Army Science & Technology

NDIA Science Engineering & Technology Conference

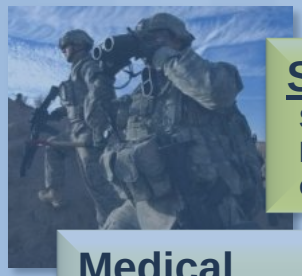
Basic Research Portfolio Overview

Jeffrey D. Singleton
Director for Basic Research
Office of the Deputy Assistant Secretary
of the Army for Research and Technology

9 April 2014

Army S&T Investments by Portfolio

PB15 FY15 6.1-6.3



Soldier/Squad

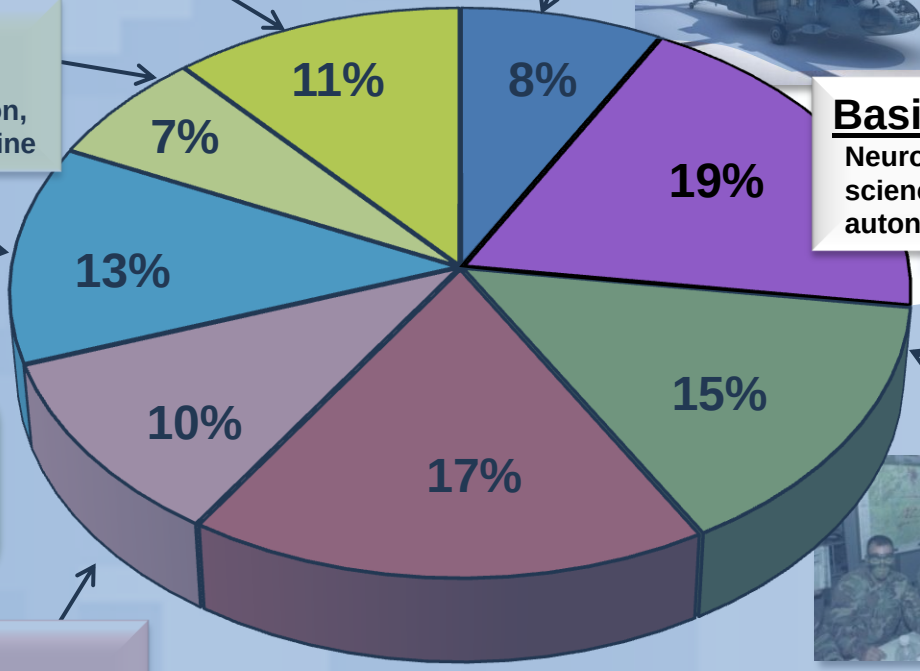
Soldier survivability equipment; human dimension/systems; power & energy; Soldier Weapons, training

Air

Advanced air vehicles; unmanned aerial systems; manned/unmanned teaming

Medical

Combat Casualty Care, Infectious Disease mitigation, clinical/rehabilitative medicine

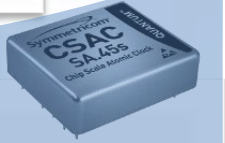


Basic Research

Neuroscience; network science, materials science; autonomy

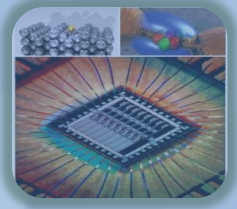
Innovation Enablers

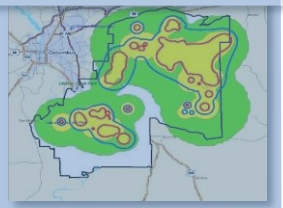
High Performance Computing; Environmental Protection; Base Protection; Studies



C3I

Secure Comms-on-the-move; cyber/EW; sensors



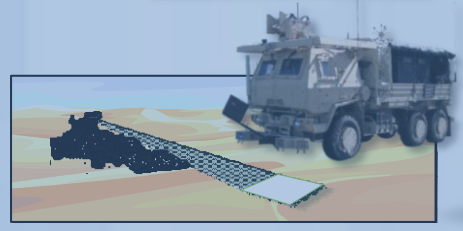


Lethality

Offensive/Defensive kinetic (guns, missiles) > 50 cal; Directed Energy (HEL) weapons

Ground Maneuver

Combat/tactical ground platforms/survivability; unmanned ground systems; austere entry; power & energy



Note: Figures may not add due to rounding

Army Basic Research

Vision

Advance the frontiers of fundamental science and technology and drive long-term, game-changing capabilities for the Army through a multi-disciplinary portfolio teaming our in-house researchers with the global academic community

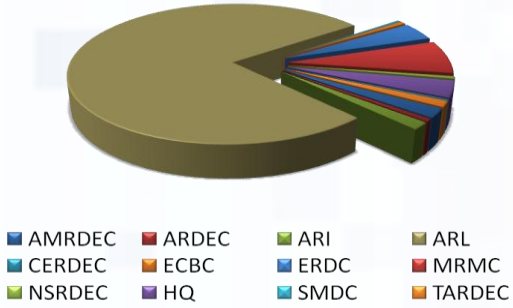
Basic Research Underpins Army Capability Development

Basic Research Portfolio

Basic Research Portfolio
6.1 Funding Request

PB15

$424M



Human Centric

$77M

Investment Areas

- Life Science
- Medical
- Training
- Behavioral and Cultural
- Neuroscience

Information Centric

$86M

Investment Areas

- Information Science
- Network Science
- Cyber Security

Material Centric

$172M

Investment Areas

- Classical Sciences
- Materials Modeling
- Biotechnology
- Nanotechnology
- Environment

Platform Centric

$55M

Investment Areas

- Simulation
- Autonomy
- Air and Ground Vehicles

Enrichment Initiatives

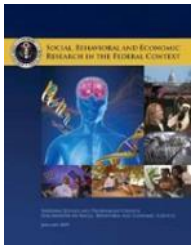
$34M

Investment Areas

- University Research Instrumentation
- Innovative Lab Research
- International Activities
- Educational Outreach

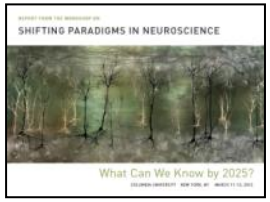
Human Centric Basic Research

High Priority Research
Executive Office of the President



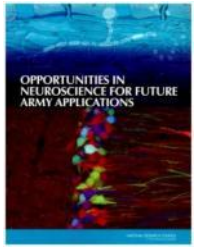
- Neuroimaging tool development is one of the **top four** research priorities *(White House)*

- Understanding the brain's structure and function is a **top three** foundational research theme *(White House)*
- Cognitive neuroscience is a **top six** disruptive basic research area *(ASD(RE))*



Office of the Secretary of Defense

National Academy of Sciences

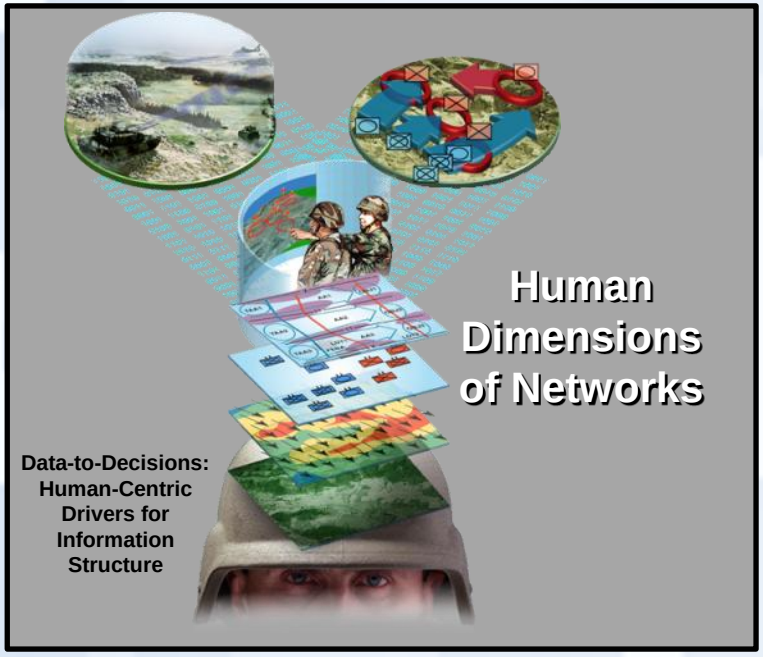


Neurotechnology industry invests >$140 billion annually

Focus Areas

- **Life Science**
  - Basic Research in Life Science
- **Medical**
  - Combat Casualty Care
  - Prevention/Treatment of Disease
  - Clinical and Rehabilitative Medicine
- **Training**
  - Graphics and Animation
  - Immersive Environments
  - Human/Virtual Interaction
- **Behavioral and Cultural**
  - Human Behavior and Social Sciences
- **Neuroscience**
  - Understanding human brain function in operationally relevant environments

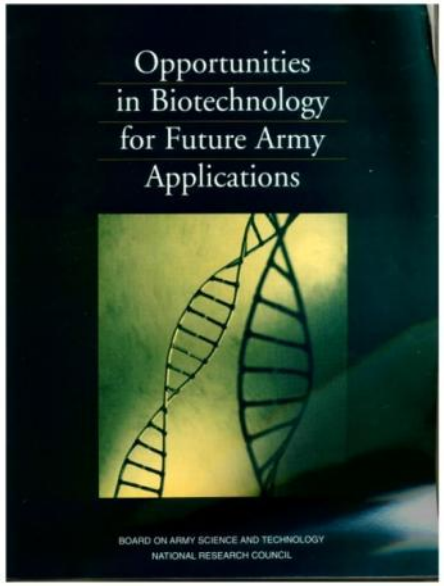
Information Centric Basic Research

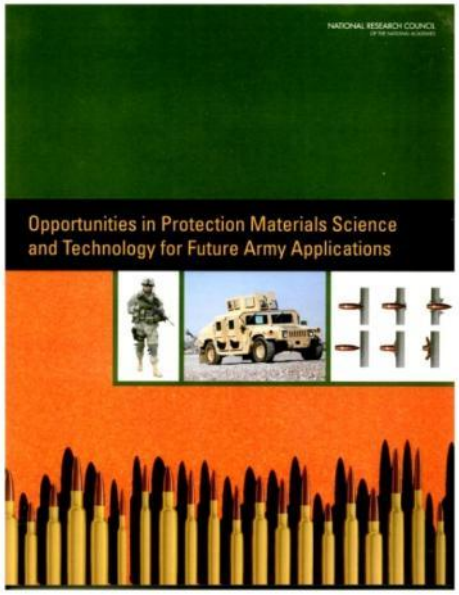


Focus Areas

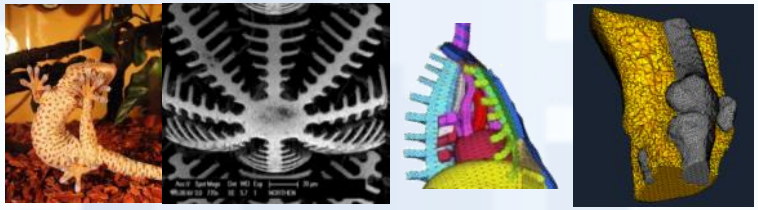
- **Information Science**
  - Computing
  - Mathematics
- **Network Science**
  - Network Science Collaboration for Social/Cognitive, Information, and Communication networks
  - Network Science Technology Experimentation and Emulation
  - Networks in Coalition Warfare
- **Cyber Security**
  - Information Protection for Mobile Ad Hoc Networks
  - Cyber Security Collaborative Research Alliance

Material Centric Basic Research





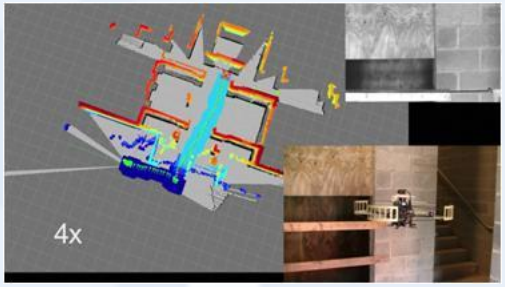
Bio: -materials, -mimetic, -inspiration, -mechanics

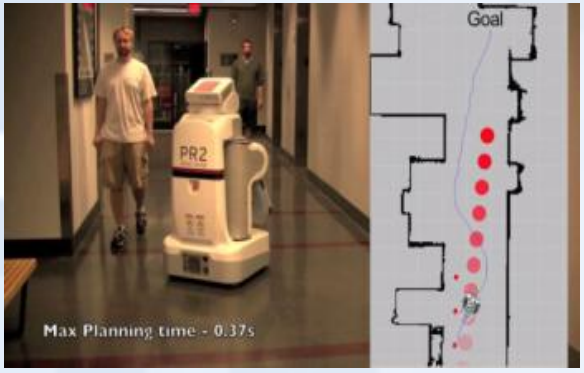


Focus Areas

- **Classical Sciences**
  - Environmental
  - Chemical
  - Physical
  - Electronics and Photonics
  - Mechanical
- **Materials**
  - High Deformation Rate Materials
  - Insensitive Munitions / Disruptive Energetics
  - Multi-Scale Modeling of Materials
- **Biotechnology**
  - Bio-inspired Technology
- **Nanotechnology**
  - Nanotechnology for the Soldier
  - Nanoelectronic Devices
- **Environmental**

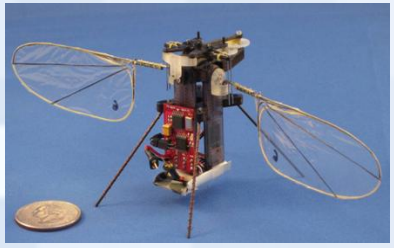
Platform Centric Basic Research

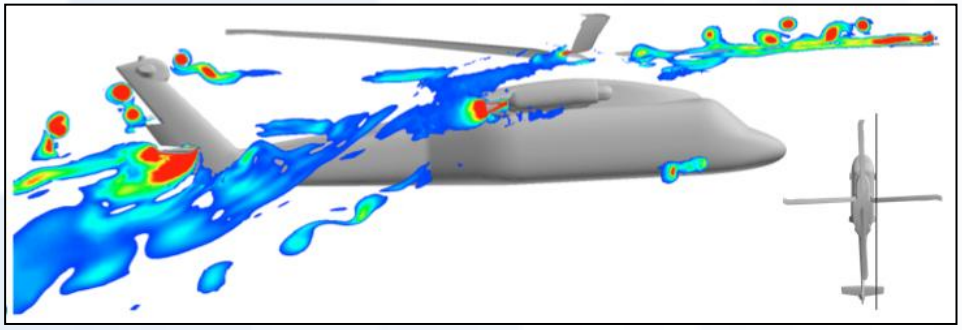




Focus Areas

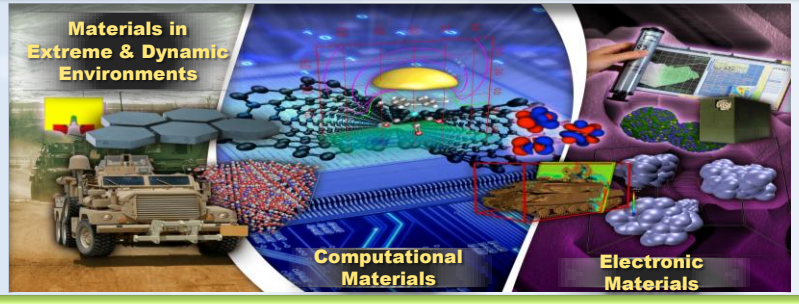
- **Simulation**
  - High performance computing research
- **Autonomy**
  - Micro Autonomous Systems Technology
  - Robotics
- **Vehicles**
  - Automotive Research
  - Vertical Lift Research





Basic Research Major Efforts

Materials Science - Multi-Scale Modeling



Goal:
Create a transformational, comprehensive "materials-by-design" capability – from atoms to continuum – for future electronic systems and protection materials systems for Soldiers, vehicles, or facilities with significant weight savings and at reduced cost; batteries with triple the energy density

Intelligent / Autonomous Systems

Goal:
Expand autonomous capabilities, utility, and portability of small robotic systems, with a focus on enhanced intelligence, biomimetic functionality, and robust mobility for future systems to support and unburden Soldiers.

Robots as Teammates

Human Sciences / Cybernetics

Goal:
Manage Soldier emotion and fatigue states, cognitive performance, and examine leading edge methodologies to improve the classification of neural state and behavior in operationally relevant environment. Use cybernetics to human systems integration

Network / Quantum Information Science / Cyber

Goal:
Provide for efficient information flows in communication, information and social/cognitive (CIS) networks to improve Soldiers' situational awareness. Develop novel detection methods and analysis tools to enhance our ability to respond quickly to advanced emerging cyber threats

The Defense Laboratory

- Inspired by Thomas Edison's vision of "a great research laboratory" maintained by Government; NRL created in 1923
- In 1945, Bush's *Science-the Endless Frontier* became model for scientific pursuits

"There are certain kinds of research - such as research on the improvement of existing weapons - which can best be done within the military establishment. However, the job of long-range research involving application of the newest scientific discoveries to military needs should be the responsibility of those civilian scientists in the universities and in industry who are best trained to discharge it thoroughly and successfully. ***It is essential that both kinds of research go forward and that there be the closest liaison between the two groups."***

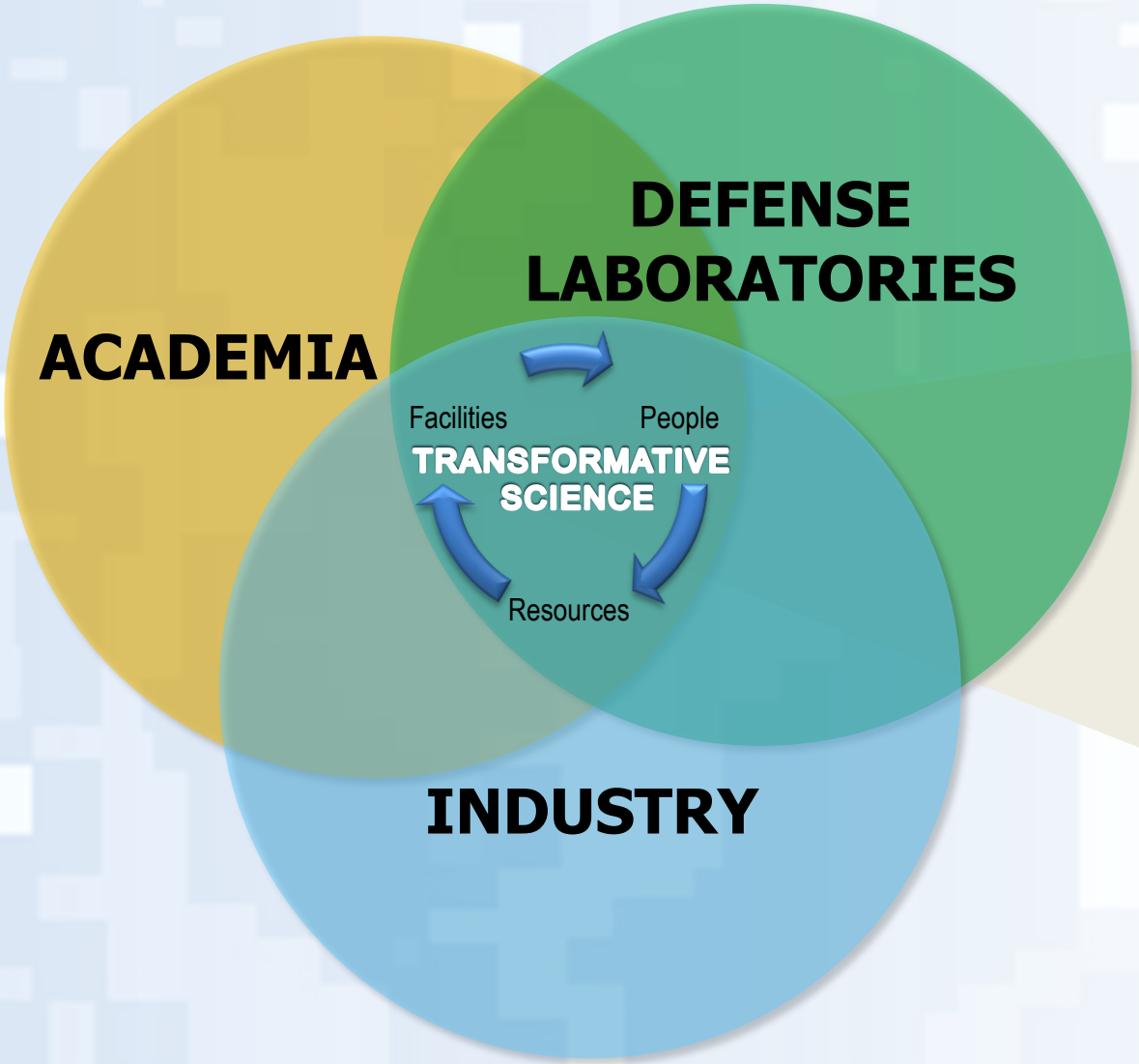
Bush, Vannevar, *Science-The Endless Frontier*, A Report to the President. July 1945

Current Defense Laboratory Model

Gates & High Walls provide 20th century security, but are barriers to 21st century innovation

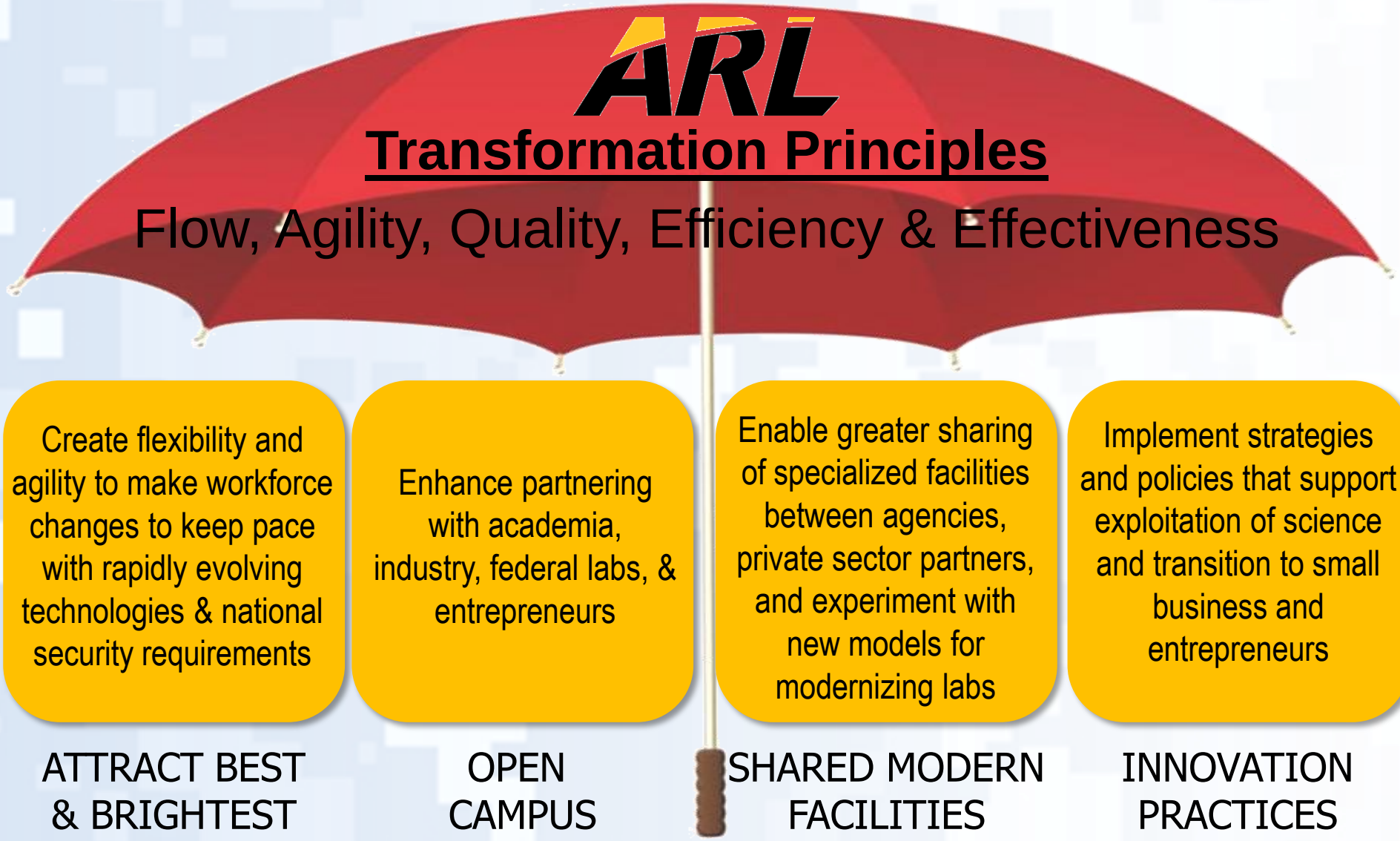
Defense laboratories relatively unchanged since inception!

Ideal State



Efficient, effective and agile research system

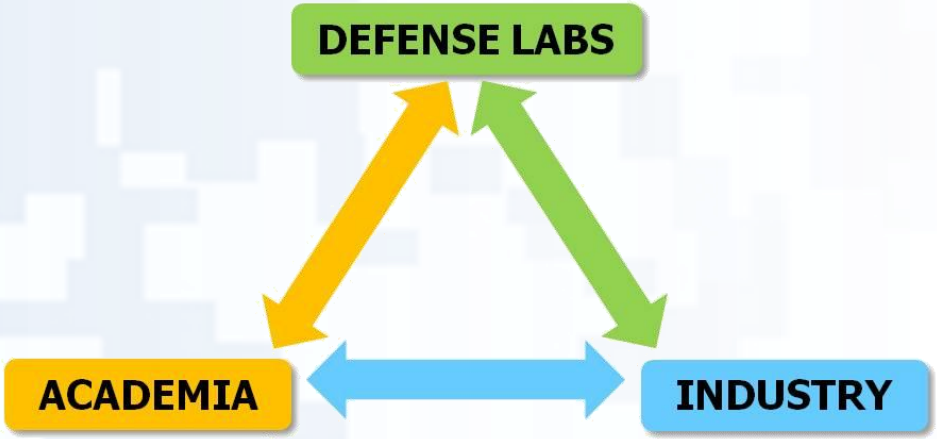
Piloting a New Laboratory Business Model



Attract the Best and Brightest

Transforming Human Capital Management Strategy

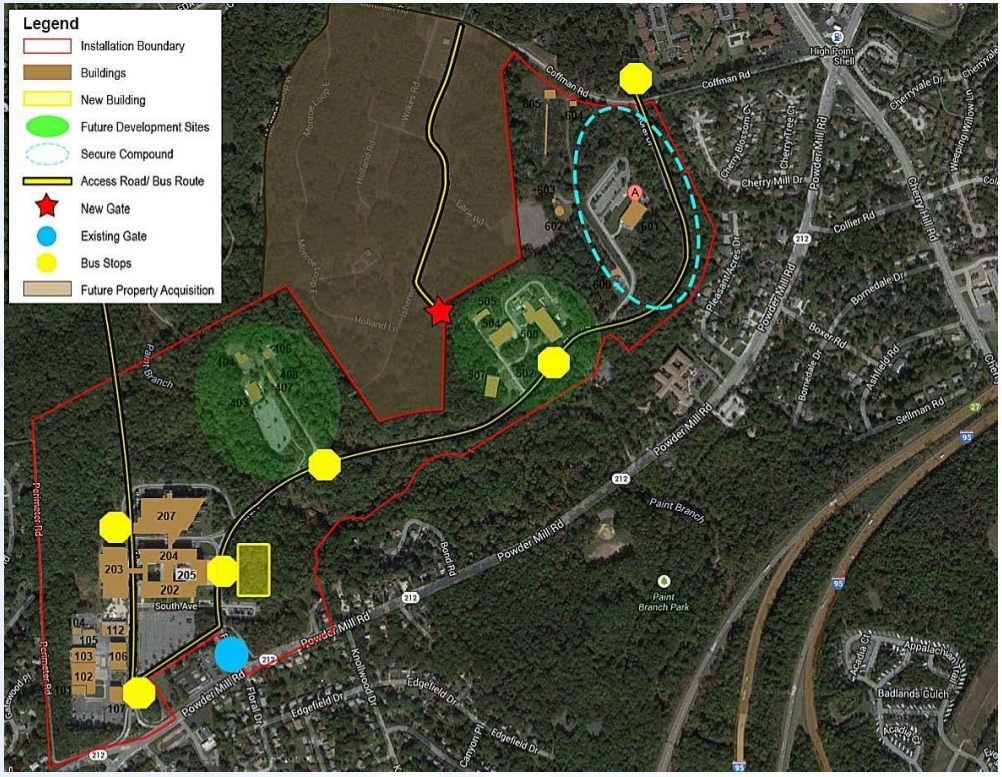
- Inject new, quality talent and begin personnel “flow” between government, academia, small-business & industry
  - Allow in-house staff opportunity to work in academic, industry and small business settings
  - Provide government employees opportunities to explore IP ventures
  - Create joint appointments between government, academia and industry



- Increase high-quality, high-impact jobs geared toward future technologies to attract future STEM workforce

Army Research Laboratory

- Establish a new world-class R&D and education campus for the Army
- Leverage Army resources for greater mission benefit
- Improve ARL performance by onsite R&D collaborations with
  - More opportunity for technology advancement and transfer of research knowledge
  - Pursues Army education and outreach goals
  - Provides workforce development opportunities for high-tech careers
- Increase public involvement and understanding of defense science technology and exploration



ARL Adelphi Lab Center
Future Development

Shared Modern Research Facilities

Specialty Electronic Materials & Sensors Cleanroom (SEMASC)

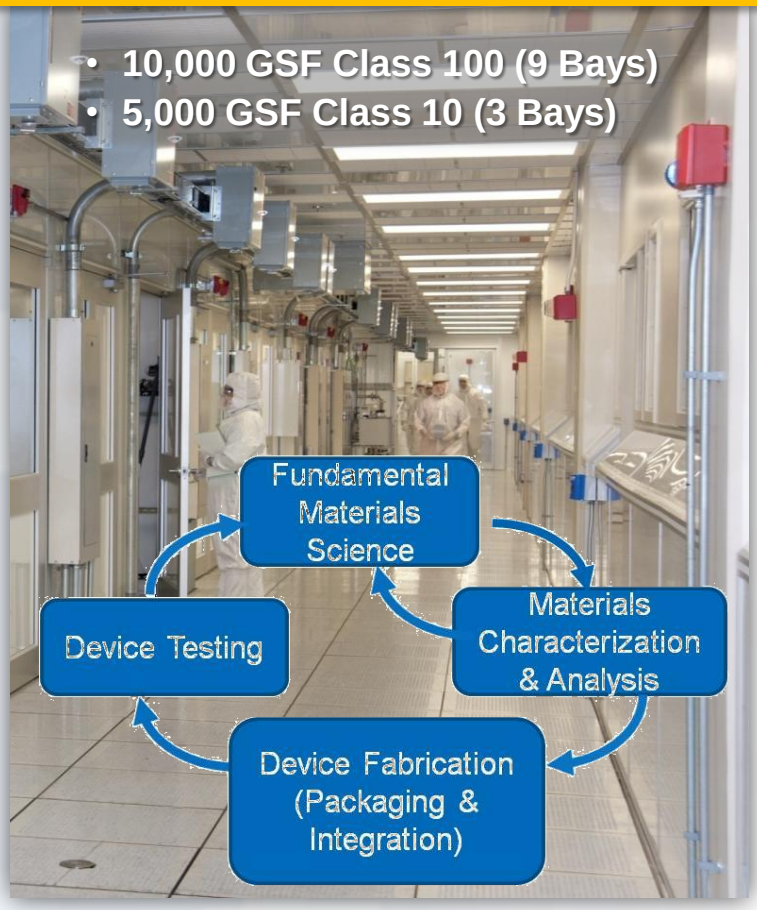
State-of-the-art semiconductor processing laboratory in Adelphi, MD

Permits rapid study of interactions between device design, growth & processing

- Innovative materials, devices, & process technologies allow verification of new materials without impacting ongoing research
- Opto-electronics, nano-science, MEMS, electronics, microscale power conditioning & generation

Collaborative research performed with domestic partners using *CRADAs, Interagency Agreements and Test Services Agreements*

- Highly collaborative (DoD, industry & academia)



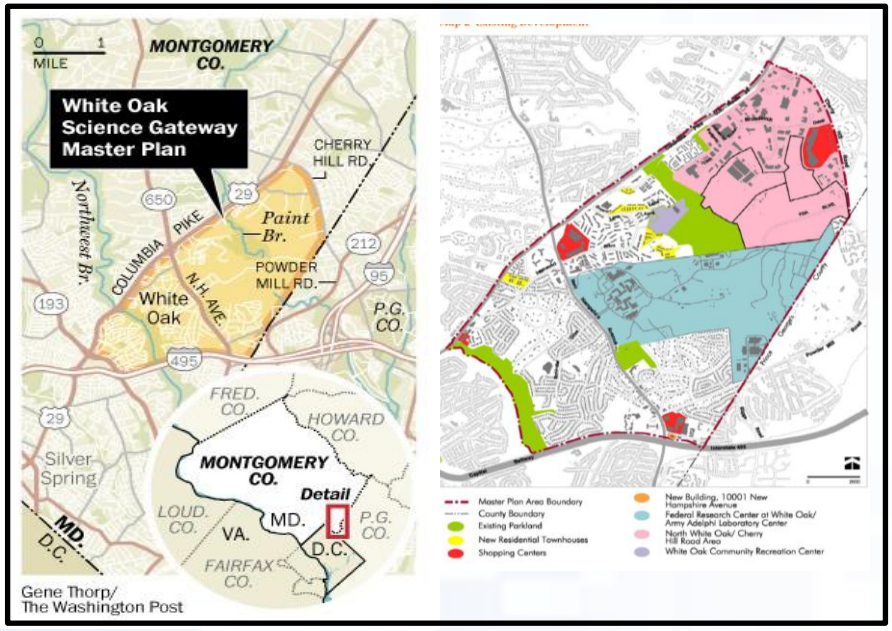
FULL PARTNERSHIP LIMITED BY CURRENT DEFENSE LABORATORY MODEL

Benefits to the Army

ARL Open Campus will be uniquely positioned as a nourishing and dynamic environment for cutting-edge research and education

Through this initiative, ARL is creating:

- A world-class shared-use R&D and education campus for industry, academia, non-profits, and government
- An environment that fosters both informal and formal interactions through careful selection of tenants
- A collaborative and profitable partnership to advance the defense mission
  - ✓ Ability to modernize facilities using leases with annual revenue that is re-invested in the Garrison
- A center that actively promotes innovation and entrepreneurship to develop revolutionary technology for the Soldier



Montgomery Planning Board advances master plan for White Oak Science Gateway - 19 SEP 13

- Create a mixed use center with reduced vehicular traffic by 25 % and connection to the 'Purple Line'

The Army STEM Requirements

- The Army Employs more than 23,000 world-class scientist and engineers as direct military, civilian, or contracted human capital

- STEM fields are critical to generating and supporting the new ideas that the government, industry and academia depend on to ensure our Nation not only remains globally competitive but also remain the world's lead in cutting-edge technology

- Multidimensional and cross-disciplinary STEM competencies are not only essential to supply specific technical talent for our research centers with experts in immerging new fields but also critical to fill our workforce with STEM-literate talent for the research and analysis work that the Army does across every field

The health of the Army, and our Nation, is dependent on our continuing and readily available supply of US STEM capabilities

ARMY EDUCATIONAL OUTREACH PROGRAM

IT STARTS HERE.

Army Educational Outreach Program – Vision & Priorities

Vision: Offer students and teachers a collaborative, cohesive, portfolio of Army sponsored STEM programs that effectively engage, inspire, and attract the next generation of STEM talent through K-college programs and expose them to DoD STEM careers

- ***Priority 1: STEM Literate Citizenry: Broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industrial Base (DIB)***
- ***Priority 2: STEM Savvy Educators: Support and empower educators with unique Army Research and Technology Resources***
- ***Priority 3: Develop and implement a cohesive, coordinated, and sustainable STEM education outreach infrastructure across the Army***

"My friends and I heard from two men on the military's BATMAN team. It was amazing. Their energy and engagement with us was unbeatable."

2013 JSHS Student Participant

ARMY EDUCATIONAL OUTREACH PROGRAM

IT STARTS HERE.

Inspire...Explore...Achieve

Junior Solar Sprint (JSS)
(4th – 8th grade)

Camp Invention
(1st – 6th grade)

eCYBERMISSION
(6th – 9th grade)

Gains in the Education of Mathematics & Science (GEMS) (5th – 12th grade)

West Point Bridge Design Contest
(6th – 12th grade)

UNITE
(9th – 12th grade)

Junior Science & Humanities Symposium (JSHS)
(9th – 12th grade)

Internships
(High School & College)

DoD Scholarship & Awards Opportunities
(SMART & NDSEG)

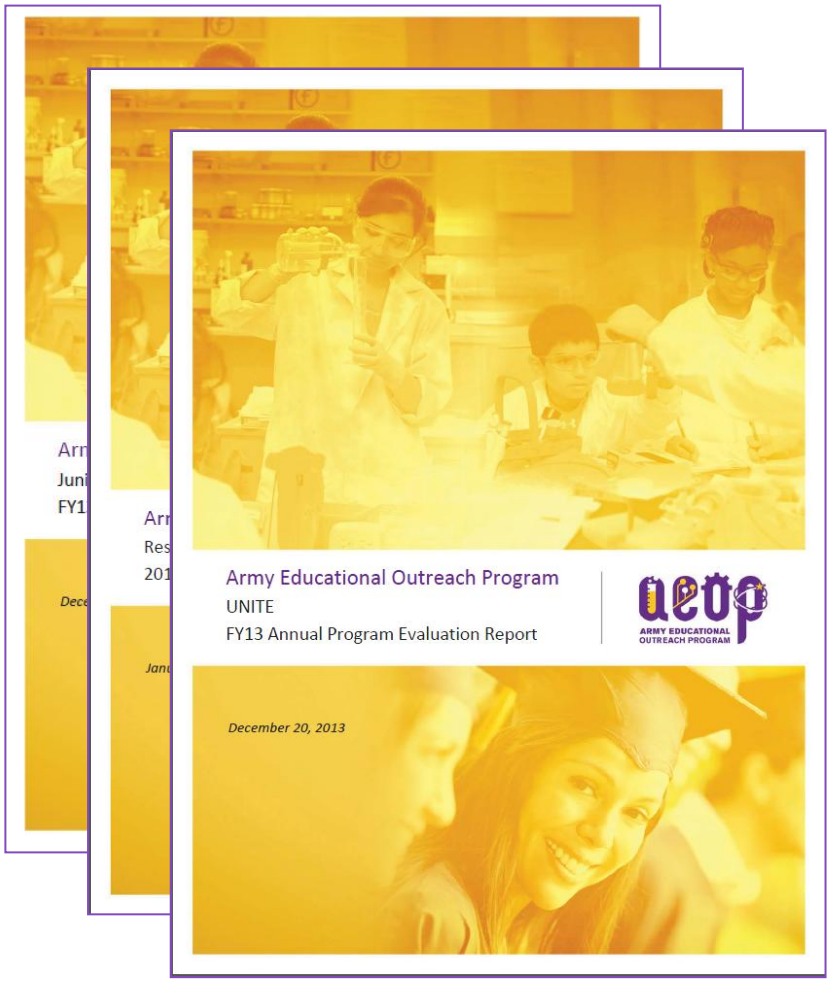
College Qualified Leaders (CQL)

Science and Engineering Apprentice Program (SEAP)

ARMY EDUCATIONAL OUTREACH PROGRAM

IT STARTS HERE.

AEOP Evidence Based Management



Sample Evaluations Results

AEOP Participants

FY12: 53,408 FY13: 66,484 FY14: 75,000*

- 99.4% of AEOP HS participants intend to pursue postsecondary education of which 74% intend to major in STEM (FY12)
- 90% of GEMS students rated their instructors as highly excited in conducting hands-on projects with them (FY13)
- 56% placement rate of students into GEMS programs (FY12)
- 39% increase in eCYBERMISSION students (FY12 to FY13)
- 27% increase in AEOP participation (FY12 to FY13)

** FY13 Reports will be complete in April 2014*

"eCYBERMISSION has increased my confidence and passion that I can excel and contribute towards the STEM fields, and has no doubt increased my desire to attend a STEM-based high school and college."

2013 eCYBERMISSION Student Participant

ARMY EDUCATIONAL OUTREACH PROGRAM

IT STARTS HERE.

Defense Innovation Marketplace
(www.DefenseInnovationMarketplace.mil)