by fundamental properties of threats, such as might be rapidly inferred from limited observations of a new, recently observed threat.

**Center for Quantum Science Research (VS3)**  
The budget shows $1.2M in FY2015 for the start of this center.
Office of Naval Research (http://www.onr.navy.mil/)

Science and Engineering Education From $37M in FY2013 to $43M
Science, Technology, Engineering and Math (STEM)
- Initiate new effort for teacher training in STEM for schools in underserved communities.
- Initiate new computer science programs for female undergraduates.
- Initiate expansion of internships to underserved students.

DARPA (http://www.darpa.mil/)
DARPA has a 3-5 year tenure for its program officers (PO). As a critical component of their job, new POs must develop new programs. Those new program topics are not fully anticipated in the budget material below. It is highly beneficial to participate in that development since it enhances the chances for funding when a BAA is released.

Cyber (CYS-01)
Active Authentication Program From $10M in FY2013 to $14M
The Active Authentication program will develop more effective user identification and authentication technologies. The Active Authentication program will address these issues by focusing on the unique aspects of the individual (i.e., the cognitive fingerprint) through the use of software-based biometrics that continuously validate the identity of the user. Active Authentication will integrate multiple biometric modalities to create a system that is accurate, robust, and transparent to the user. FY 2014 Plans:
- Demonstrate enhanced authentication using multiple biometrics representing complementary aspects of the individual.
- Evaluate the level of confidence that is achievable using multiple advanced authentication mechanisms and quantify the resulting level of security using red teaming and other techniques.
- Prototype a new authentication platform suitable for use on major DoD platforms in collaboration with potential transition sponsors.

Automated Program Analysis for Cybersecurity From $15M in FY2013 to $19M
APAC is developing automated program analysis techniques for mathematically validating the security properties of mobile applications. This will involve creating new and improved type-based analysis, abstract interpretation, and flow-based analysis methods with a far greater ability to accurately demonstrate security. FY 2014 Plans:
- Improve the effectiveness of prototype tools and specific properties through further competitions.
- Use measurements against the program metrics to identify prototype tools that are likely candidates for technology transition.
- Refine tools in response to transition partner challenges. properties without false alarms than is possible today. APAC technologies will enable developers and analysts to identify mobile applications that contain hidden malicious functionality and bar those applications from DoD mobile application marketplaces.

Electronic Sciences (ES-01)
Arrays at Commercial Timescales From $0 in FY2013 to $9.9M
This program will take a fundamental look at the role of digital arrays and how commonality and aggregation can be affected by emerging capabilities. Simultaneously, this effort will focus on the
development of arrays which can quickly create different unique RF personalities/capabilities on top of common digital hardware. The project will demonstrate levels of diversity in the use of the electromagnetic spectrum which is severely limited by the current approach of hand designing the array with heavily specialized RF beamformers that are unique to each system.

- Develop array components that can demonstrate interoperability over a wired or wireless network such that the realized performance is an integrated sum of each individual array’s performance.
- Develop design techniques suited to common digital hardware components for phased array elements that can be seamlessly integrated into a wide range of platforms.
- Develop electromagnetic interface elements capable of reconfiguring for various array use cases and operational specifications.

**Transformative Sciences (TRS-01)**

**Social Media in Strategic Communication**

From $15M in FY2013 to $20M

The SMISC program will develop techniques to detect, classify, measure, and track the formation, development, and spread of ideas and concepts (memes) in social media. This will provide warfighters and intelligence analysts with indications and warnings of adversary efforts to propagate purposefully deceptive messaging and misinformation. Social media creates vulnerabilities that can be exploited to threaten national security and has become a key operating environment for a broad range of extremists. SMISC will develop technology and a new supporting foundational science of social networks that will enable warfighters to defend against malevolent use of social media and to counter extremist influence operations. FY 2014 Plans:

- Integrate algorithms for meme detection and tracking with algorithms for detecting deception, persuasion, and influence operations.
- Develop high fidelity diffusion models for messages, narratives, and information across social media.
- Combine integrated algorithms with diffusion models to create predictive simulations for the spread of given messages, narratives, and information.

**Networked Approaches to Intractability**

From $0 in FY2013 to $4.5M

Networked Approaches to Intractability program will tackle complex problems such as corruption, human trafficking, and genocide that appear intractable. The U.S. military is increasingly involved with societies plagued by such seemingly self-perpetuating evils. Problems in this class often include social, cultural, ideological, political, and economic constraints, and consequently stakeholders with radically differing world views and frames of reference. Limited U.S. patience for long-term engagements and interconnectedness with other similarly complex problems further characterize the challenge. Social networking has shown initial promise for problems of this nature, such as bribery, though on a smaller scale. The Networked Approaches to Intractability program will develop social networking-based applications that incorporate recent breakthroughs in game theory and multi-party negotiation to break vicious social cycles and create virtuous social cycles. The program seeks approaches to modeling and reasoning about problems of this nature, incentive mechanisms to elicit relevant information from stakeholders, and the creation of tools for combatant commanders and stakeholders collaboratively addressing such challenges.

FY 2014 Plans:

- Research the design of social networking-based applications to address seemingly intractable "super wicked" problems such as corruption, human trafficking, and genocide.
- Develop plans for demonstrating these applications in military stability, security, transition, and reconstruction operations.
Coordinate with PACOM to apply techniques relevant to their theater of operations.

**Vanishing Programmable Resources**  
*From $0 in FY2013 to $3.5M*

The Vanishing Programmable Resources (VAPR) program will create electronic systems capable of physically disappearing (either in whole or in part) in a controlled, triggerable manner. VAPR will enable a host of previously unrealizable technologies that can be programmed to disappear, are biocompatible, and/or are physically reconfigurable. Applications include sensors for conventional indoor/outdoor environments (buildings, transportation, and materiel), environmental monitoring over large areas, and simplified diagnosis, treatment, and health monitoring in the field. The program will develop and establish an initial set of materials and components along with integration and manufacturing capabilities to undergird a fundamentally new class of electronics defined by their performance and transience. These transient electronics ideally should perform in a manner comparable to Commercial Off-The-Shelf (COTS) systems, but with limited device persistence that can be programmed, adjusted in real-time, triggered, and/or sensitive to the environment. VAPR will build an initial capability to make transient electronics a deployable technology for the DoD and Nation. **FY 2014 Plans:**

- Begin development of electronic materials that exhibit a useful combination of transience and the necessary physical characteristics required for sufficient electronic performance.
- Begin development of materials and mechanisms for control of transience effects.
- Begin development of device modeling tools that incorporate transience effects.

**Basic Operational Medical Science (MED-01)**

**Auto Diagnostics to Enable Prevention/Therapeutics**  
*From $24M in FY 2013 to $40M*

The ADEPT program will develop the underlying technologies to rapidly respond to a disease or threat and improve individual readiness and total force health protection by providing capabilities, which are currently available only in centralized laboratories in the U.S., to non-tertiary care and individual settings. ADEPT will develop and exploit synthetic biology for the in vivo creation of nucleic acid circuits that continuously and autonomously sense and respond to changes in physiologic state and for novel methods to target delivery, enhance immunogenicity, or control activity of vaccines, potentially eliminating the time to manufacture a vaccine ex vivo. ADEPT advancements to control cellular machinery include research to optimize orthogonality and modularity of genetic control elements; identify methods to increase sensitivity and specificity; and demonstrate methods to control cellular machinery in response to changes in physiological status. ADEPT will develop methodologies for measuring health-specific biomarkers from a collected biospecimen to enable diagnostics at the point-of-need or resource limited clinical facilities (point-of-care), in-garrison or deployed. Additionally, ADEPT will develop techniques that will enable the rapid establishment of transient immunity through stimulation of the production of components of the immune system to impart effective but temporary protection. This transient immunity would bridge the time gap between the delivery of a vaccine and the development of a long term protective immune response. **FY2014 plans:**

- Demonstrate in mammalian cells the function of a synthetic circuit that can integrate multiple signals associated with health status and respond with a targeted change in cell function.
- Demonstrate the ability to generate synthetic nucleic acid and protein circuit components that respond to an exogenously supplied small molecule drug trigger.
- Demonstrate in mammalian cells the function of an orthogonal, multi-functional nucleic acid-based circuit with sense-and-responder functionality that responds to biomarkers of
cell state.
- Refine developed molecular approaches and develop targeted molecular assays designed for deployable diagnostics.
- Demonstrate biostabilization reagents/materials with numerous biospecimen types and processing/fluidic approaches to be eventually integrated into disposable and on-person diagnostic devices.
- Demonstrate methods for room temperature analyses and reagent stabilization with numerous biospecimen types and fluidic approaches to permit collection and transport of patient samples for diagnostic analysis.
- Demonstrate signal amplification methods in conjunction with processing/assay methods.
- Demonstrate developed sample preparation methods in conjunction with simple and multiplexed analysis of biospecimens representative of those either self-collected under low-resource settings or collected by trained professionals at the physician office settings to assist the diagnosis of an individual.
- Demonstrate delivery of synthetic oligonucleotide constructs to cells appropriate to produce an antibody response.
- Demonstrate antibody and immunoadhesin production targeted to specific disease classes.
- Optimize antibody sequence for maximal therapeutic strength of immune response in vivo.

The FY2014 budget submission indicates no significant changes in the basic research programmatic funding as compared to FY2013.

The FY2014 budget submission indicates no significant changes in the basic research programmatic funding as compared to FY2013.

Office of the Secretary of Defense

Basic Research Initiatives From $19M in FY2013 to $11M
The Minerva Research Initiative is a university-based social science basic research program directed from within the Office of the Secretary of Defense (OSD) and executed by the Services. This program seeks to build a deeper understanding of the social, cultural, and political forces that shape regions of the world of strategic importance to the United States. The Minerva portion of this budget line is reduced from $16M in FY2013 to $7M in FY2014.

National Security Sci and Engn Faculty Fellowship From $26M in FY2013 to $36M
NSSEFF ensures that DoD has a research portfolio that supports the foremost creative, innovative, and productive University researchers, their students and trainees. FY 2014 Plans:
- Continue support for current NSSEFF Fellows, and conduct a program review.
- Organize and conduct two scientific workshops to further develop the collaborative relationships between DoD researchers and NSSEFF Fellows
- Utilize the metrics developed in FY 2013 to assess the program effectiveness and impact
  - Conduct a new competition.
Appendix 2: FY2014 Selected DOD Applied Research (6.2) Programs

**Air Force**

**Advanced Connectivity Technologies**

*From $10M in FY2013 to $24M*

Develop improved, survivable, higher bandwidth communications, networking, and signal processing technologies to provide secure, adaptive, covert, anti-jam, and assured global battlespace connectivity tailored to anti-access and area denial environments and contested operations. FY 2014 Plans:

- Initiate the development of a modular airborne network bridge for the creation of an air-air/air-ground secure tactical intranet.
- Initiate the development of wideband, long-range, rapidly deployable aerial backbone network for command, control, intelligence, surveillance, and reconnaissance (C2ISR) dissemination.
- Initiate research in support of the development of a protected, wide-band satellite communication architecture.

**Cyber Defense Technologies**

*From $14M in FY2013 to $21M*

Develop cyber defense and supporting technologies to detect, defend, and respond to attacks on computer systems as well as provide forensic analysis concerning the attacks. FY 2014 Plans: Initiate development of technologies to support cyber missions’ ability to keep pace with rapidly changing next-generation communications networks/devices and deliver a full range of cyber effects.

**Army**

**Fire Control Target Recognition & Classification**

*From $0 in FY2013 to $2M*

This effort incorporates the latest technologies, advanced algorithms, and fire control optical systems that will provide a target recognition and classification capability that currently does not exist. FY 2014 Plans:

- Will utilize systems engineering to investigate the state-of-the-art of optics, microprocessors and target recognition/classification algorithms based on market surveys of private industry/academia/other government agencies’ sensor technologies;
- Establish, develop and mature the associated fire control system requirements and performance goals;
- Generate and evaluate concepts for software and hardware architectures for optimal fire control system performance and size, weight and power considerations.

**Wireless Information Assurance (IA)**

*From $2.8M in FY2013 to $9.4M*

This effort investigates, codes and fabricates software, algorithms and devices to protect wireless tactical networks against computer network attacks. Effort includes technologies that are proactive rather than reactive in countering attacks against tactical military networks. Work being accomplished under PE 0603008A/project TR2 compliments this effort. FY 2014 Plans:

- Will design and code sophisticated software assurance algorithms to differentiate between stealthy life cycle attacks and software coding errors;
- Design and assess secure coding methodologies that can detect and self correct against malicious code insertion;
- Investigate theoretical control graph techniques for improvements in malware detection that can detect malware variants incorporating polymorphic and metamorphic transformation engines;
- Research and design sophisticated, optimized cyber maneuver capabilities that incorporate
  the use of reasoning, intuition, and perception while determining the optimal scenario on
  when to maneuver, as well as the ability to map and manage the network to determine
  probable attack paths and the likelihood of exploit; investigate dynamically and efficiently
  altering tactical network services, ports, protocols and systems to inhibit red force ability to
  perform malicious network reconnaissance to determine location of critical networking
  services;
- Research and assess data sharing and collaboration techniques between offensive and
defensive operations to enable advanced warning and response actions.

Geo-Enabled Mission Command Enterprise From $1M in FY2013 to $4M
This effort explores and advances components and methods that optimize the utility of the Army
Geospatial Enterprise (AGE) to the total Army. FY 2014 Plans:
- Will design and develop the framework for a common, scalable architecture to deploy
  geospatial, geo-environmental, and social cultural data, in the form of analytics and tools
  through the Army Geospatial Enterprise;
- Conduct research and experiments to develop standoff detection and early warning
  capability of threats to critical infrastructure in extreme environments by innovative fiber
  optic sensing technology;
- Define and establish technology and processes supporting the Army Geospatial Enterprise for
  sharing and transforming geospatial products between and among the defined Computing
  Environments that make up the Common Operating Environment;
- Design and develop optimized processes, methods, and infrastructure to enable the reduction
  of cycle-time and manpower requirements required for the analysis, exploitation, and
  visualization of geospatial data.

DARPA
Autonomous Diagnostics for Prevention/Therapeutics From $15M in FY2013 to $30M
The overarching goal of the ADEPT 6.2 program is to increase our ability to rapidly respond to a
disease or threat and improve individual readiness and total force health protection by providing
centralized laboratory capabilities at non-tertiary care settings. ADEPT will focus on the
development of Ribonucleic Acid (RNA)-based vaccines, potentially eliminating the time and
labor required for traditional manufacture of a vaccine while at the same time improving
efficacy. ADEPT will also focus on advanced development of key elements for simple-to-operate
diagnostic devices. FY 2014 Plans:
- Demonstrate quantitative performance metrics for integrated components developed to
demonstrate capability toward a complete diagnostic device prototype.
- Demonstrate ability to manipulate type of immune response induced by RNA-based vaccines.
- Demonstrate ability to target delivery of RNA-based vaccines to specific cell types.
- Develop novel methodologies to deliver nucleic acid constructs encoding one or hundreds of
  antibodies identified from immunized or convalescent patients.
- Demonstrate immediate broad spectrum transient immune prophylaxis in host via delivery
  of nucleic acids that transiently produce multiple antibodies.

Dialysis like Therapeutics From $10M in FY2013 to $20M
Applied research under this program further develops and applies existing component
technologies and then integrates these to create a complete blood purification system for use in
the treatment of sepsis. Included in this effort will be development, integration and
demonstration of non-fouling, continuous sensors for complex biological fluids; implementation of high-flow microfluidic structures that do not require the use of anticoagulation; application of intrinsic separation technologies that do not require pathogen specific molecular labels or binding chemistries; and refinement of predictive modeling and control (mathematical formalism) with sufficient fidelity to enable agile adaptive closed-loop therapy.

- Integrate continuous sensing, biocompatible high-flow fluid manipulation, intrinsic separation from complex fluid, and predictive modeling and control in a prototype device for the treatment of sepsis.
- Use feedback from initial animal model testing to inform the development of a prototype device for additional safety and efficacy studies in a large animal model.
- Continue regulatory approval process and initiate plan for investigational device exemption submission.

**Restoration of Brain Function Following Trauma**

The Restoration of Brain Function Following Trauma program will exploit recent advances in the understanding and modeling of brain activity and organization to develop approaches to treat traumatic brain injury (TBI). Critical to success will be the ability to detect and quantify structural and molecular changes produced in the human brain from explosive blast and correlate those changes with neurocognitive evaluation. This program will also develop technologies for monitoring and controlling the cells responsible for immune and regenerative responses in the human body. The ultimate goal is identification of efficacious therapeutics or other therapies that can halt progression of injury and/or reduce the severity or duration of TBI.

**Power Efficiency For Embedded Computing Technology**

The PERFECT program will provide the technologies and techniques to overcome the power efficiency barriers which currently constrain embedded computing systems capabilities and limit the potential of future embedded systems. The PERFECT program will overcome processing power efficiency limitations using near threshold voltage operation, massive and heterogeneous processing concurrency, new architecture concepts, and hardware and software approaches to address system resiliency, combined with software approaches to effectively utilize resulting system concurrency to provide the required embedded system processing power efficiency. FY 2014 Plans:

- Develop an analytical modeling framework for fundamental design trade-off analysis and documentation for local resilience and power optimizations and global optimization methodologies and techniques.
- Establish algorithmic analysis and design methodologies for power efficient and resilient processing.
- Define power efficient, heterogeneous, highly concurrent conceptual architectural design approaches.
- Define and evaluate the impact of 3D approaches for power efficient processing.

**Adaptive Integrated Reliability**

The Adaptive Integrated Reliability program goals are to leverage real-time monitoring and the ability to effect fine grained real-time control to significantly increase the lifecycle reliability of complex aerospace and defense systems. The program will also develop and demonstrate technology to reduce the incidence of catastrophic failure in complex aerospace defense systems through real-time detection and adaptation. The program will develop novel in-situ prognostication and health monitoring techniques applicable to complex air and space platforms. The program will develop tractable approaches to predict, identify, and respond to failures.
endemic to complex systems such as failure cascades, destructive emergent behavior, and off-nominal responses. To accomplish this, the program will leverage recent advances in adaptive control for fault isolation and mitigation. FY 2014 Plans:
- Initiate development of the integrated reliability monitoring and prediction approach to include design, analysis, processing, and appropriate sensor and platform architectures.
- Initiate development of embedded sensors that possess the requisite size, energy, and environmental durability to support the Adaptive Integrated Reliability approach.

**High Assurance Cyber Military Systems**  
*From $16M in FY2013 to 23M*

The High Assurance Cyber Military Systems program will develop and demonstrate the technologies required to secure mission-critical embedded computing systems. Recent advances in program synthesis, formal verification techniques, low-level and domain-specific programming languages, and operating systems mean that fully verified operating systems for embedded devices may be within reach at reasonable costs. The program will develop, mature, and integrate these technologies to produce an embedded computing platform that provides a high level of assurance for mission-critical military applications. FY 2014 Plans:
- Demonstrate compositionality which is the ability to construct high assurance systems out of high assurance components.
- Extend the core high-assurance embedded operating system with additional functionality, including automatically generated device drivers and communication protocols.
- Automatically synthesize correct-by-construction control systems from high-level specifications.
- Perform static and dynamic assessments after modifications are made on the militarily-relevant vehicles to evaluate the effectiveness of the synthesis and formal-methods tools.

**Logan***  
*From $6 M in FY2013 to $13M*  

*Previously part of Cyber Fast Track*

The Logan program will provide DoD enhanced capabilities to conduct Computer Network Attack (CNA). Techniques will be developed to disrupt and degrade adversary information systems and network operations, with particular interest in techniques likely to be robust to adversary countermeasure strategies. FY 2014 Plans:
- Automate and test prototypes in conjunction with transition partner.
- Optimize and harden prototypes and complete transition.

**Integrated Cyber Analysis System**  
*From $3M in FY2013 to $9M*

The Integrated Cyber Analysis System (ICAS) program will develop techniques to automate the discovery of probes, intrusions, and persistent attacks on enterprise networks. The ICAS program will develop technologies to correlate interactions and behavior patterns across all system data sources and thereby rapidly uncover aberrant events and detect compromise. This includes technologies for automatically representing, indexing, and reasoning over diverse, distributed, security-related data and system files. FY 2014 Plans:
- Develop and implement algorithms for automatically identifying and quantifying specific security risks extant on an enterprise network.
- Integrate, evaluate, and optimize algorithms via testing against targeted attack/persistent threat scenarios provided by potential DoD users.
- Initiate transition of the most promising technologies to enterprises throughout the DoD.
Active Cyber Defense (ACD)  
From $5M in FY2013 to $12M
The Active Cyber Defense (ACD) program will enable DoD cyber operators to more fully leverage their inherent home field advantage when defending the cyber battlespace. ACD technologies, drawn from discoveries realized in the Cyber Fast Track program, will build on these advantages and increase the attacker’s work factor by enabling cyber defenders to counter adversary cyber tradecraft in real time. FY 2014 Plans: Implement techniques for countering adversary cyber tradecraft in early prototype software applications.

Crowd-Sourced Formal Verification  
From $13M in FY2013 to $20M
The Crowd-Sourced Formal Verification (CSFV) program will create technologies that enable crowd-sourced approaches to securing software systems through formal verification. CSFV will enable non-specialists to participate productively in the formal verification process by transforming formal verification problems into user-driven simulations that are intuitively understandable. FY 2014 Plans:
- Develop five web-based interactive computer simulations based on mapped high-level software specifications and codes.
- Launch public web site to attract the widest possible base for crowd-sourcing formal verifications.
- Map solutions as code annotations back into formal verification tools and assess the effectiveness of these solutions by verifying the absence of errors on the MITRE Common Weakness Enumeration/SANS Institute Top 25 lists.
- Refine initial simulations and develop new simulations for greater verification effectiveness.

Cyber Warfare Control System  
From $0 in FY2013 to $5M
The Cyber Warfare Control System (CWCS) program will create a semi-automated system that can sense and respond to cyber attacks more rapidly than human operators. CWCS will combine fully automated cyber defense with man-in-the-loop cyber offense to bring to bear the full range of cyber responses allowed under applicable policies. Technologies to be developed and integrated may include anomaly detection, big data analytics, case-based reasoning, heuristics, game theory, and stochastic optimization. A CWCS prototype system should be capable of competing at a high level in cyber competitions. FY 2014 Plans:
- Develop the high-level architecture for a semi-automated/man-in-the-loop cyber warfare control system.
- Identify signals exploitable for cyber warfare and develop new instrumentation approaches for obtaining these signals.
- Develop a rigorous analytic formulation for cyber warfare using techniques from game theory, stochastic optimization, and other quantitative disciplines.

XDATA  
From $15M in FY2013 to $26M
*Formerly Network Flow Analytics
The XDATA program seeks to develop computational techniques and software tools for analyzing large volumes of data, both semi-structured (e.g., tabular, relational, categorical, meta-data, spreadsheets) and unstructured (e.g., text documents, message traffic). Central challenges to be addressed include a) developing scalable algorithms for processing imperfect data in distributed data stores, and b) creating effective human-computer interaction tools for facilitating rapidly customizable visual reasoning for diverse missions. The program will develop open source software toolkits that enable flexible software development supporting users processing large volumes of data in timelines commensurate with mission workflows of targeted defense applications. An XDATA framework will support minimization of design-to-deployment time of
new analytic and visualization technologies on diverse distributed computing platforms, and also accommodate changing problem spaces and collaborative environments. FY 2014 Plans:
- Complete development of a framework for processing data from diverse sources with advanced analytics and visualization for diverse missions and diverse platforms.
- Develop and demonstrate analytic tools on petabyte scale.
- Develop adaptive visualization methods for large data for varying users and contexts.
- Demonstrate end-to-end systems in transactional problem domains.

Manned-Unmanned Collaborative Autonomy
From $0 in FY2013 to $5M
Currently most autonomous unmanned systems, from robots for IED operations to sophisticated drones, are actually operated with supervised autonomy with one or more humans "in-the-loop" for every unmanned system. This prevents humans from effectively performing their mission while also directing the operations of unmanned teammates, thereby negating the force multiplication potential of robotics. The Manned-Unmanned Collaborative Autonomy program will develop concepts and implementing software for a truly shared autonomy - human "on-the-loop" - in which multiple unmanned systems can perform missions with minimal guidance from, and limited cognitive interference with, a single human operator in conventional arenas, such as air or ground, as well as atypical environments such as littoral waters. Approaches to develop shared autonomy will build on past successes in a range of efforts, including pilot-on-the-loop simulations under the past DARPA Unmanned Combat Air Rotor (UCAR) and Unmanned Combat Air Vehicle (UCAV) efforts as well as the significant progress made in DARPA’s Warfighter Under Stress program. FY 2014 Plans:
- Develop architecture for manned-unmanned collaborative autonomy.
- Develop underlying technologies for collaborative autonomy, such as mission planning using commander’s intent.

Functional Materials and Devices
From $10M in FY2013 to $19M
The Functional Materials and Devices thrust will address problems with high-performance functional optical materials and components development. Improved materials require deliberate control at the scale of the relevant phenomena. This thrust will leverage the advanced fabrication capabilities currently available, coupled with design of optical materials and component structure, to drive functional materials to high performance for soldier-centric DoD applications by design. Novel optical materials exploiting three-dimensional degrees of freedom to increase wavefront control, and IR emissive materials are examples of materials in which design of structure at the scale of the critical phenomena can have significant impact on their performance. This thrust will also explore newly emerging areas where structure may play an important role. FY 2014 Plans:
- Demonstrate and conduct user testing of 10x hands free zoom capability.
- Demonstrate and conduct user testing of fully integrated heads-up display with eye tracking.
- Integrate and test of wide field of view compact camera with gaze-following foveation.
- Demonstrate integrated software environment for computational imaging.

In vivo Nanoplatforms
From $5M in FY2013 to $18M
The In vivo Nanoplatforms (IVN) program seeks to develop the nanoscale systems necessary for in vivo sensing and physiologic monitoring and delivery vehicles for targeted biological therapeutics. The nanoscale components to be developed will enable continuous in vivo monitoring of both small (e.g. glucose, lactate, and urea) and large molecules (e.g. biological threat agents). A reprogrammable therapeutic platform will enable tailored therapeutic delivery to specific areas of the body (e.g. cells, tissue, compartments) in response to traditional,
emergent, and engineered threats. The key challenges to developing these systems include safety, toxicity, biocompatibility, sensitivity, response, and targeted delivery. FY 2014 Plans:
- Achieve a safe in vivo nanoplatform sensor to detect one military-relevant analyte (e.g. glucose) in living cells for one month.
- Achieve a safe in vivo nanoplatform therapeutic to reduce a military-relevant pathogen or disease cofactor in living cells by 50%.
- Facilitate development of a regulatory approval pathway for diagnostic and therapeutic nanoplatforms.

Arrays at Commercial Timescales (ACT) From $0 in FY2013 to $18M
Phased arrays are critical system components for high performance military electronics with widespread applications in communications, electronic warfare and radar. The Arrays at Commercial Timescales (ACT) program will develop adaptive and standardized digital-at-every-element arrays. The hand designed, static RF beamformers will be replaced with cost effective digital array systems capable of a yearly technology refresh. The basic research component of this program is budgeted under PE 0601101E, Project ES-01. FY 2014 Plans:
- Initiate development of common digital hardware components for phased array elements that can be seamlessly integrated into a wide range of platforms.
- Initiate the development of digital array systems with performance capabilities that evolve with Moore’s law at commercial time scales.
- Initiate the development of electromagnetic (EM) interface elements capable of reconfiguring for various array use cases and operational specifications.
- Develop array components that can demonstrate interoperability over a wired or wireless network such that the realized performance is an integrated sum of each individual array's performance.
- Demonstrate reconfigurability of EM interface components for various array performance specifications and demonstrate compatibility with common digital back-end.

Efficient Computing and Sensing through Optics (ECSO) From $0 in FY2013 to $11M
The Efficient Computing and Sensing through Optics program will develop a system of efficient, high-speed optical sources, waveguides, detectors and non-linear elements for parallelized computation in the optical domain. The program will deliver a device capable of low-power optical transforms and convolutions yielding efficient computation orders of magnitude faster than the state of the art. Applications include real-time network security and object identification. FY 2014 Plans:
- Identify architectures scalable to future telecom line rates.
- Demonstrate real-time correlation for 8 bits at 40 Gbps.

Micro-coolers for Focal Plane Arrays (MC-FPA) From $0 in FY2013 to $5M
The Micro-coolers for FPAs program will develop low Size, Weight, Power, and cost (SwaP-C) cryogenic coolers for application in high performance IR cameras. This program will exploit the Joule-Thompson (JT) cooling principle, in a silicon-based MEMS technology, for making IR FPA coolers with very low SwaP-C. MEMS microfluidics, piezoelectric MEMS, and complementary metal-oxide semiconductor (CMOS) electronics will be used to demonstrate an integrated cold head and compressor, all in a semiconductor chip. The goal of the MC-FPA Program will be to demonstrate cooling down to 150K. An extended wavelength-range short-wave IR detector will be integrated with a micro-cooler for demonstration of the MC-FPA. FY 2014 Plans:
- Develop 640X480 extended shortwave infrared (1-2.4 micrometer cutoff) FPA.
- Design a readout integrated circuit for the IR FPA chip.
Demonstrate camera electronics for the FPA with provision for chip-scale micro-cooler.

Vanishing Programmable Resources (VAPR) From $0 in FY2013 to $6.5M
The Vanishing Programmable Resources (VAPR) program will create electronic systems capable of physically disappearing (either in whole or in part) in a controlled, triggerable manner. VAPR will enable a host of previously unrealizable technologies that can be programmed to disappear, are biocompatible, and/or are physically reconfigurable. The program will develop and establish an initial set of materials and components along with integration and manufacturing capabilities to undergird a fundamentally new class of electronics defined by their performance and transience. These transient electronics will perform in a manner comparable to Commercial Off-The-Shelf (COTS) systems, but with limited device persistence that can be programmed, adjusted in real-time, triggered, and/or sensitive to the environment. To manufacture transient systems at scale will require significant research and development into: higher levels of circuit integration and complexity to realize advanced circuit functionalities; integrated system designs to achieve required function (in modes that offer programmed or triggered transience); integration of novel materials into circuit fabrication processes; and development of new packaging strategies. The efficacy of the technological capability developed through VAPR will be demonstrated through a final test vehicle of a transient sensor system. The goal is to develop a suite of design principles, develop strategies and pathways, process flows, tools and basic components that are readily generalizable and can be leveraged towards the development of many other transient electronics devices. FY 2014 Plans:

- Begin development of foundry fabrication of transient electronics with key functions (RF, memory, digital logic, power supply, etc.).
- Begin development of increased circuit integration and complexity to implement advanced functionalities.
- Begin development of transient sensors and power supply strategies.
- Begin development of transient device fabrication approaches.
- Begin demonstration of transience modes in test vehicles.

Chemical / Biological Defense Program

Physical Science Applied Research From $0 in FY2013 to $11M
Biosurveillance (BSV)/Disease Surveillance: Integrate existing disparate military and civilian datasets, investigate methodologies to appropriately integrate open source data into advanced warning systems, and leverage and enhance advanced epidemiological models and algorithms for disease prediction, impact and biological threat assessment. Contribute to the development of global, near real-time, disease monitoring and surveillance systems that address secondary infection, fuse medical syndromic, environmental, and clinical data, and feed into agent-based epidemiological modeling, medical resource estimation and decision support tools. Focus on agent-based epidemiological modeling and fusion of disease surveillance data. FY 2014 Plans:

- Advance research into data integration platforms through the BSV Ecosystem effort.
- Develop approaches for unique and emerging data collection, aggregation and provision of human, vector and animal/zoonotic health surveillance data.
- Develop algorithms, verification, and validation for these data feeds to synthesize and interrogate multiple sources of data to provide high confidence in the prediction, early warning and forecasting (inclusive of mitigation strategies) of infectious disease outbreaks.
- Leverage biosurveillance and point of need diagnostic efforts to support in-context, rapid detection, identification and response capabilities on the global scale through integrated access via the BSV Ecosystem.
**Tech Base Med Defense Bio CM**  
**From $7M in FY2013 to $16M**

Therapeutics - Bacterial Therapeutics: Identify, optimize and evaluate lead therapeutic candidates effective against designated bacterial threat agents. FY 2014 Plans:
- Evaluate bioactive peptides for the ability to stimulate host protective pathways.
- Determine synergy between lead series MurB antibacterial cell wall inhibitors and conventional antibiotics against B. anthracis and Y. pestis.
- Evaluate the electron transport chain, multidrug efflux systems, and purine pathways as a target for broad-spectrum antibacterial development.

**Office of the Secretary of Defense (OSD)**  
**Appd Research for the Advancement of S&T Priorities**  
**From $0 in FY2013 to $33M**

The FY 2014 S&T priorities include: Electronic Warfare (EW), Human Systems, Counter Weapons of Mass Destruction (CWMD), Engineered Resilient Systems (ERS), Data to Decisions (D2D), Autonomy, and Cybersecurity. Investigations conducted in this PE will facilitate concept exploration efforts and studies of alternative concepts. Efforts are formulated and managed by teams of subject matter experts drawn from the Office of the Secretary of Defense, the Military Services, and Defense Agencies. The PE will also provide necessary administrative support to the Priority Steering Councils and S&T Focus Areas. FY 2014 Plans: Conduct concept exploration efforts that focus on the seven S&T priority areas. Challenge areas within the priorities include:

**Electronic Warfare:**
- Spatial and spectral parameters
- Integrated, network-enabled EW systems
- Electronic protection measures

**Human Systems:**
- System interfaces
- Social and cultural understanding
- Personnel and training
- Protection and sustainment
- Counter Weapons of Mass Destruction:
  - Systems integration
  - Activity recognition
  - Advanced signature detection and tracking
  - Advanced radiation detection

**Engineered Resilient Systems:**
- Systems analysis methods and tools
- Early concept engineering techniques
- Advanced architecture and design analysis techniques
- New approaches to analysis and testing
- Methods and tools for more robust designs
- Advanced algorithms

**Data to Decisions:**
- Enhanced images
- Temporal and text analytics
- Better software architectures
- Improved algorithms for data fusion
- Improved understanding of user interactions

**Autonomy:**
- Machine reasoning and intelligence
- Human/autonomous systems interaction and collaboration
- Scalable Testing of Autonomous systems
- Testing and Evaluation and Verification and Validation

Cyber:
- Mission assurance and effectiveness
- Operating securely in an insecure world

**S&T Focus Areas**

The S&T Focus Areas task facilitates cooperation and collaboration among Components and optimizes development of selected S&T efforts across the DoD enterprise. Select technology areas are examined and projects are initiated to address gaps or opportunities. Efforts are formulated and managed by teams of subject matter experts drawn from the Office of the Secretary of Defense, the Military Services, and Defense Agencies. FY 2014 Plans: Candidate projects for S&T Focus Areas include: exceptional materials properties and processing routes through electromagnetic field - materials coupling; active informatics photonic materials; development of models and architecture for digital curation; nanoscale battery architectures; and 3-dimensional (3D) stereochemistry through multitasking polymer catalysts; garbage and waste mining – creation of material stock for mobile manufacturing.

**National Network for Manufacturing Innovation Institutes**

Two recently announced DoD institute technology focus areas are (1) Digital Manufacturing and Design Innovation (DMDI) and (2) Lightweight and Modern Metals Manufacturing Innovation (LM3I). These institutes will address cross-cutting manufacturing technologies to meet critical national security and energy needs. The total DoD funding contribution will be $50M per institute, with other government agencies rounding out the balance to reach $70M in federal funding per institute, with an expected minimum 1:1 funding match by industry/others. The establishment of both institutes will be overseen by the Office of the Secretary of Defense (OSD), with solicitations managed by DoD field activities.
Appendix 3: Abbreviated illustration of a Program Officer Datasheet

Dr. David M. Stepp
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david.m.stepp@us.army.mil

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
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
IEEE Transactions on Dielectrics and Electrical Insulation, 3(3), 392 - 398  1996
### Appendix 4: Acronym Glossary

#### Agency Specific

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFIRM</td>
<td>Armed Forces Institute for Regenerative Medicine</td>
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<tr>
<td>AFOSR</td>
<td>Air Force Office of Scientific Research</td>
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<tr>
<td>AFRL</td>
<td>Air Force Research Laboratories</td>
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<tr>
<td>ARL</td>
<td>Army Research Laboratories</td>
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<tr>
<td>ARO</td>
<td>Army Research Office</td>
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<tr>
<td>BA</td>
<td>Budget Activity (new designation for the R&amp;D accounts)</td>
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<tr>
<td>BSV</td>
<td>Bio Surveillance</td>
</tr>
<tr>
<td>C2ISR</td>
<td>Command, Control, Intelligence, Surveillance and Reconnaissance</td>
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<tr>
<td>CBDP</td>
<td>Chemical/Biological Defense Program</td>
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<tr>
<td>CBWD</td>
<td>Chemical/Biological Warfare Defense</td>
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<tr>
<td>CCRU</td>
<td>Cross-cut Research Initiative</td>
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<tr>
<td>CDMRP</td>
<td>Congressionally Directed Medical Research Program</td>
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<td>CM</td>
<td>Counter Measures</td>
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<tr>
<td>CNA</td>
<td>Computer Network Attack</td>
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<tr>
<td>CoE</td>
<td>Center of Excellence</td>
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<tr>
<td>COTS</td>
<td>Commercial Off-the-Shelf (products)</td>
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<tr>
<td>CSI</td>
<td>Congressional Special Interest (also known as budget “adds”)</td>
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<tr>
<td>CTA</td>
<td>Collaborative Technology Alliance</td>
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<tr>
<td>CWMD</td>
<td>Combating Weapons of Mass Destruction</td>
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<td>D2D</td>
<td>Data to Decisions</td>
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<tr>
<td>DARPA</td>
<td>Defense Advanced Research Projects Agency</td>
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<tr>
<td>DDR&amp;E</td>
<td>Director, Defense Research and Engineering</td>
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<tr>
<td>DHP</td>
<td>Defense Health Program</td>
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<tr>
<td>DMRDP</td>
<td>Defense Medical Research and Development Program</td>
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<tr>
<td>DTRA</td>
<td>Defense Threat Reduction Agency</td>
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<tr>
<td>DURIP</td>
<td>Defense University Research Instrumentation Program</td>
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<tr>
<td>EM</td>
<td>Electromagnetic</td>
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<tr>
<td>ERS</td>
<td>Engineered Resilient Systems</td>
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<tr>
<td>ESTCP</td>
<td>Environmental Security Technology Certification Program</td>
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<tr>
<td>EW</td>
<td>Electronic Warfare</td>
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<tr>
<td>FPA</td>
<td>Focal Plane Array</td>
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<tr>
<td>GDF</td>
<td>Guidance for the Development of the Force</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HSCB</td>
<td>Human Social Cultural and Behavior Modeling</td>
</tr>
<tr>
<td>IED</td>
<td>Improvised Explosive Devices</td>
</tr>
<tr>
<td>IR</td>
<td>Infra-Red</td>
</tr>
<tr>
<td>ISR</td>
<td>Intelligence, Surveillance and Reconnaissance</td>
</tr>
<tr>
<td>Minerva</td>
<td>Name of DOD program engaging the social science community</td>
</tr>
<tr>
<td>MOVINT</td>
<td>The ability to track moving things on land and sea (Movement Intelligence)</td>
</tr>
<tr>
<td>MTO</td>
<td>Microsystems Technology Office (DARPA)</td>
</tr>
<tr>
<td>MURI</td>
<td>Multidisciplinary University Research Initiative</td>
</tr>
<tr>
<td>NDEP</td>
<td>National Defense Education Program</td>
</tr>
<tr>
<td>NDSEG</td>
<td>National Defense Science and Engineering Graduate Fellowships</td>
</tr>
<tr>
<td>NRL</td>
<td>Naval Research Laboratory</td>
</tr>
<tr>
<td>NSSEFF</td>
<td>National Security Science and Engineering Faculty Fellowship</td>
</tr>
<tr>
<td>OSD</td>
<td>Office of the Secretary of Defense</td>
</tr>
<tr>
<td>PACOM</td>
<td>DOD U.S. Pacific Command</td>
</tr>
<tr>
<td>PE</td>
<td>Program Element – term from DOD budgeting</td>
</tr>
<tr>
<td>PM</td>
<td>Program Manager (same as PO)</td>
</tr>
</tbody>
</table>
PO Program Office (same as PM)
R&E Research and Engineering Enterprise (DOD Assistant Secretary)
RF Radiofrequency
SERDP Strategic Environmental Research and Development Program
STO Strategic Technology Office (DARPA)
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
YIP Young Investigator Program

General
BAA Broad Agency Announcement
CFDA Catalog of Federal Domestic Assistance Number
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
FFO Federal Funding Opportunity
FY Fiscal Year
IHE Institutions of Higher Education
MAPS Mission Agency Program Site (provided by USC Res Adv)
MEMS/NEMS Micro- Nano-ElectroMechanical Systems
NASA National Aeronautics and Space Administration
NIST National Institute for Standards and Technology (in DOC)
NOAA National Oceanic and Atmospheric Administration (in DOC)
NSF National Science Foundation
PBR President’s Budget Request (submitted to Congress)
RDT&E Research, Development, Test and Evaluation
RFA Request for Application
SBIR Small Business Innovative Research
S&T Science and Technology
STEM Science, Technology, Engineering and Mathematics (education)
TBA To be Announced
USDA US Department of Agriculture