# Army Science & Technology

## NDIA Science Engineering & Technology Conference

# Basic Research Portfolio Overview

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**Office of the Deputy Assistant Secretary**
**of the Army for Research and Technology**


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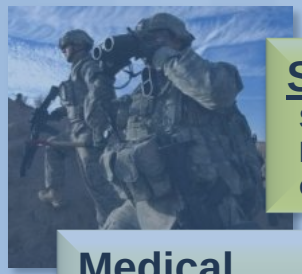
# Army S&T Investments by Portfolio

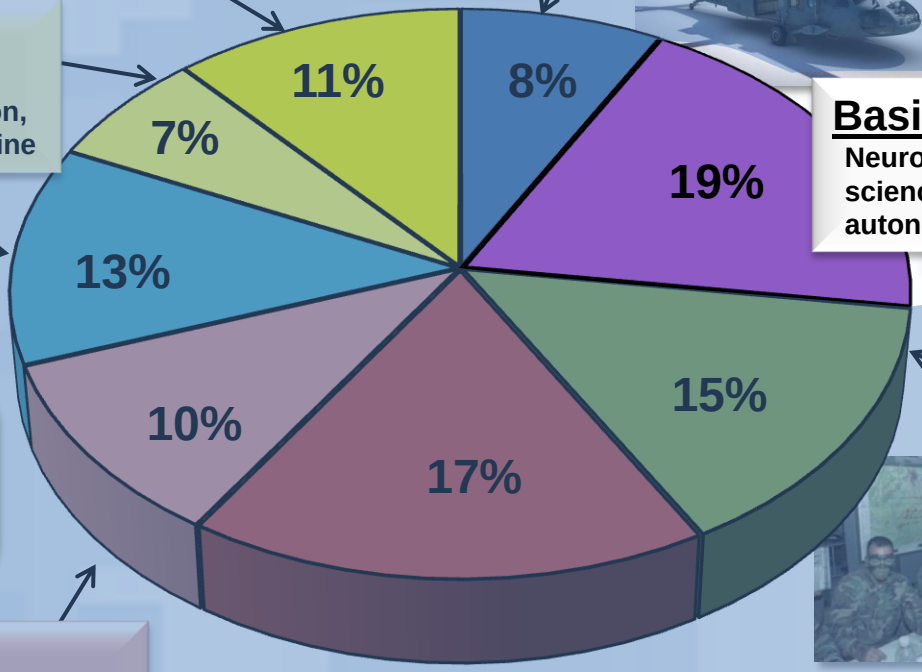
*PB15 FY15 6.1-6.3*



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

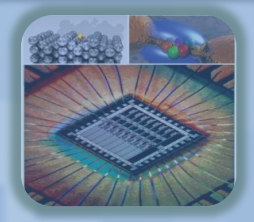
## Air
Advanced air vehicles; unmanned aerial systems; manned/unmanned teaming

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

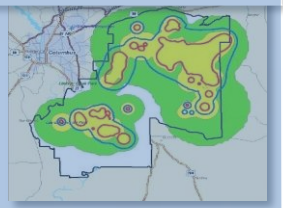



## Basic Research
Neuroscience; network science, materials science; autonomy

## Innovation Enablers
High Performance Computing; Environmental Protection; Base Protection; Studies

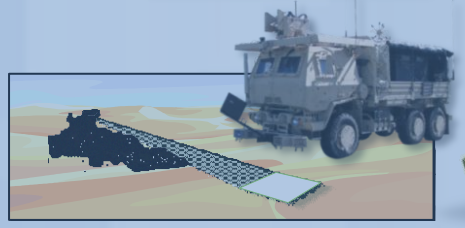


## C3I
Secure Comms-on-the-move; cyber/EW; sensors



## 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**

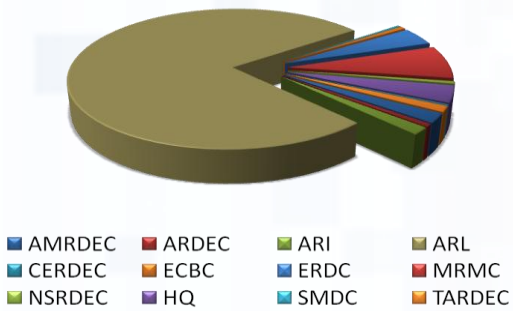
**Basic Research Underpins Army Capability Development**

# 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

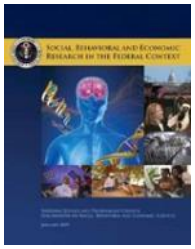
$34M

**Investment Areas**

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

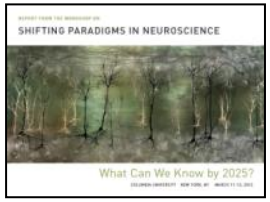
# Human Centric Basic Research

**High Priority Research**
**Executive Office of the President**



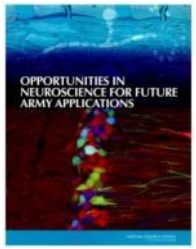
- Neuroimaging tool development is one of the **top four** research priorities *(White House)*

- 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**

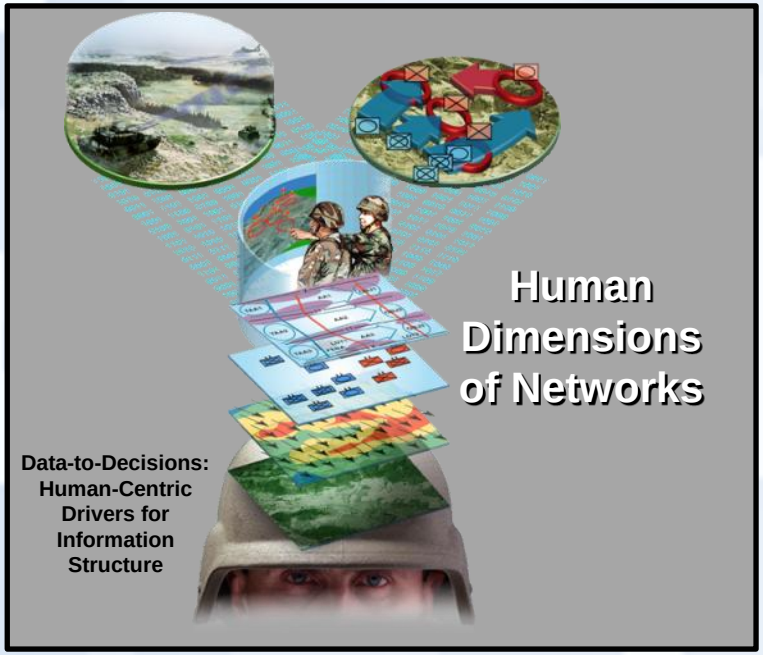



**Neurotechnology industry invests >$140 billion annually**

## 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

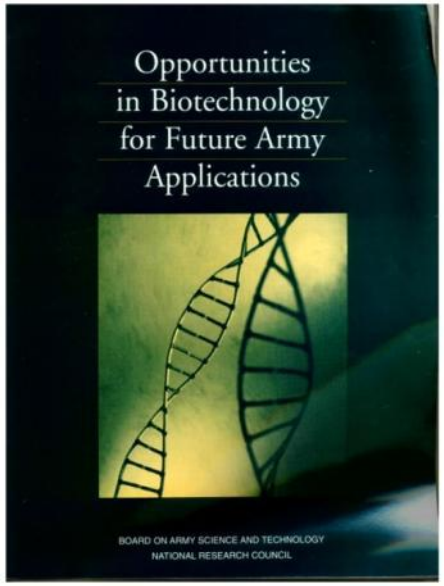
# Information Centric Basic Research

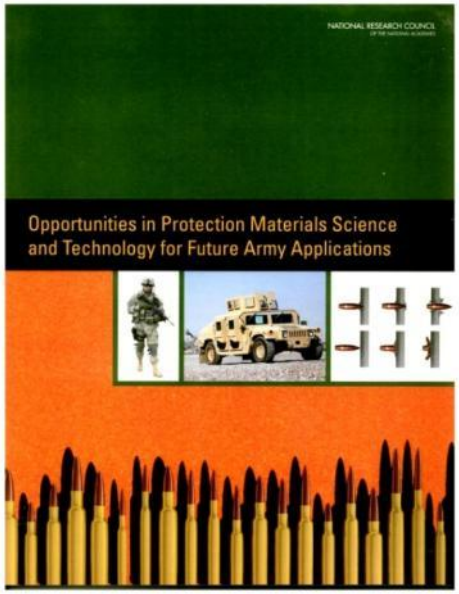



## Focus Areas

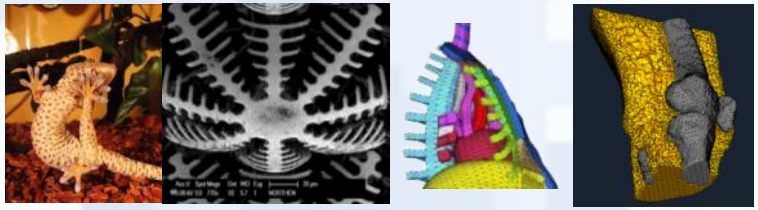
- **Information Science**
  - Computing
  - Mathematics
- **Network Science**
  - Network Science Collaboration for Social/Cognitive, Information, and Communication networks
  - Network Science Technology Experimentation and Emulation
  - Networks in Coalition Warfare
- **Cyber Security**
  - Information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

# Material Centric Basic Research



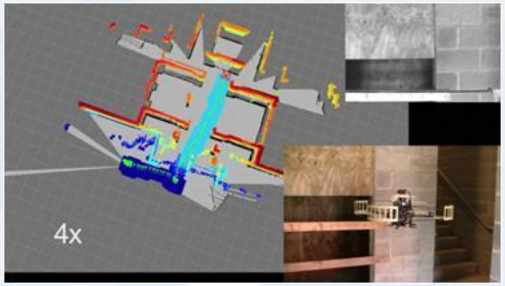

***Bio: -materials, -mimetic, -inspiration, -mechanics***

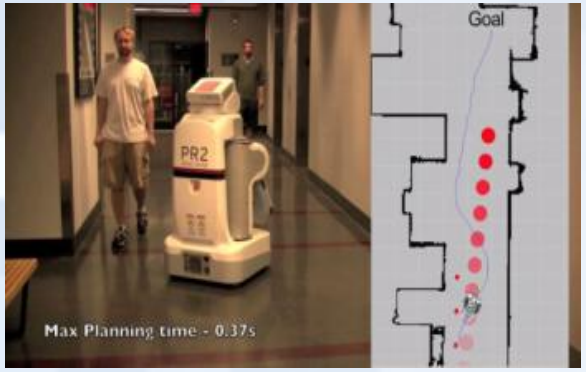


## Focus Areas

- **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**

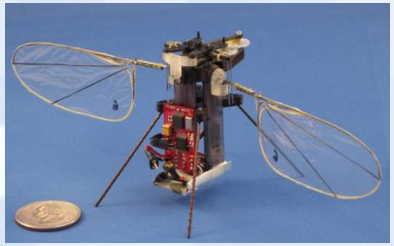
# Platform Centric Basic Research

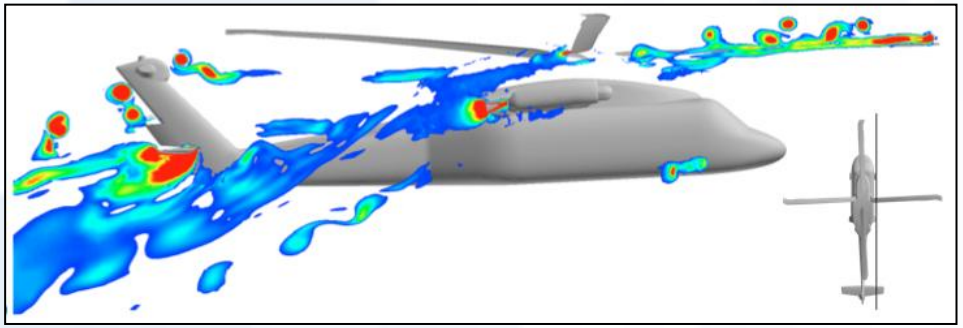


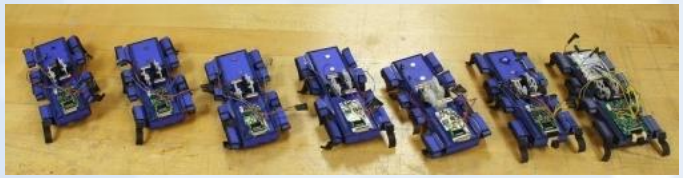




## Focus Areas

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

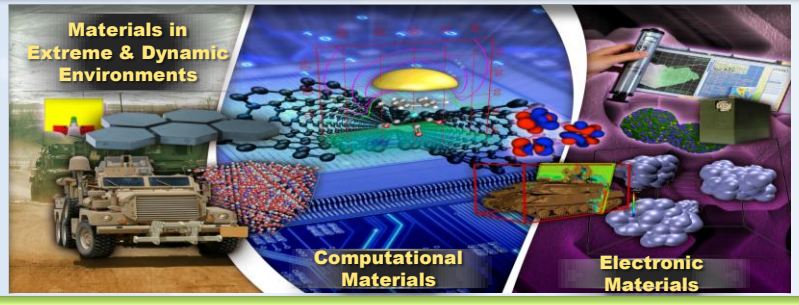






# Basic Research Major Efforts

## 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.

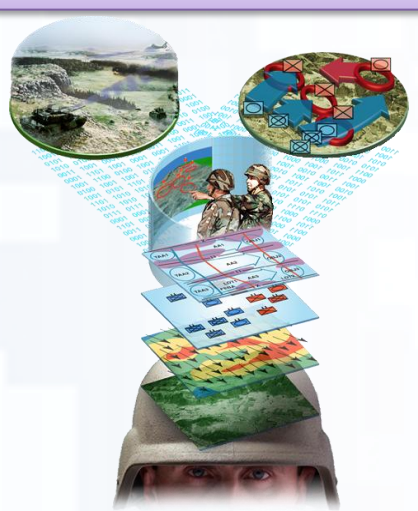
Robots as Teammates

## 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."***

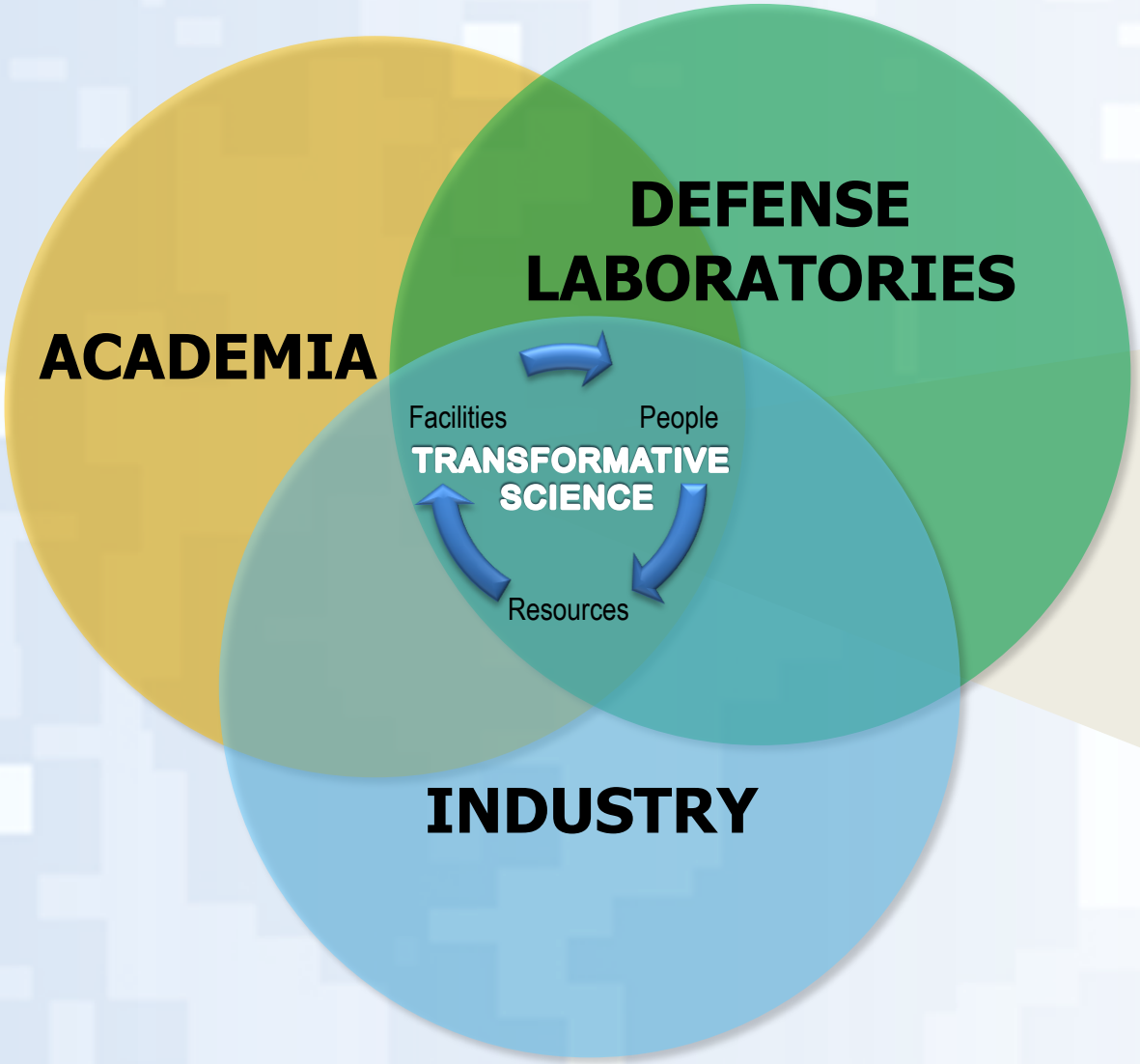
Bush, Vannevar, *Science-The Endless Frontier*, A Report to the President. July 1945

## 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

ARL

## Transformation Principles

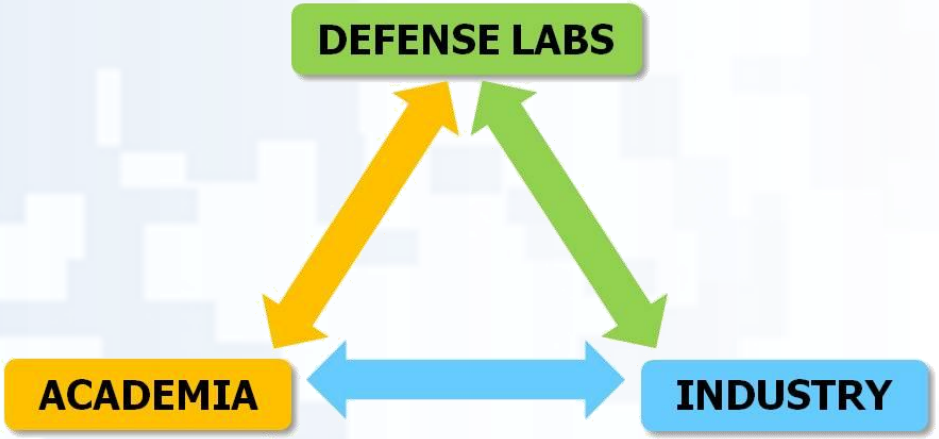
Flow, Agility, Quality, Efficiency & Effectiveness

| ATTRACT BEST & BRIGHTEST | OPEN CAMPUS | SHARED MODERN FACILITIES | INNOVATION PRACTICES |
|---|---|---|---|
| Create flexibility and agility to make workforce changes to keep pace with rapidly evolving technologies & national security requirements | Enhance partnering with academia, industry, federal labs, & entrepreneurs | Enable greater sharing of specialized facilities between agencies, private sector partners, and experiment with new models for modernizing labs | Implement strategies and policies that support exploitation of science and transition to small business and entrepreneurs |

# Attract the Best and Brightest

## Transforming Human Capital Management Strategy

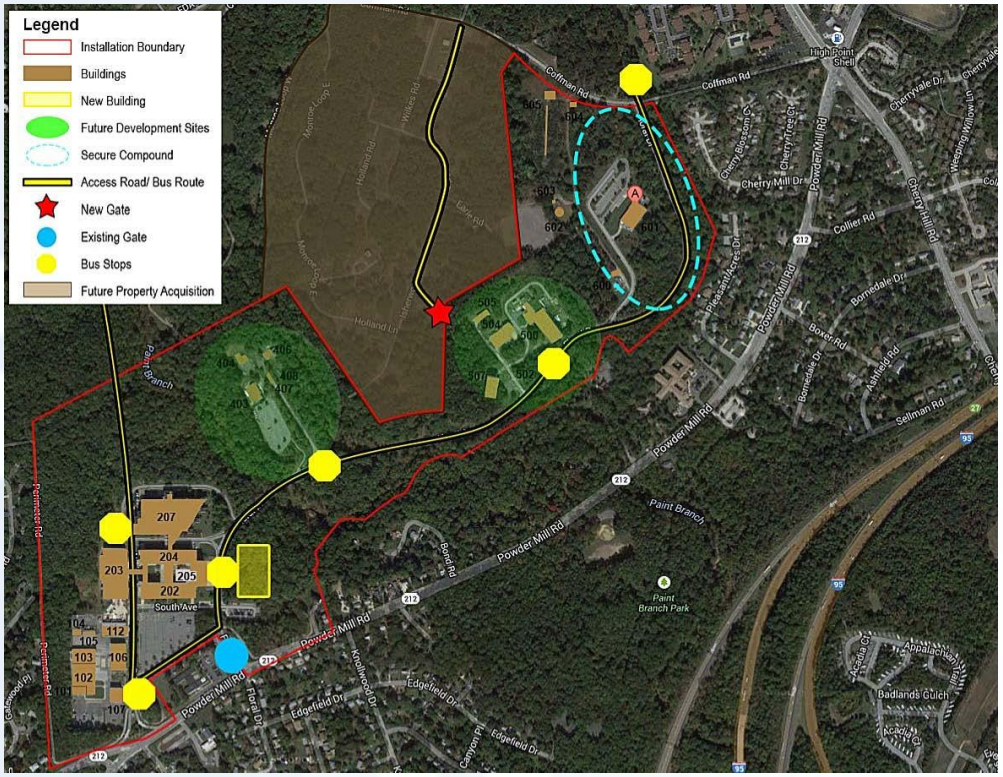
- Inject new, quality talent and begin personnel “flow” between government, academia, small-business & industry
  - Allow in-house staff opportunity to work in academic, industry and small business settings
  - Provide government employees opportunities to explore IP ventures
  - Create joint appointments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

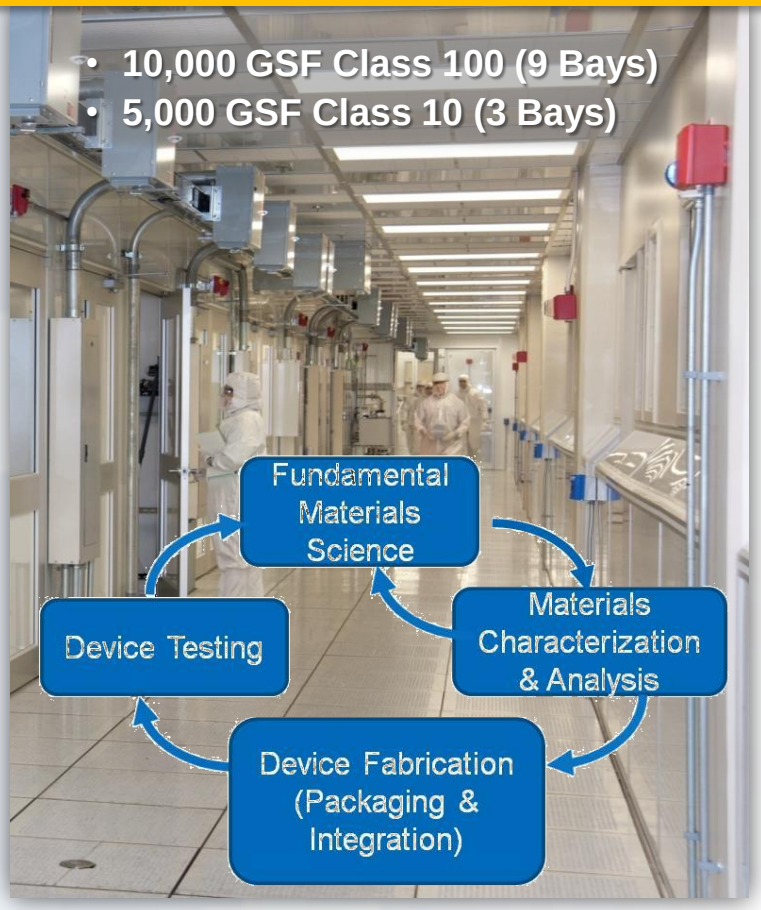
*State-of-the-art semiconductor processing laboratory in Adelphi, MD*

**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)



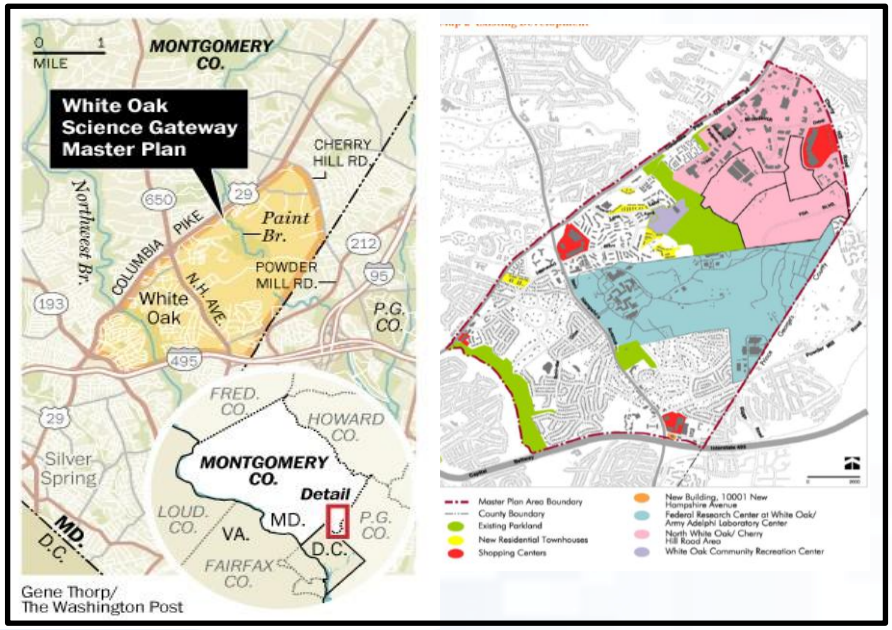

**FULL PARTNERSHIP LIMITED BY CURRENT DEFENSE LABORATORY MODEL**

# 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)

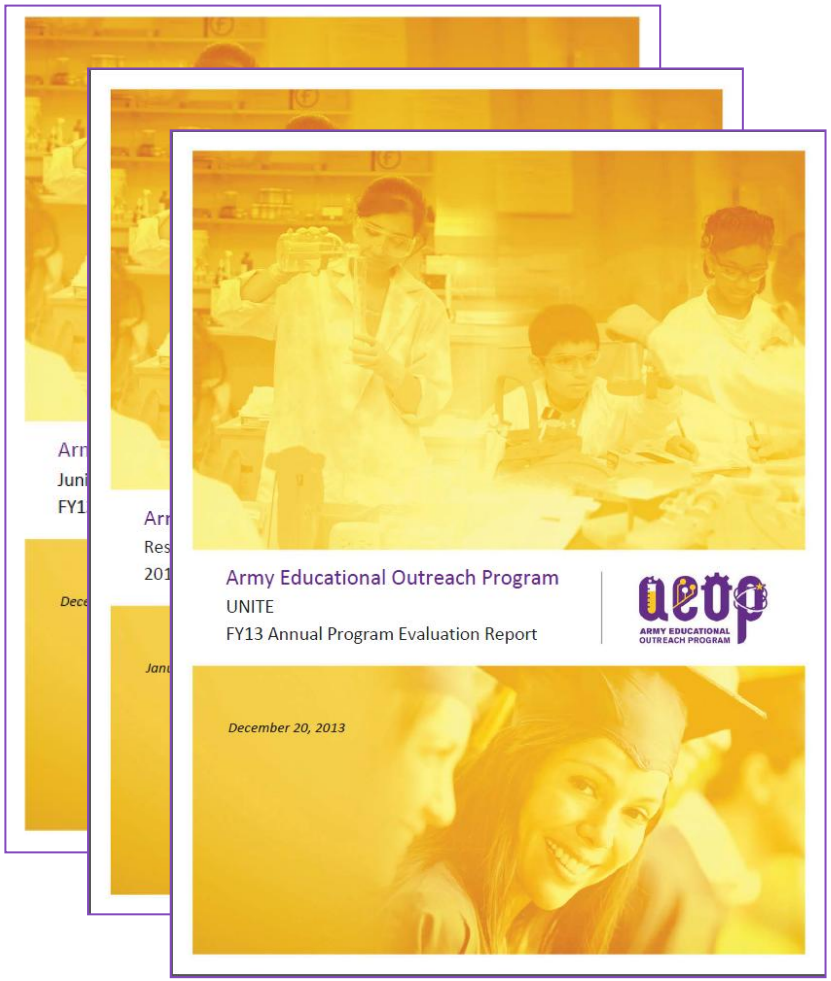
**Science and Engineering Apprentice Program** (SEAP)

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)