

# Army Science & Technology



## Army Science and Technology Program

### National Defense Industrial Association 16th Annual Science and Engineering Technology/ Defense Tech Exposition



Mary J. Miller  
Deputy Assistant Secretary of the Army  
Research and Technology

24 March 2015

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DESIGN • DEVELOP • DELIVER • DOMINATE  
SOLDIERS AS THE DECISIVE EDGE



- Principles and Vision
- Science and Technology Enterprise
- Strategy
- Resources
- Technology Portfolios





# *Principles and Vision*





# Army S&T Principles

**MISSION:** Identify, develop and demonstrate technology options that inform and enable effective and affordable capabilities for the Soldier

**VISION:** Providing Soldiers with the technology to Win

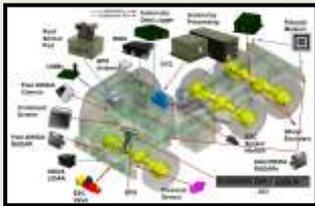
## Current Force



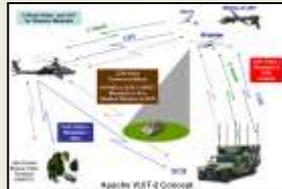
**Deployable Force Protection Adaptive Red Team**



**Advanced Rotary Wing Aerial Delivery Sling Load Net**



**Autonomous Mobility Appliqué System**



**Video from Unmanned Aerial Systems**



**High Speed Container Delivery System**

Enabling the Future Force



## Future Force



**Cyber tools**

**Next Generation Rotorcraft**



**Neuroscience**



**High Energy Lasers**



**Occupant Centric Platform**

Enhancing the Current Force





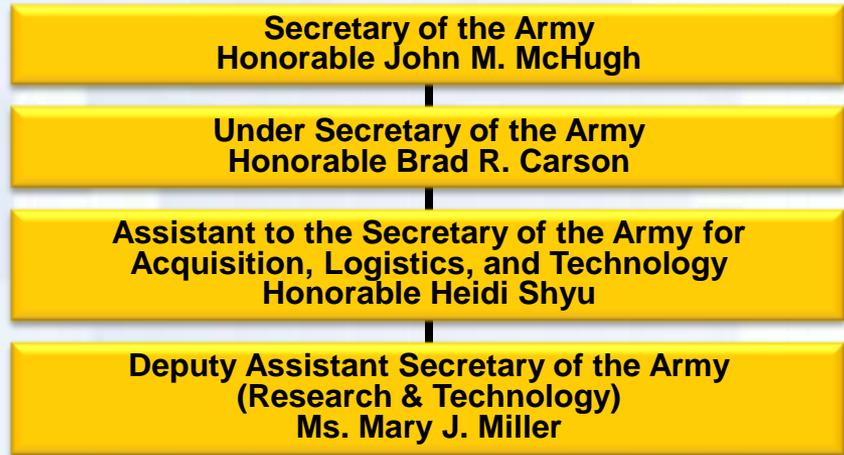
- **Solve current problems – Operational Needs Statements (ONS)/Joint Urgent ONS (JUONS)**
- **Improve current system capability – Engineering Change Proposals (ECPs), product improvements**
- **Drive down technical risk for Programs of Record (PoRs)**
- **Inform affordable and achievable requirements**
- **Investigate new technology/approaches for potential Army application**
- **Determine technology/system vulnerabilities and identify mitigation**
- **Conduct “technology watch” functions**



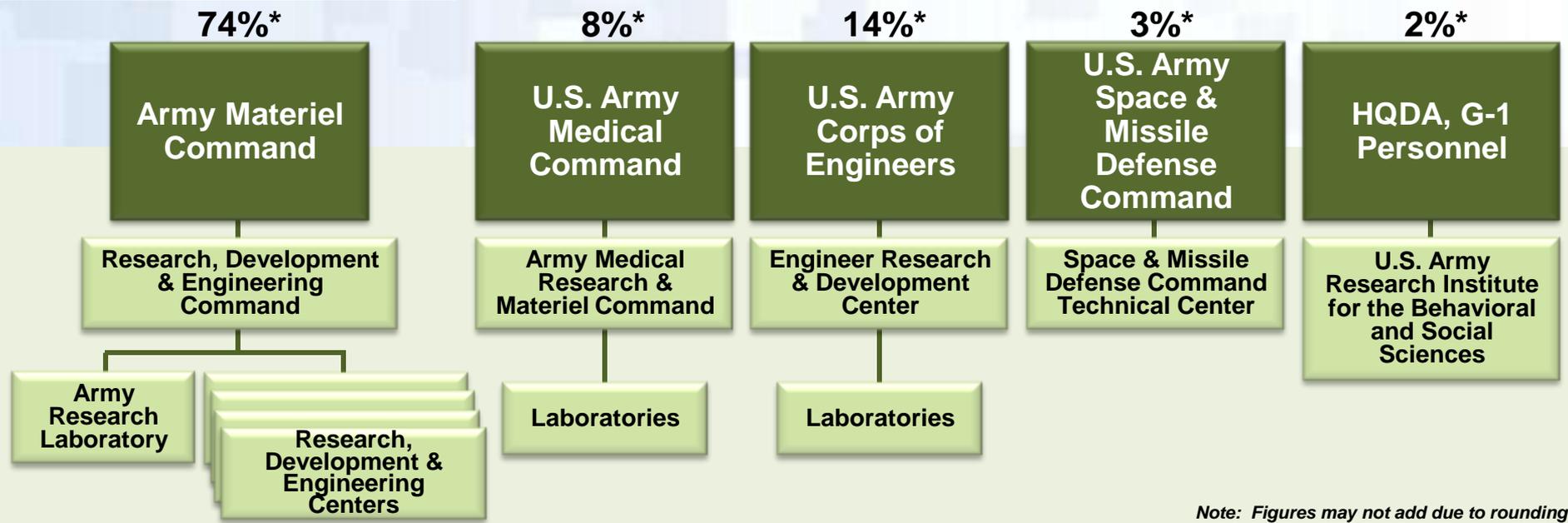




# Army S&T Enterprise



\* Percent of S&T core program executing, PB16



Note: Figures may not add due to rounding





# *Strategy*

***How do we make investment decisions?***





# Army Enduring Challenges

- Greater **force protection (Soldier, vehicle, base)** to ensure survivability across all operations
- Ease **overburdened** Soldiers in Small Units
- Timely **mission command & tactical intelligence** to provide situation awareness and communications in all environments
- Reduce logistic burden of **storing, transporting, distributing** and **retrograde** of materials
- Create **operational overmatch** (enhanced lethality and accuracy)
- Achieve operational **maneuverability** in all environments and at **high operational tempo**
- Enable ability to **operate in CBRNE environment**
- Enable **early detection and improved outcomes for Traumatic Brain Injury (TBI) and Post Traumatic Stress Disorder (PTSD)**
- Improve **operational energy**
- Improve **individual & team training**
- **Reduce lifecycle cost** of future Army capabilities



# How we prepare for an uncertain future...

## Addressing the probable, possible, and unthinkable



- To maintain a leading edge in technology, S&T must continue; once given up, too expensive and too time-consuming to regain lost ground
- Threat assessments primarily address the “probable”
- Preventing tactical, operational, and strategic surprise requires S&T to address the “possible” and the “unthinkable”



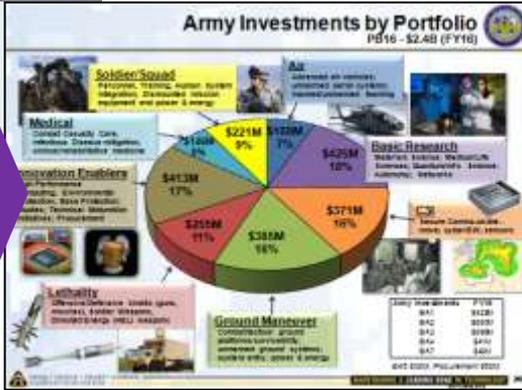
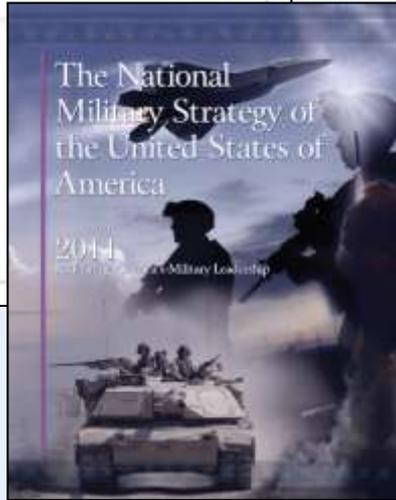
**Army S&T must have a broad investment strategy**





# Sources Informing Capability Investment

National/DoD Priorities



Army Priorities



- Communities of Interest (COI)
- Joint Capabilities Integration and Development System (JCIDS)
- International/Allies

- Army Equipment Modernization Plan & Strategy
- Army Strategic Planning Guidance
- CSA Challenge – Force 2025 and Beyond: Expeditionary; More Lethal; Tailorable; Scalable; Self-Sufficient; Leaner
- TRADOC: Army Warfighting Challenges, CNA, CBA, ICD, CDD, CPD
- Wargaming/Exercises
- Long-range Investment Requirements Analysis (LIRA)



# Technology Wargaming

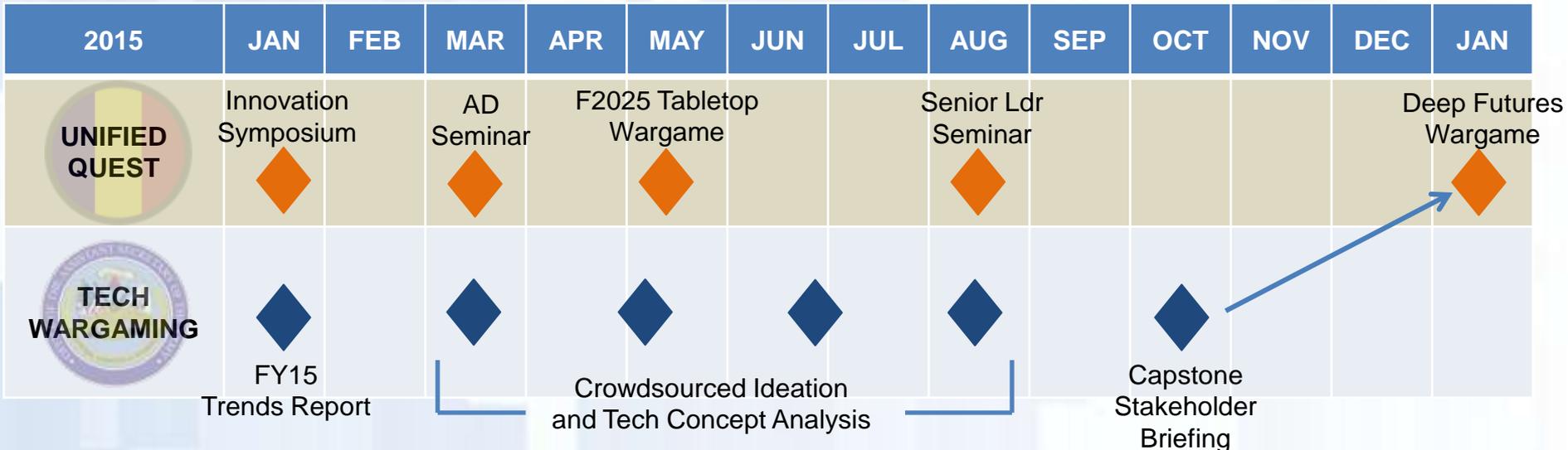
## What is Technology Wargaming?

- Explores the technological context for the future force
- Identifies areas of potential technological surprise
- Examines potential future technological concepts

## What does it entail?

- Horizon scanning and S&T trends analysis
- Crowdsourced ideation/brainstorming to engage non-traditional communities
- Future concept identification and technology assessment

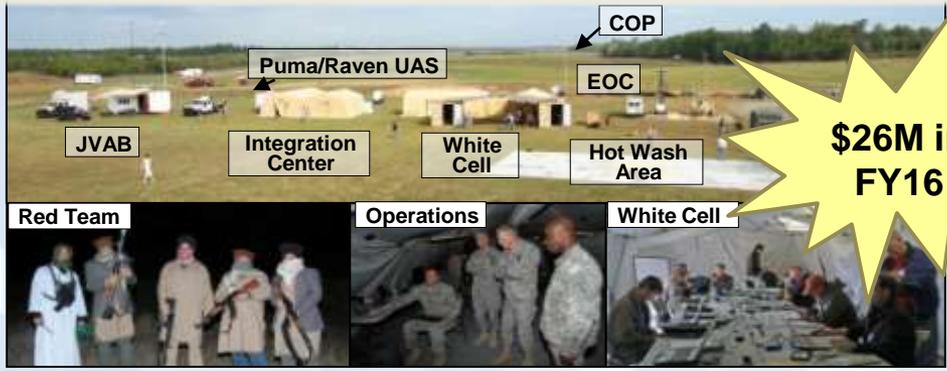
**Outcomes support TRADOC Unified Quest and provide input to S&T POM guidance**





# Army S&T Red Teaming

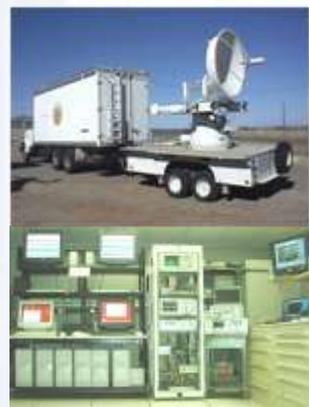
*New theaters present new challenges – future operations with technically savvy opponents requires “red teaming” of technologies and systems to maintain military superiority*



Live Field Experiments

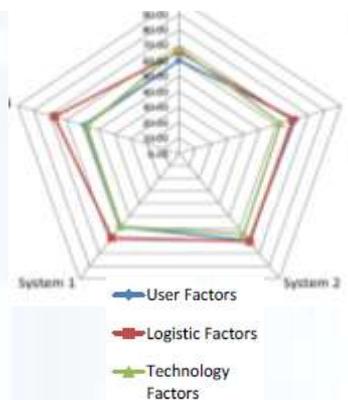
- FY16 Topics**
- Directional Networking/Contested Tactical Communications
  - Assured Positioning, Navigation and Timing
  - Advanced Precision Munitions
  - Platform Sensor Protection from Lasers
  - Electro-Magnetic Armor
  - Future Rotorcraft Blade Control
  - Denial and Deception Technologies
  - Airborne Intelligence, Surveillance and Reconnaissance (ISR)/Precision Geolocation
  - Next Generation Area Denial
  - Unmanned Aerial System (UAS) Threat and Counter-UAS Technologies
  - Autonomous/Semi-Autonomous Ground Vehicle Systems

- Identify and understand potential vulnerabilities *early* in the materiel development lifecycle:
  - Emerging technologies
  - Emerging systems/sub-systems
- Conducts lab, virtual, and live field experiments to stress and assess technology components and integrated systems
- State-of-the-art tools and methodologies to address potential vulnerabilities across a spectrum of threats and environments
- Challenge the conventional approaches to technology insertion – identify risks, reduce vulnerabilities and optimize performance in operations



Threat Emulation

Tradespace Characterization





# *Resources*

*How are we funded?*

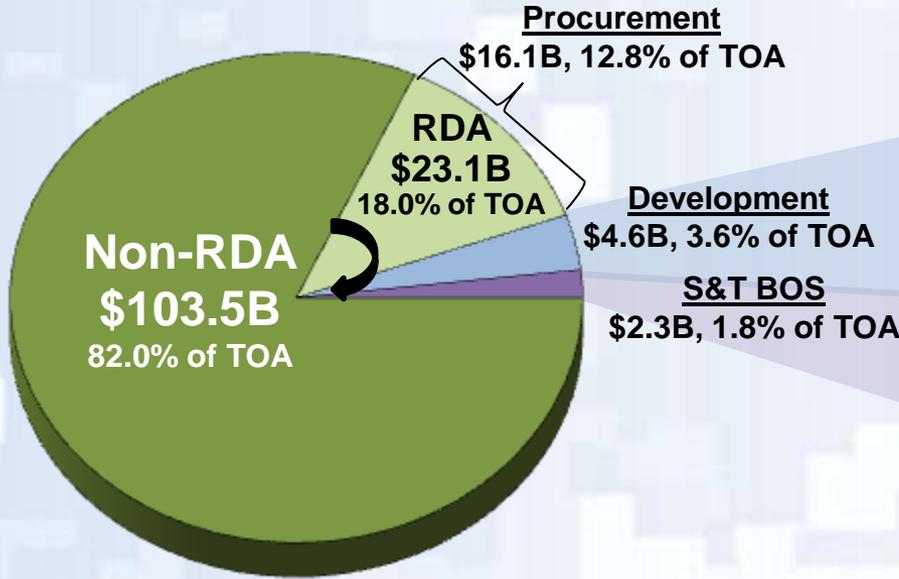




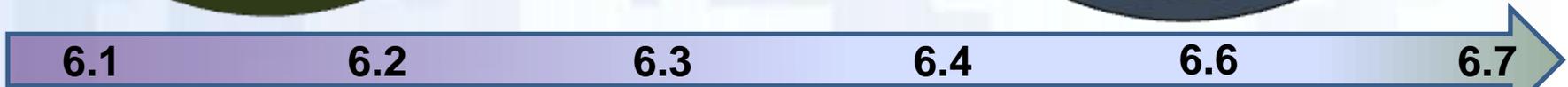
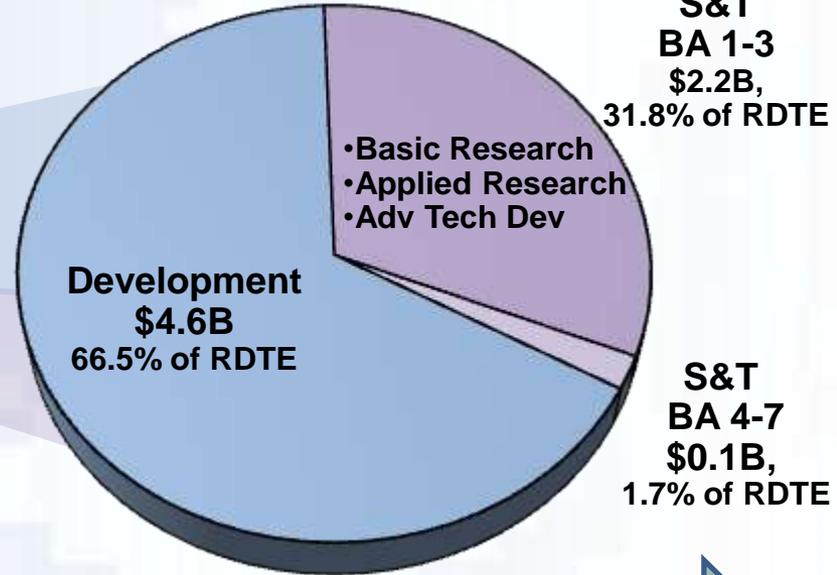
# FY16 Army S&T Funding

As of PB16

**TOA \$126.5B**



**RDTE \$6.9B**



**6.1 Basic Research**

64% Universities/  
Industry  
33% In-House  
3% OGA, Other

Investigation & analysis of basic law of nature, phenomenon to increase scientific knowledge

**6.2 Applied Research**

33% Industry  
53% In-House  
14% OGA, Other

Application of knowledge to develop useful materials, devices and systems or methods

**6.3 Advanced Technology Development**

60% Industry  
28% In-House  
12% OGA, Other

Development of subsystems & components to integrate into system prototypes

**6.4 Adv. Component Development and Prototypes**

90% Industry  
10% In-House

Maturation of systems/sub-systems through competitive prototyping and experimentation

**6.6 RDTE Management Support**

90% Industry  
10% In-House

RDT&E Management Support

**6.7 Operational System Development**

84% Industry  
16% In-House

Manufacturing technologies and pre-planned product improvements

Note: Figures may not add due to rounding



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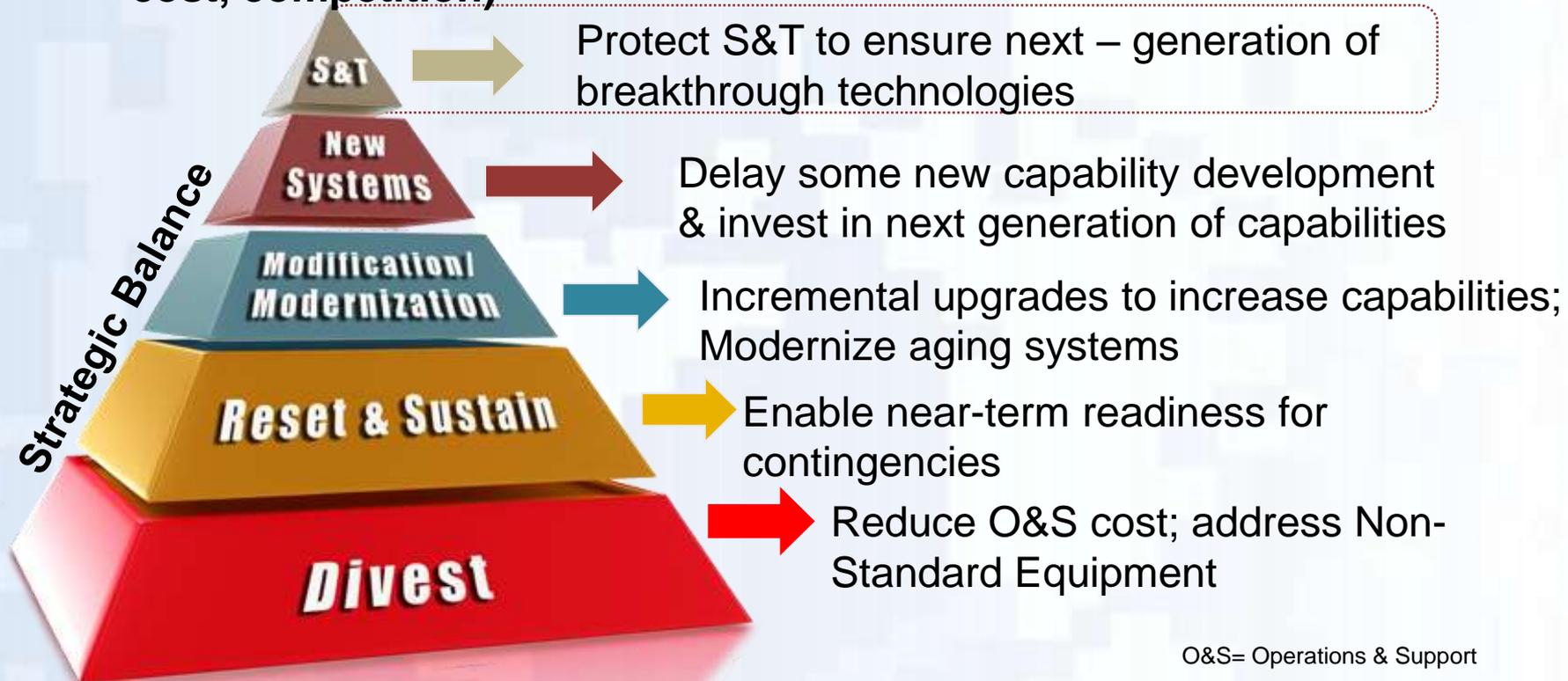
**MAINTAINING A LEADING EDGE IN TECHNOLOGY**

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# Modernization Strategy in a Fiscally Challenged Environment



- Reduce procurement quantities to match force structure reductions
- Gained efficiencies
  - Leveraging multi-year procurement (Black Hawk, Chinook)
  - Incorporate Better Buying Power initiatives (contracting, should-cost, competition)



# S&T Resources Funding Categories, Work Focus, Timeframes



As of PB16

**S&T**  
(RDT&E  
BA 1-3)  
**\$2.2B** (1.7% TOA, 9.5% RDA)



## Development

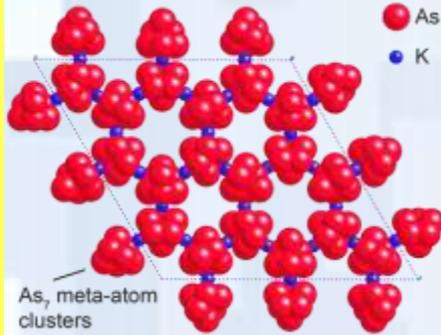
\$4.7B (3.7% TOA, 20.5% RDA)

## Acquisition (Procurement Appropriation)

\$16.1B (12.8% TOA, 70.0% RDA)

**6.1: Basic Research**  
\$425M (19% of S&T)

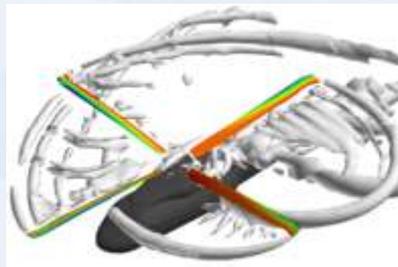
### Material Science



- Understanding to solve Army-unique problems
- Knowledge for an uncertain future

**6.2: Applied Research**  
\$880M (40% of S&T)

### Aeromechanics and Computational Methods



- Applications research for specific military problems
- Components, subsystems, models, new concepts

**6.3: Advanced Technology Development**  
\$896M (41% of S&T)

### Occupant Centric Protection



- Demonstrate technical feasibility at system and subsystem level
- Path for technology spirals to acquisition—rapid insertion of new technology

**6.4: Technology Maturation Initiatives** \$41M

- Funds technology maturation efforts, including competitive prototyping and experimentation in support of selected pre-Milestone B Programs of Record.

**6.6: Technical Information Activities** \$27M

- Advisory Bodies
- Reporting and Info Dissemination
- Studies and Tech Assessment

**6.7: Manufacturing Technology** \$48M

- Address manufacturing issues and facilitate affordable production of weapon systems and materials

**Far Term**

12-20+ yrs

**Mid Term**

6-12 yrs

**Near Term**

0-6 yrs

Note: Figures may not add due to rounding



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# *Technology Portfolios*



# Army Investments by Portfolio

PB16 - \$2.4B (FY16)



## Soldier/Squad

Personnel, Training, Human System Integration, Dismounted mission equipment and power & energy



## Air

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



## Medical

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

## Innovation Enablers

High Performance Computing; Environmental Protection; Base Protection; Studies; Technical Maturation Initiatives; Procurement



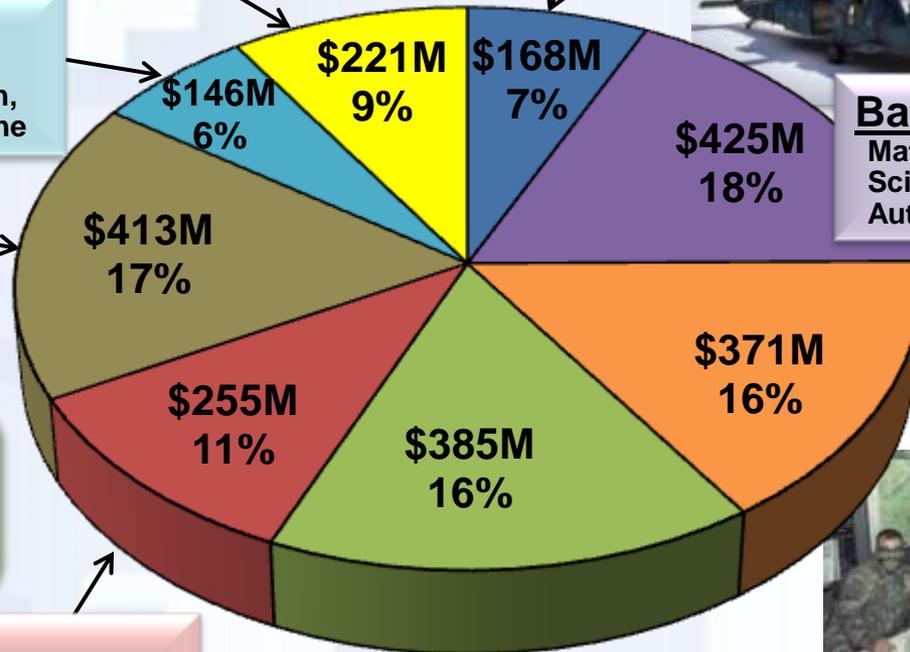
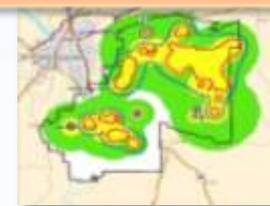
## Basic Research

Materials Science; Medical/Life Sciences; Quantum/Info Science; Autonomy; Networks



## C3I

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



## Lethality

Offensive/Defensive kinetic (guns, missiles), Soldier Weapons, Directed Energy (HEL) weapons



## Ground Maneuver

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

Army Investments	FY16
BA1	\$425M
BA2	\$880M
BA3	\$896M
BA4	\$41M
BA7	\$48M

BA6 \$32M, Procurement \$62M

# Technology Development for Combat Vehicle Prototyping

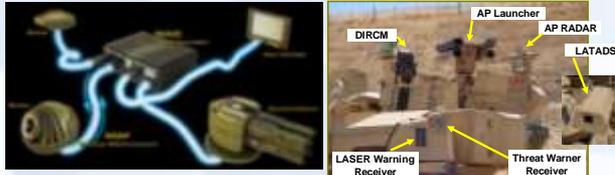


**Purpose:** Enable the next generation combat platforms delivering leap-ahead mobility, survivability and lethality capabilities, and light-weighting approaches. Ensure future acquisition program requirements are informed with what is technically feasible and affordable while driving down future acquisition program technical risk.

## Survivability Technology Demonstrator



## Active Protection System (APS) Prototype



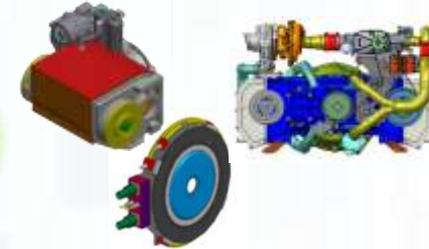
## Modular APS Framework Modular APS Controller



## Vehicle Power & Data Architecture Technology Demonstrator



## Automotive Sub-system Prototypes



## Turret & Weapon Sub-system Prototype



## 50mm Main Armament



**Products:** Major efforts include: Advanced System Concepting; Automotive Subsystem Prototypes (Powertrain, Track & Suspension); Survivability Technology Demonstrators (Armor, Structure, Blast Protection, Modular Active Protection System) ; 50mm Medium Caliber Weapon System Prototype & Ammunition; Vehicle Power & Data Architecture Technology Demonstrator; and Hostile Fire Detection (HFD) Systems



# Optimize Human and Team Performance

**Purpose:** Provide scientific data to enhance recruitment, MOS assignment, and training to ensure the right Soldier is in the right job and has the right skills and competencies; develop personalized training to accelerate Warfighter proficiency

*Develop Advanced Cognitive, Physical, and Social Assessments to Optimize Human Performance throughout the Soldier's Lifecycle*



**Identify/  
Recruit**



**Train/  
Develop**



**Employ/  
Equip**



**Retain/Sustain  
Health**



**Transition/  
Reset**

**Product:** Multiple research studies, which inform senior Army leadership of innovative solutions, that can be adopted throughout Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities and Policies (DOTMLPF-P); new assessment tools for Commanders and Soldiers to enhance and maintain readiness and performance; and human performance-based engineering guidelines for development of next generation equipment

***“The U.S. Army’s differential advantage derives, in part, from the integration of advanced technologies with skilled Soldiers and well-trained teams” - AOC***

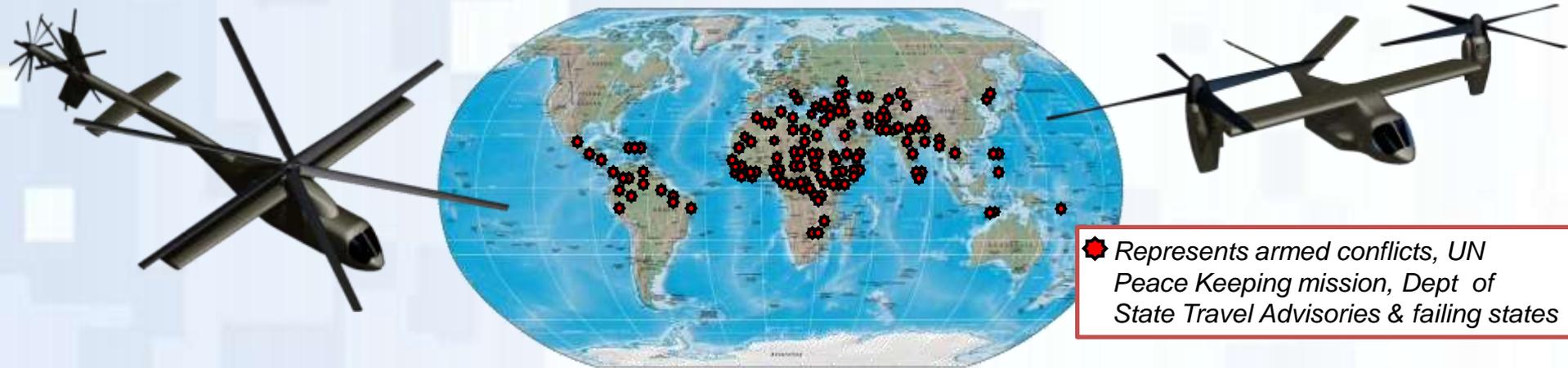


# Joint Multi-Role Technology Demonstrator (JMR TD)



**Purpose:** Demonstrate transformational vertical lift capabilities to prepare the DoD for decisions regarding the replacement of the current vertical lift fleet

## Capability to Perform Worldwide Operations



**For the entire year, considering 24-hour cycles:**

**4K/95 °F – CANNOT conduct 24-hour ops for 66 days per year due to environmental limitations**

**6K/95 °F - only limited by environment 5 days per year**

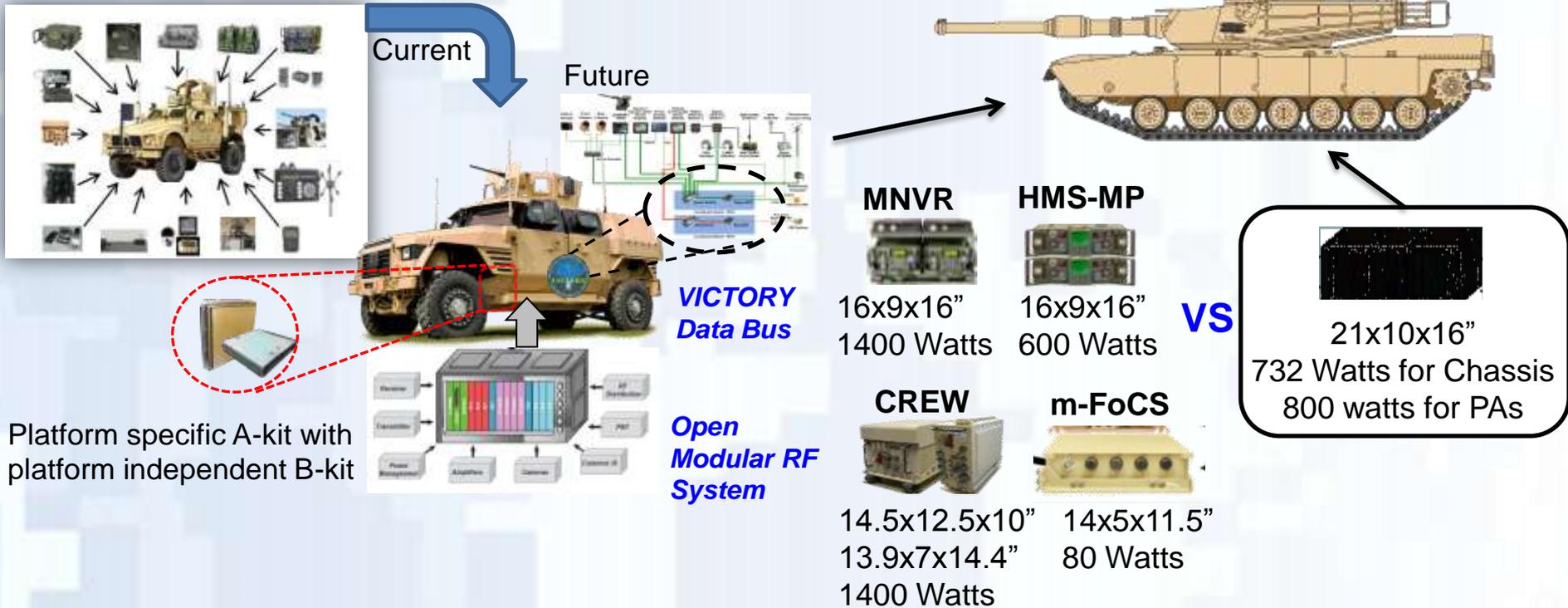
**Product:** Two (2) demonstrator aircraft showcasing affordable capabilities that enable higher speed, better lift efficiency, lower drag (L/De), and improved Hover Out of Ground Effect (HOGE) at high/hot conditions (6K/95). Flight and mission systems architecture demonstrations occur from FY17 through FY19.





# Intelligence/Electronic Warfare

**Purpose:** Develop and implement standards that enable collapsing of multiple Command Control Communications Computer Intelligence Surveillance and Reconnaissance (C4ISR) / Electronic Warfare (EW) functions into a common chassis.



**Product:** Electronics chassis, backplane, mounting, RF, control and topology specifications (A-Kit); Adaptable B-Kit to demonstrate mission configuration agility for C4ISR/EW; Modular RF architecture; and National Security Agency (NSA) certifiable embedded security.



# High Energy Laser Mobile Demonstrator (HEL MD)

**Purpose:** Demonstrate a mobile HEL system that defeats rockets, artillery and mortar (RAM), Unmanned Aerial Systems (UAS) and intelligence, surveillance and reconnaissance (ISR) threats at tactical ranges



*High Energy Laser Mobile Demonstrator Platform*



*10kW HEL Demonstration: Defeated UAS and Light Mortar in Flight*

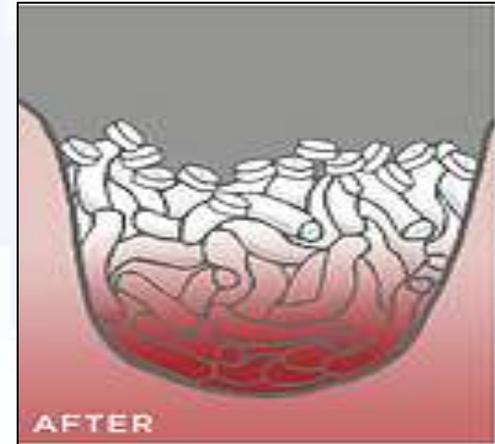
**Product:** Integrated 10kW commercial-off-the-shelf laser for system checkout; ruggedized 50kW laser for demonstration in FY17; ruggedized 100kW laser for demonstration in FY20; and an advanced beam control system and adaptive optics by FY22. All subsystems will be integrated on a single mobile tactical platform with the final demonstration in FY22. This effort leverages the High Energy Laser Joint Technology Office investments in solid state laser development and advanced beam control systems.



# Combat Casualty Care



**Purpose:** Mature and demonstrate new technologies (concepts, techniques, and materiel) to provide improved clinical care to casualties in far forward areas and during transport to higher echelons of care, thereby saving lives



**XSTAT™ (FDA Approval: Apr 2014)**

*A first-in-kind hemostatic device for the treatment of gunshot wounds on the battlefield*

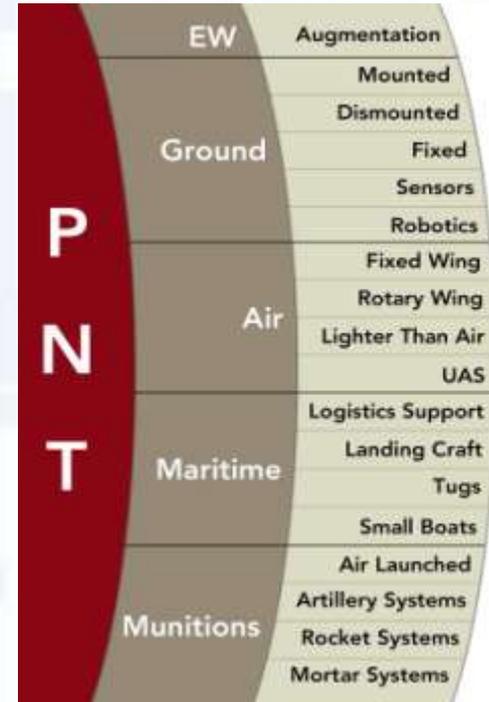
**Products:** Point of injury or tactical care; including life-saving tourniquets and hemostatic dressings to control bleeding; medical evacuation (MEDEVAC) or patient transport improvements; advances in blood components to prevent bleeding and restore circulation; early intervention for blunt force head trauma; ongoing studies in conjunction with US trauma centers; less invasive, endovascular technologies to treat vascular trauma and shock; temporary vascular shunts to save mangled extremities





# Assured Position, Navigation and Timing (PNT)

**Purpose:** Develop technologies that provide dismounted and mounted soldiers the capability to obtain trusted PNT information while operating in conditions that impede or deny access to GPS



## **Products:**

**Pseudolites**- Augmentation of military GPS signals in through a terrestrial/aerial based transmission enabling satellite signal acquisition/tracking, navigation & timing in degraded/denied environments

**Mounted PNT**- robust integrated multi-sensor

system for vehicular applications, supporting all PNT needs and maintaining PNT assurance during operations in GPS denied environments

**Dismounted PNT** – low-SWAP multi-sensor PNT system, maintaining PNT assurance for the Soldier

**Anti-Jam Antennas** - Enables GPS signal acquisition and tracking in challenged environments





# Materials by Design

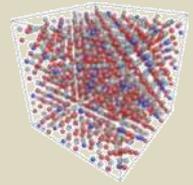
**Goal of Transformational Material Science:** Enable a fundamental change in the way we develop new materials for Army applications through the exploitation of relevant material scales

**Multidisciplinary Physics**  
**Material Science**  
**Electrodynamics**  
**Chemistry**

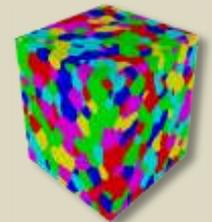
Micro Scale  
Single Crystals



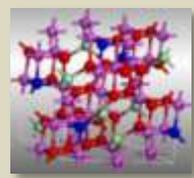
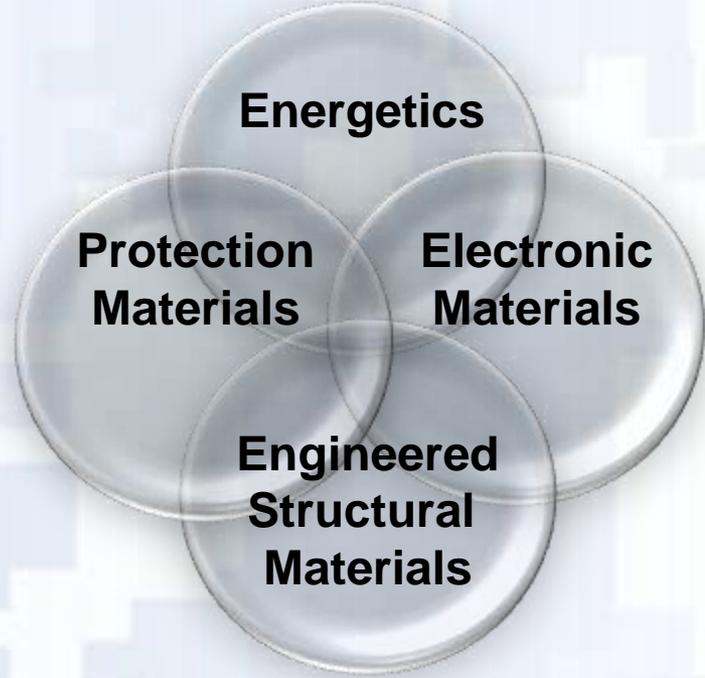
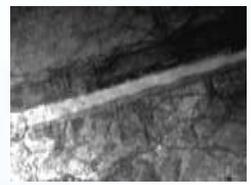
Energetic Material



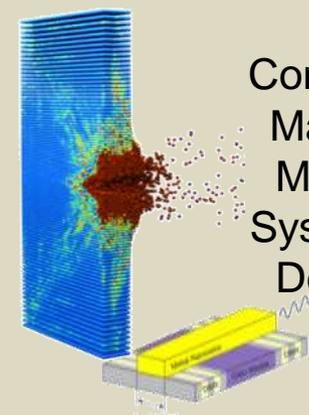
Molecular Scale  
Assemblies of Molecules



Meso Scale  
Polycrystal



Atomic Scale  
Atoms/Molecules



Continuum  
Material,  
Material  
Systems &  
Devices

# Manufacturing Technology Initiatives

FY16 Total \$48M



As of PB16

## Ground Maneuver (\$15.2M)

- Affordable Protection from Objective Threats
- Automated Armor Manufacturing
- Efficient Power Take-off
- Fuel Cell Hybrid Systems
- Advanced Missile & Munitions Components
- Wide-Band GaN MMIC Producibility
- 7.62mm Advanced AP Penetrator & Assembly Cost Reduction
- Integrated Magnesium Manufacturing Technology for Lightweight Structures
- Ground Vehicle Coating System (GVCS)
- High Energy Safe 5V Li-Ion Battery
- Weight Sensitive Armor Protection (WSAP)
- Light-Weight Metal Matrix Composites (MMCs)



## Soldier/Squad (\$2.6M)

- PE Films
- Pop-Up BioInsulation



## Lethality (\$1.3M)

- Loading of ALIMX-101 in 500lb Bombs
- Complex Missile Seekers
- MEMS Safe and Arm



## C3I Systems (\$8.2M)

- PMOS Pixel Process
- Flexible Electronics for Large Area Sensors
- Short Wave Infrared (SWIR) Imagers
- 12um Pixel High Definition Uncooled LWIR
- Large Format III-V Long-Wave & Dual-Band Infrared Focal Plane Arrays (IRFPA)
- Macrocell Receiver Conversion for mmW



## Air Systems (\$5.4M)

- Ballistically-Tolerant Aviation Fuel Bladders
- Direct Digital Mfg for Helicopter Engines & other DoD Warfighter Platforms
- AH-64 Composite Sump



## Innovation Enablers (\$15.7M)

- Accelerated Adaptive Fabrication Enterprise
- Additive Mfg to Restore/Reclaim/Reutilize High Value Aviation Assets
- Additive Mfg Energetics and Electronics
- Additive Mfg for New Build, Remanufactured and Life Extension of Critical Weapon Systems Components



# Manufacturing Institutes



- **Digital Manufacturing and Design Innovation Institute (DMDII)**



- Established in 2014 as a proving ground for cutting-edge digital manufacturing technologies (<http://dmdii.uilabs.org>)
- DMDII will award its first applied research contracts (\$17M+), to more than 40 large and small companies, academic institutions and other organizations

- **Integrated Photonics Institute for Manufacturing and Innovation (IP-IMI)**



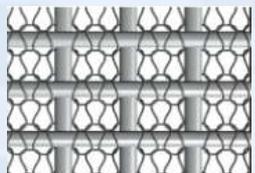
- IP-IMI establishes state-of-the-art design and manufacturing of complex photonic integrated circuits (currently in source selection)

- **Flexible Hybrid Electronics Manufacturing Innovation Institute (FHE-MII)**



- FHE-MII advances state-of-the-art hybrid electronics on non-traditional malleable substrates (currently in source selection)

- **Modern Fibers and Textiles Institute (MFTI)**



- MFTI revolutionizes fibers and textiles manufacturing through researching and prototyping fibers with novel properties (announced March 18, 2015)



# Defense Innovation Marketplace

([www.DefenseInnovationMarketplace.mil](http://www.DefenseInnovationMarketplace.mil))



The screenshot shows the homepage of the Defense Innovation Marketplace. At the top, the title "DEFENSE INNOVATION MARKETPLACE" is displayed in white on a dark blue background. Below the title is a row of logos for various DoD agencies, including DARPA, and the text "And Other DoD Agencies". A navigation bar contains links for HOME, RESOURCES, FAQs, NEWS & EVENTS, ABOUT, and CONTACT US, along with a search bar. The main content area is titled "CONNECTING INDUSTRY & DoD" and describes the marketplace as a centralized resource for market research. It includes sections for "For Industry" and "For Government" with links to search tools. A "Featured Item" section highlights the "ARL Technical Implementation Plan 2015-19". On the right side, there are several vertical panels: "OSD INITIATIVES" with buttons for "Long-Range R&D Program Plan", "Better Buying Power 3.0", and "Dynamic Spectrum Industry Day"; "VIRTUAL TECHNOLOGY INTERCHANGES" with buttons for "Air Force Technology Focus Areas" and "Weapons Tech COI and IR&D Interchange"; "INNOVATION OPPORTUNITIES" with buttons for "Resources for Industry", "Submit IR&D Data", and "Resources for DoD"; and "FEEDBACK" with a button for "What did you Miss?". At the bottom right of the main content area, it says "Updated 3/3/15".

## CONNECTING INDUSTRY & DoD

The Defense Innovation Marketplace is a centralized resource for market research:

**For Industry**, to learn about Department of Defense (DoD) S&T/R&D investment priorities, capability needs and technology interchanges.

**For Government** to [access search tools](#) to assess and then leverage industry IR&D projects for current and future programs.

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## NEW IN THE MARKETPLACE

### Strategic Documents

- Army Operating Concept 2020-2040 **\*\*NEW\*\***
- Army Human Dimension Concept
- The Naval S&T Strategy RIF Overview Briefing
- Army Installation Energy and Environment 2025 Strategy
- Defense Innovation Initiative
- US Army S&T Campaign Plan 2015-2035

[More...](#)

### Doing Business with DoD

- MDA Advanced Technology Initiative BAA **\*\*NEW\*\***
- AF Modernization of Navy-Grade Alloy Steel Plate Presolicitation FOA **\*\*NEW\*\***
- Army Multi-modal Signal and Fusion Processor RFI **\*\*NEW\*\***
- Navy Vaccine Development BAA **\*\*NEW\*\***
- DARPA Young Faculty Award Research Announcement
- DARPA Future Arctic Sensing Technologies BAA

[More...](#)

### News & Events

- 30th Annual National Test & Evaluation Conference **\*\*Mar 3\*\***
- Army FASCAM Industry Day **\*\*Mar 5\*\***
- Women In Defense National Conference **\*\*Mar 11\*\***
- USD AT&L's Testimony to the HASC

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### Featured Item



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