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
Outline

• Principles and Vision
• Science and Technology Enterprise
• Strategy
• Resources
• Technology Portfolios
Principles and Vision
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
- High Speed Container Delivery System
- Video from Unmanned Aerial Systems

**Future Force**

- Enabling the Future Force
  - Cyber tools
  - Next Generation Rotorcraft
  - Neuroscience
  - High Energy Lasers
  - Occupant Centric Platform

**Enhancing the Current Force**

- Red Team
- Unmanned Aerial Systems
Roles for S&T

- 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
Science and Technology Enterprise

Who are we and how are we organized?
Army S&T Enterprise

Secretary of the Army
Honorable John M. McHugh

Under Secretary of the Army
Honorable Brad R. Carson

Assistant to the Secretary of the Army for Acquisition, Logistics, and Technology
Honorable Heidi Shyu

Deputy Assistant Secretary of the Army (Research & Technology)
Ms. Mary J. Miller

* Percent of S&T core program executing, PB16

74%*
Army Materiel Command
- Research, Development & Engineering Command
  - Army Research Laboratory
  - Research, Development & Engineering Centers

8%*
U.S. Army Medical Command
- Army Medical Research & Materiel Command
  - Laboratories

14%*
U.S. Army Corps of Engineers
- Engineer Research & Development Center
  - Laboratories

3%*
U.S. Army Space & Missile Defense Command
- Space & Missile Defense Command Technical Center

2%*
HQDA, G-1 Personnel
- U.S. Army Research Institute for the Behavioral and Social Sciences

Note: Figures may not add up due to rounding.
Army S&T Enterprise—Research, Development & Engineering Centers & Labs

- U.S. Army Materiel Command
- U.S. Army Medical Command
- U.S. Army Corps of Engineers
- U.S. Army Space and Missile Defense Command
- Headquarters, Department of the Army, G-1

Total Civilian Manpower: ~17,000
- ~12,000 Scientists & Engineers
- ~5,000 Technicians, Analysts, and Administrative support
- ~500 Military S&E
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

- Communities of Interest (COI)
- Joint Capabilities Integration and Development System (JCIDS)
- International/Allies
- National/DoD Priorities
- Army Priorities
- International/Industry/Academia
- Threat
- NGIC/Intel Community
- 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

<table>
<thead>
<tr>
<th>2015</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>JAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIFIED QUEST</td>
<td>Innovation Symposium</td>
<td>AD Seminar</td>
<td>F2025 Tabletop Wargame</td>
<td>Senior Ldr Seminar</td>
<td>Deep Futures Wargame</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECH WARGAMING</td>
<td>FY15 Trends Report</td>
<td>Crowdsourced Ideation and Tech Concept Analysis</td>
<td>Capstone Stakeholder Briefing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FY15 Trends Report
Crowdsourced Ideation and Tech Concept Analysis
Capstone Stakeholder Briefing
Deep Futures Wargame
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

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

$26M in FY16

- 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

Live Field Experiments

Threat Emulation

Tradespace Characterization

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

How are we funded?
FY16 Army S&T Funding

TOA $126.5B

Non-RDA $103.5B
- 82.0% of TOA

RDA $23.1B
- 18.0% of TOA

Procurement
- $16.1B, 12.8% of TOA

Development
- $4.6B, 3.6% of TOA

S&T BOS
- $2.3B, 1.8% of TOA

RDTE $6.9B

- Basic Research
- Applied Research
- Adv Tech Dev

Development
- $4.6B, 66.5% of RDTE

S&T BA 1-3
- $2.2B, 31.8% of RDTE

S&T BA 4-7
- $0.1B, 1.7% of RDTE

Note: Figures may not add due to rounding

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
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)

- Delay some new capability development & invest in next generation of capabilities
- Incremental upgrades to increase capabilities; Modernize aging systems
- Enable near-term readiness for contingencies
- Reduce O&S cost; address Non-Standard Equipment

O&S= Operations & Support
S&T Resources
Funding Categories, Work Focus, Timeframes

**S&T Resources**

<table>
<thead>
<tr>
<th>S&amp;T (RDT&amp;E BA 1-3)</th>
<th>Development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$4.7B (3.7% TOA, 20.5% RDA)</td>
</tr>
<tr>
<td>$2.2B (1.7% TOA, 9.5% RDA)</td>
<td></td>
</tr>
</tbody>
</table>

**6.1: Basic Research**
$425M (19% of S&T)
- Understanding to solve Army-unique problems
- Knowledge for an uncertain future

**6.2: Applied Research**
$880M (40% of S&T)
- Applications research for specific military problems
- Components, subsystems, models, new concepts

**6.3: Advanced Technology Development**
$896M (41% of S&T)
- Demonstrate technical feasibility at system and subsystem level
- Path for technology spirals to acquisition—rapid insertion of new technology

**Acquisition (Procurement Appropriation)**
$16.1B (12.8% TOA, 70.0% RDA)

**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.

**6.5: Technical Information Activities** $27M
- Advisory Bodies
- Reporting and Info Dissemination
- Studies and Tech Assessment

**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
Technology Portfolios
Army Investments by Portfolio

PB16 - $2.4B (FY16)

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

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

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

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

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

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

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

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.

**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.

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
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.

[Diagram showing worldwide operations and environmental limitations]

- Represents armed conflicts, UN Peace Keeping mission, Dept of State Travel Advisories & failing states
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.

**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.

**10kW HEL Demonstration:** Defeated UAS and Light Mortar in Flight.
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.
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.
### Manufacturing Technology Initiatives

#### FY16 Total $48M

<table>
<thead>
<tr>
<th>Initiative</th>
<th>Funding (M)</th>
<th>Description</th>
</tr>
</thead>
</table>
| **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) |
| **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 |
| **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 |
| **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 |

As of PB16
• 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
Questions?