



U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT, & ENGINEERING CENTER (ARDEC)



ARDEC Armaments & Munitions Technology Thrusts

Ms. Barbara Machak
Director, Enterprise Systems Integrations Center
12 November 2013



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

MISSION

Empower, unburden and protect the Warfighter by providing superior armaments solutions that dominate the battlefield.

VISION

Innovative Armaments Solutions for Today and Tomorrow



RDECOM Organization



GEN Dennis L. Via
CG AMC



Ms. Heidi Shyu
ASA(ALT) & AAE



Mr. Dale A. Ormond
Director RDECOM



CSM Lebert Beharie
CSM RDECOM



Mr. Jyuji Hewitt
Deputy Director RDECOM



BG Daniel P. Hughes
DCG RDECOM

RFEC
Atlantic

RFEC
Pacific

RFEC
Americas



AMRDEC
Aviation & Missile
Research, Development
& Engineering Center



ARDEC
Armaments Research,
Development &
Engineering Center



ARL
Army Research
Laboratory



CERDEC
Communication-
Electronics Research,
Development &
Engineering Center



ECBC
Edgewood Chemical
Biological Center



NSRDEC
Natick Soldier
Research,
Development &
Engineering Center



TARDEC
Tank and Automotive
Research,
Development &
Engineering Center

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Strategic Partners



Assigned/Direct Support ———
Coordination - - - - -

Headquarters, Department of the Army



Army Materiel Command, AMC

Gen. Dennis L. Via ★★★★★



Assistant Secretary of the Army Acquisition, Logistics and Technology

Ms. Heidi Shyu



Joint Munitions & Lethality LCMC

BG Kristin K. French ★



TACOM LCMC

MG Michael J. Terry ★★



Research, Development and Engineering Command, RDECOM

Mr. Dale Ormond



PEO Ammunition

BG John J. McGuiness ★



Armament Research, Development and Engineering Center, ARDEC

Dr. Gerardo J. Melendez



- Program Executive Office Combat Support and Combat Service Support
- Program Executive Office Ground Combat Systems
- Program Executive Office Soldier

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.



Engineering Lifecycle



RESEARCH



DEVELOPMENT



PRODUCTION



FIELD SUPPORT



DEMILITARIZATION

Advanced Weapons:

Line of sight/beyond line of sight fire; non line of sight fire; scalable effects; non-lethal; directed energy; autonomous weapons

Ammunition:

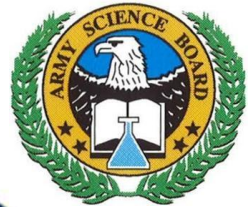
Small, medium, large caliber; propellants; explosives; pyrotechnics; warheads; insensitive munitions; logistics; packaging; fuzes; environmental technologies and explosive ordnance disposal

Fire Control:

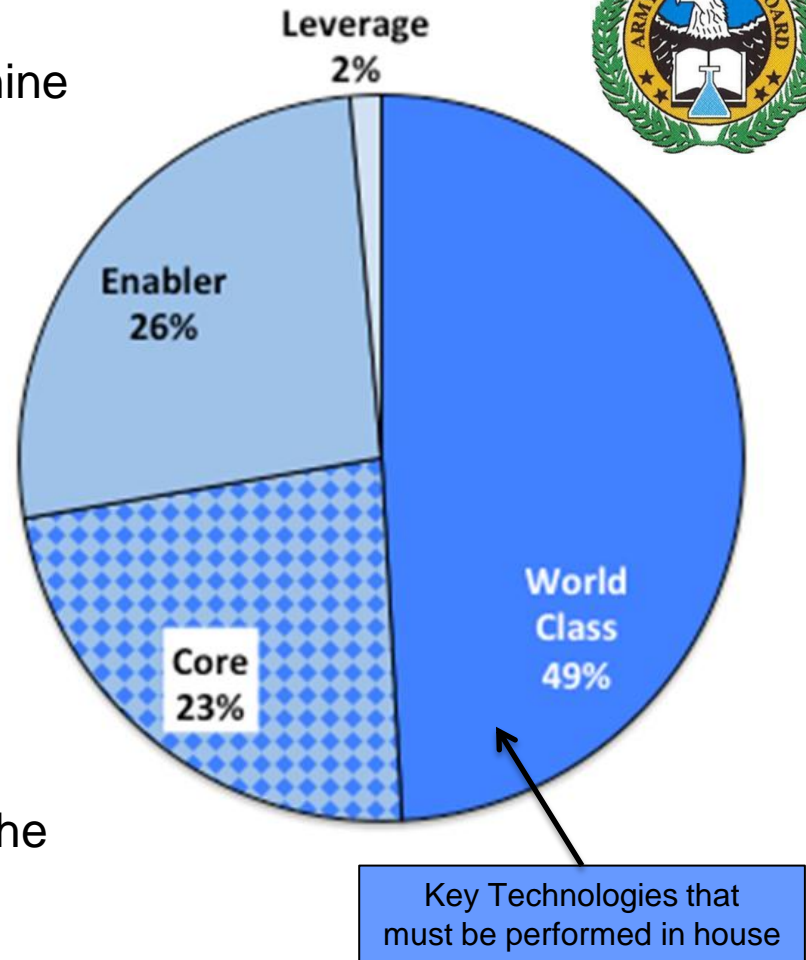
Battlefield digitization; embedded system software; aero ballistics and telemetry

ARDEC provides the technology for over 90% of the Army's lethality and a significant amount of support for other services' lethality

Army Science Board Budget Analysis on Lethality



- Army Science Board conducted analysis on nine Army core competencies
 - Lethality
 - Missiles & Air Defense
 - Survivability & Protection
 - Rotorcraft
 - Sustainment
 - Ground Vehicles
 - C4ISR
 - Autonomous Systems
 - Soldier
- Lethality was assessed at 49% as “World Class”, the highest for all nine competencies
- 98% of the lethality work must be funded by the Army



Lethality core competency is mostly unique to the military and does not have a large commercial investment for leverage



ARDEC Core Competencies

Weapon Systems & Technologies

- Integrated Weapon Systems
- Gun / Cannon Tubes & Mounts
- Non-Lethal Weapons & Target Effects
- Remote Weapon Stations/Weapon Pods
- Ammo autoloaders and magazines
- Weapons Manufacturing Technology
- Weapon Evaluation
- Cannon Fatigue Life Testing & Certification
- Directed Energy Weapon Systems
- Weapon Material Applications

Munition Systems & Technologies

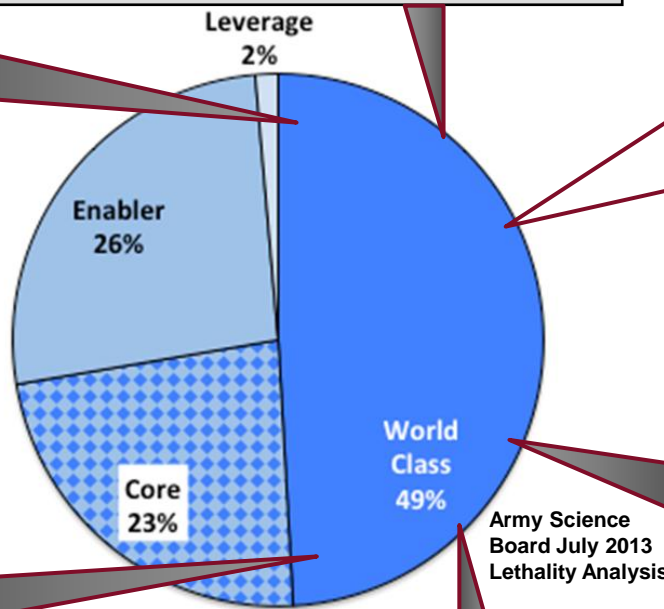
- Gun Launched Munition Systems
- Non-Lethal and Scalable Munitions
- Maneuver Support Munitions
- Grenades & Demolitions
- Countermeasure Flares / Decoys
- Smoke Munitions/ Grenades Signal Flares
- Guidance, Navigation, and Control
- Propulsion Systems
- Aeroballistics
- Fuzing System
- Telemetry
- Power Systems
- Producibility & Manufacturing Sciences
- Explosive Ordnance Devices
- Munition Evaluation
- Vulnerability Analysis & Assessment
- Interior/Terminal Ballistics

Logistics

- Ammunition Unique Packaging, Handling, Storage and Transportation
- Asset Visibility & Distribution Management
- Sets, Kits, Outfits & Tools
- Logistic Engineering & New Equipment Training

Fire Control Systems

- Embedded/Real-Time Software
- Fire / Weapon Control Hardware
- Fire / Weapon Control Hardware Integration
- Fire Control Components
- Ballistic Data & Products
- Prognostic / Diagnostics
- TMDE & Automated Test Sets
- Networked Lethality
- Weapon System Information Assurance
- Emergency Management & Anti-Terrorism Systems
- Embedded Training for Ground and Soldier Platforms



Energetics, Warheads & Materials

- Propellants
- Explosives
- Pyrotechnics
- Advanced Materials / Nanotechnologies
- Environmental Technologies
- Stockpile Reliability
- Warheads / Lethal Mechanisms
- Anti-Tamper Devices
- Integrated Explosive Detection Systems
- Demil Technologies

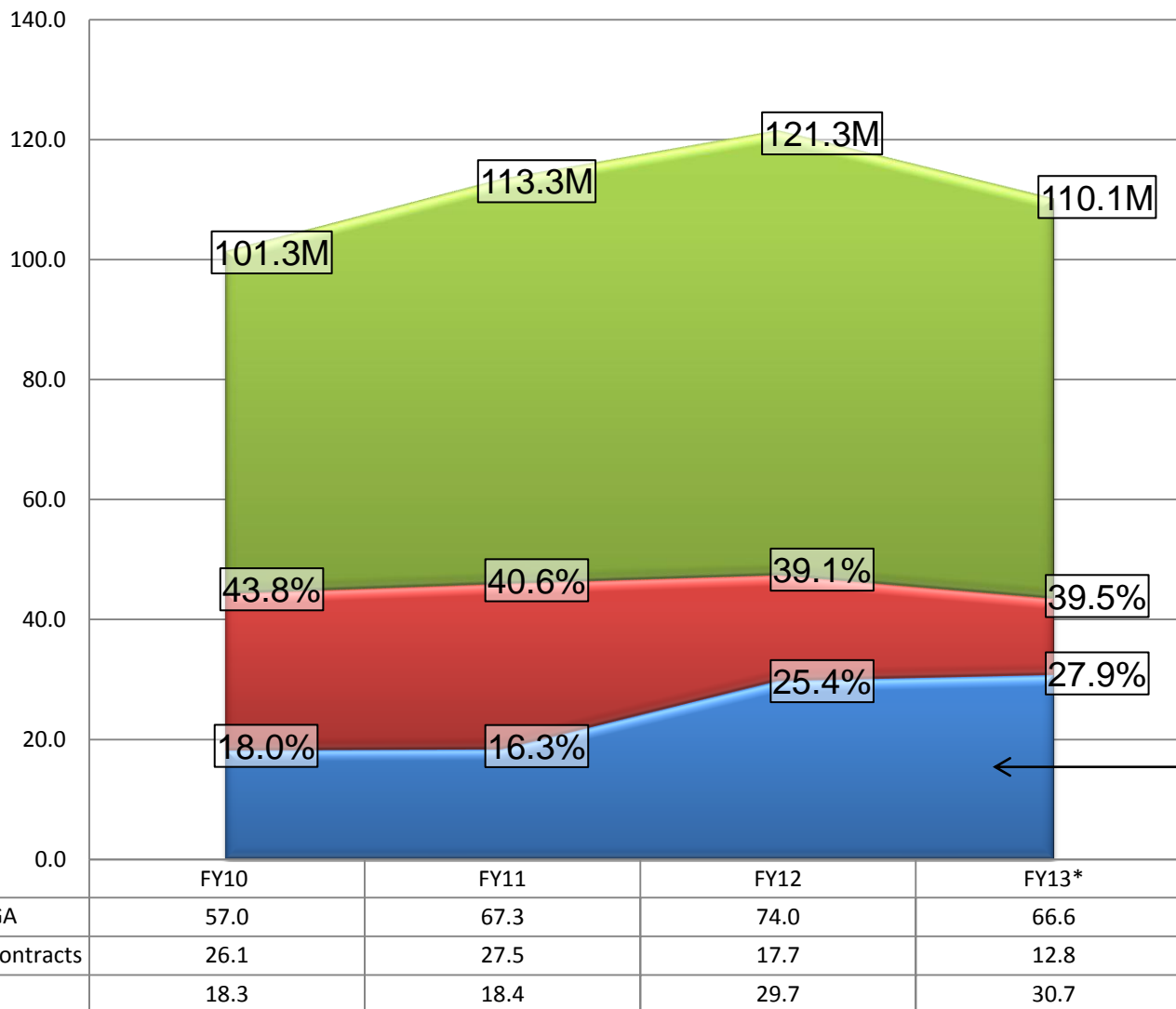
Enterprise Engineering & Business

- Systems Engineering & Analysis
- Software Engineering
- Prototyping
- Quality, Reliability & System Safety Engineering
- Product and Technical Data Management
- Modeling & Simulation of Armaments
- Acquisition Support
- Industrial Base Analysis/Obsolescence Mgmt
- Business Process Management (CMMI, ISO, Lean Six-Sigma, Enterprise Resource Planning, Financial Management)



Science & Technology Funding Trends

ARDEC Core S&T Budget (BA 6.2, 6.3 and 6.7; \$M)



Jul 13 Small Arms & Accessories added as a Technology Objective

* Estimate

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.



Army Enduring Challenges

- Greater **force protection (Soldier, vehicle, base)** to ensure survivability across all operations (16.8% of ARDEC Portfolio)
- Ease **overburdened** Soldiers in Small Units (4.0%)
- Timely **mission command & tactical intelligence** to provide situation awareness and communications in all environments (0.5%)
- Reduce logistic burden of **storing, transporting, distributing** and **retrograde** of materials (2.4%)
- Create **operational overmatch** (enhanced lethality and accuracy) (69.6%)
- Achieve operational **maneuverability** in all environments and at **high operational tempo** (2.5%)
- Enable ability to **operate in CBNRE environment** (0.8%)
- Enable **early detection and improved outcomes for Traumatic Brain Injury (TBI) & Post Traumatic Stress Disorder (PTSD)** (0.0%)
- Improve **operational energy** (0.0%)
- Improve **individual & team training** (0.0%)
- **Reduce lifecycle cost** of future Army capabilities (A metric for all efforts!)

ARDEC Portfolio is Aligned to Army Enduring Challenges!





ARDEC S&T User Gaps



- 120mm Mortars **extended range** and **increased precision**.
- **Extended range** w/ conventional munitions and guided munitions
- Increased **precision** in **GPS denied** environments
- Munitions against **advanced armors** and **hardened above/below ground targets**
- **Tailorable effects** that match munitions to targets (to include scalable lethal to non-lethal)
- Cluster munitions replacement for area fires or imprecisely located targets
- **Remote** and autonomous delivery of **fires** for increased survivability

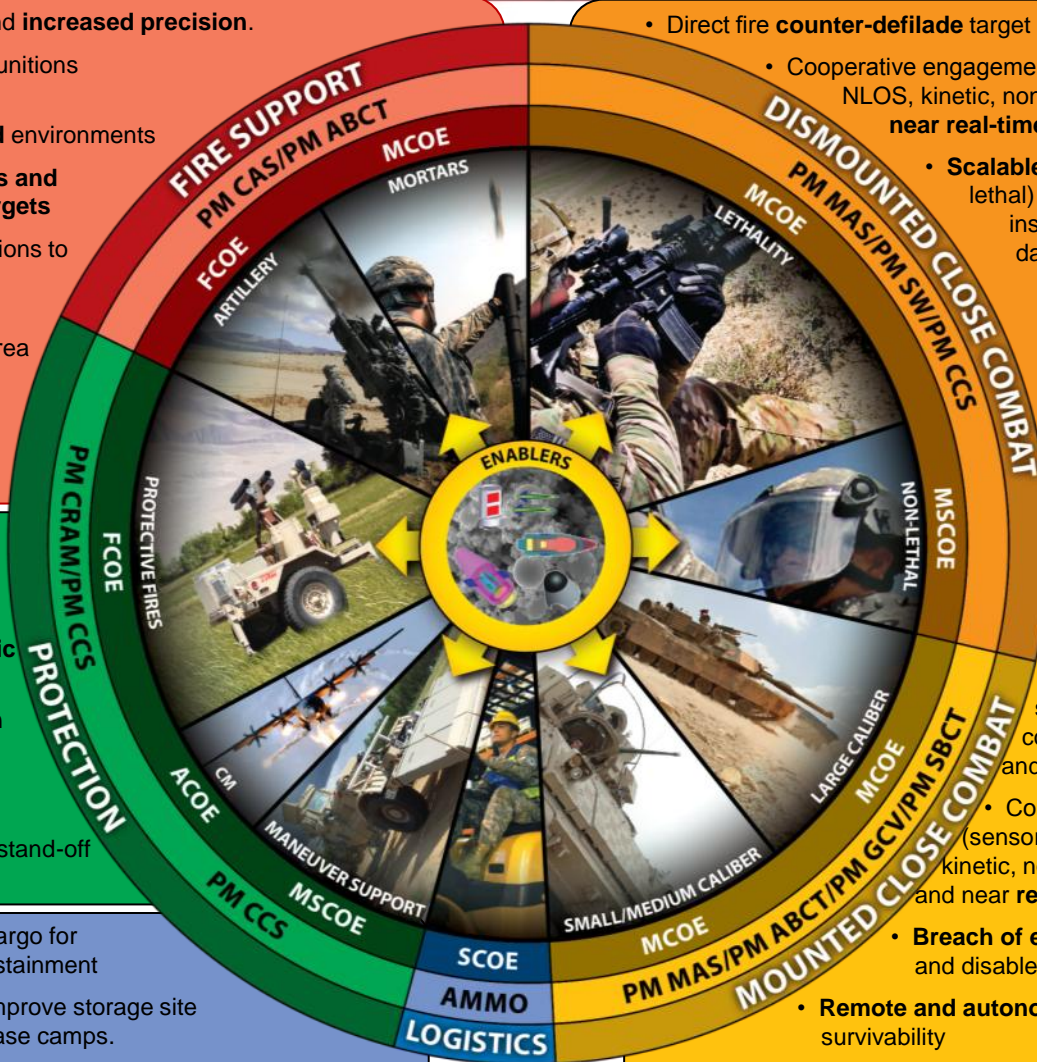
- **CUAS** at close range
- **CRAM** for base protection and armored vehicles on the move
- Detect and **counter electromagnetic or directed energy** attacks
- **Explosive detection/neutralization** above/below ground, at standoff distances, and convoy speeds
- **Breach of entry points** into urban infrastructure & disable assets from stand-off

- **Efficient handling/throughput** of cargo for faster/more effective deployment/sustainment
- **Explosives safety techniques** to improve storage site planning and minimize footprint at base camps.
- Real-time, automated, **asset tracking and prognostics/diagnostics** systems to manage/maintain ammunition.
- **Automated** rapid weapon system **rearm** and **resupply** to reduce manpower requirements and soldier exposure to risk.
- Lightweight **renewable/recyclable/reusable packaging** to reduce operational energy usage during distribution and retrograde.

- Direct fire **counter-defilade** target engagement capability
- Cooperative engagements (sensor to shooter, LOS, NLOS, kinetic, non-kinetic lethal capabilities) and **near real-time networked fires**
- **Scalable** (non-lethal and non-lethal to lethal) force to shape the fight, defeat insurgents, reduce casualties, minimize damage
- **Multispectral obscurants and illumination** to limit enemy freedom of action
- **Imperceptible trace** to prevent enemy detection of U.S. forces

- Large Cal direct fire to defeat ATGM
- Large Cal to defeat ATGM teams with **precision airburst munitions**
- Lethal overmatch and **tactical standoff** to extend the close-combat battle against tanks and armored vehicles

- Cooperative engagements (sensor to shooter, LOS, NLOS, kinetic, non-kinetic lethal capabilities) and near **real-time networked fire**
- **Breach of entry points** into urban infrastructure and disable assets from stand-off
- **Remote and autonomous delivery of fires** for increased survivability
- NL anti-material weapon effective at extended ranges



ARDEC S&T Portfolio FY13-19



- 120mm Guided Enhanced Fragmentation Mortar Program (6.3)
- 81mm Precision NLOS Munition for Light Forces (6.3)
- 81mm Automated Direct/Indirect Fire Mortar (ADIM) (6.3)
- Extended Range Projectile Technology Research (6.2)

- Cluster Munitions Replacement (6.3)
- *Extended Range Munition Integration (Artillery)* (6.3)
- *Extended Range Indirect Fire Weapon* (6.2/6.3)
- *Collaborative Engagement Munitions* (6.2)

- Extended Area Protection & Survivability (EAPS) (6.3)
- Integrated Fixed/Mobile Close-in Counter UAS (6.3)
- *Squad CUAS* (6.2/6.3)

- Integrated Base Defense Hostile Protection System (6.3)
- *Next Generation Ground Based Scalable Munitions* (6.2)
- Solid State Active Denial Technology (SS-ADT) (6.3)

- Tunable Pyrotechnics (6.2/6.3)
- Counter-counter measures (6.2)

- Wall Breaching (6.3)
- IED Neutralization Technology (IEDNT) (6.2)
- *Explosive Hazard Predetonation System* (6.3)
- *Explosive Detection Technology Integration* (6.3)
- *Area Clearance Capability* (6.3)

Italics = Future

DIST. A



- Shoulder Launched MOUT/Urban Lethality Technologies (6.3)
- Enhanced Sniper Technologies (6.2/6.3)
- Small Arms 40mm Grenade Precision and Extended Range/Guided (6.2/6.3)
- Small Arms Weapons and Fire Control (6.3)
- Small Arms Technology Concepts & Material/Process Technology (6.2/6.3)
- *Advanced Energy Small Arms Concept Exploration* (6.2)
- *Squad Multi-Role Armament Technologies* (6.2)
- *Integrated Decision Enhancing Capabilities for Fire Control* (6.2/6.3)

- *Individual Non-lethal System (INS)* (6.2/6.3)
- *Hand Held Active Denial* (6.2/6.3)

- Next Generation Kinetic Energy Cartridge (6.2/6.3)
- *Recoil Reduction Disruptive Technologies* (6.2)
- *Large Caliber Remote Armament System Integration* (6.3)

- Advanced Lethality and Accuracy System for Medium Caliber (6.3)
- Adv Remote/Robotic Armament Sys (ARAS) (6.3)
- *Medium Caliber Remote Armament System Integration* (6.3)
- Cannon Life Extension Program (6.7)

- Automated Material Handling (6.3)
- *Total Ammunition Logistics Knowledge* (6.3)
- Explosives Safety for Automated Base Camp Planning (6.2/6.3)
- *Adaptive Packaging* (6.3)

ARDEC S&T Portfolio FY13-19 Enablers



Fuze and Power

- Multi-Purpose Technologies - enable a single munition to engage variable targets and target types
- Affordable, energy efficient, real-time embedded on munition sensor/signal processing
- Novel, affordable, and energy efficient MEMS-based components
- Energy harvesting from weapon platform or munitions in flight

Warheads

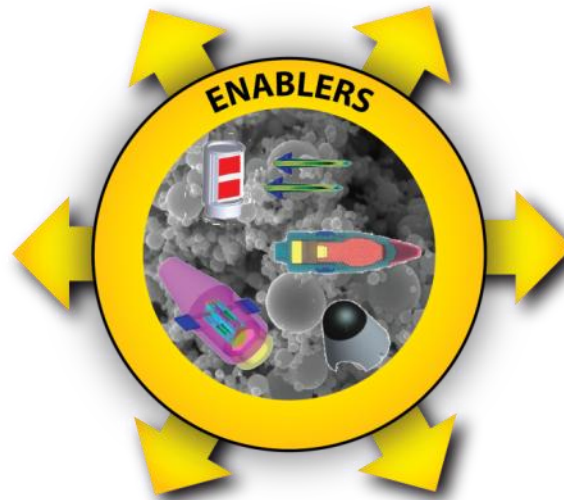
- Novel warhead materials
- Novel approach and techniques to improve penetrator performance
- Advanced warhead designs integrated into munition body

GNC

- Enhanced stand-off across existing weapon platform and munitions medium to large caliber): Enhanced projectile trajectory modification techniques
- Sensing technologies that enable precise engagement of fired munitions engaging moving targets
- Technologies that enable affordable precision engagement in 40mm low and high velocity grenades
- Affordable seekers

Fire Control and Networked Fires

- Integrated and enhanced fire control technologies to enable target acquisition, accuracy at extended ranges (to detect, acquire, locate, classify, identify, prioritize and assess damage):



Energetics and Propulsion

- Energetic materials that provide greater energy with less sensitivity to unplanned stimuli
- Greener energetic materials that reduce manufacturing waste stream and training costs and do not present a safety hazard to our Warfighter
- High rate mechanical response and damage models for energetic materials
- High temperature burn characterization of thermally damaged energetics
- Multi-Phase reacting flow models (granular propellant)
- Quantitative burn characterization of mechanically damaged energetic Materials for IM warheads

Other Leveraged Enablers

Materials
Seekers
Networking
Logistics Technology
Modeling & Simulation

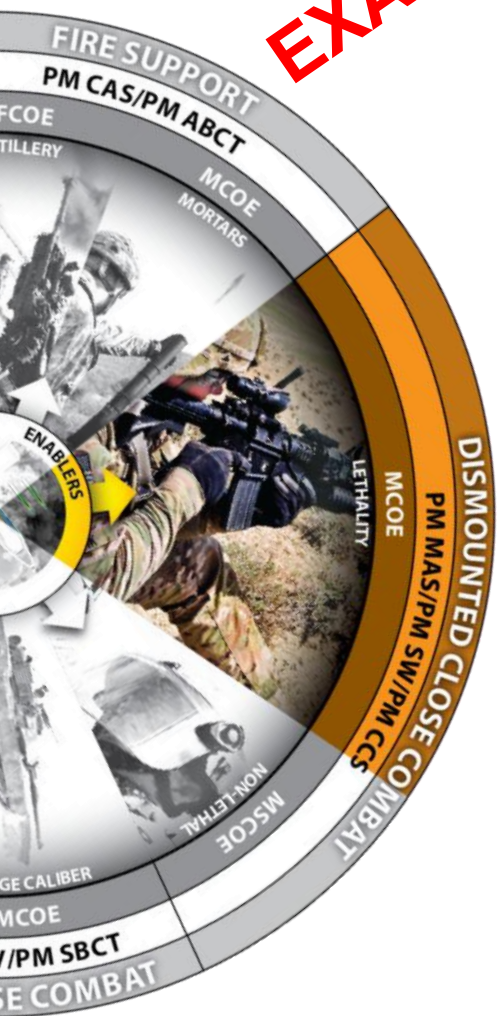


ARDEC S&T Portfolio

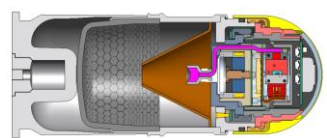
Dismounted Close Combat – Lethality



EXAMPLE



NEAR (FY13-16)	MID (FY17-20)	FAR (2021+)
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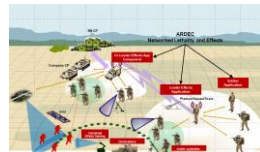
Improved Air Burst Accuracy
40mm LV Grenade (6.3)



Extended Range/Guided 40mm
LV Grenade (6.2/6.3)



MOUT/Urban Lethality
Technologies (6.3)



Integrated Decision Enhancing
Capabilities for Fire Control (6.2/6.3)

OPPORTUNITIES

- Enhancing Squad effectiveness while reducing soldier load: precision, longer range, CUAS
- Technologies that enable affordable precision engagement in 40mm low and high velocity grenades: GNC, terminal guidance, GPS Denied environment, MEMS-based components, embedded on munition sensor/signal processing
- Multi-Purpose Technologies - enable a single munition to engage variable targets and target types
- Technologies that enable the next generation, Soldier-carried weapon system that will be lightweight, multi-functional, mission-configurable, and effective against exposed and defilade targets out to extended ranges

Enduring Future Thrusts



- Technologies to reduce weapon tube erosion
- High g survivable power sources
- Materials for warheads, structural components
- Use of additive manufacturing to enhance performance and speed timeline from gap to operational use
- Extending range across all calibers
- Reducing Warfighter burden





Teaming with ARDEC



- **Science & Technology**
POC: Joseph Pelino, joseph.pelino.civ@mail.mil
- **CRADAs/Patent Licenses/Testing Services/Engineering Services**
POC: Tim Ryan, timothy.s.ryan.civ@mail.mil
- **IR&D Technical Interchange**
POC: Sylvester Anyanwu, sylvester.o.anyanwu2.civ@mail.mil
- **Small Business Innovation Research**
POC: Carol L'Hommedieu, carol.j.lhommedieu.civ@mail.mil
- **International Cooperation**
POC: Lu Ting, lu.ting.civ@mail.mil
- **DOTC**
POC: Don Geiss, donald.a.geiss.civ@mail.mil
 - **Small Arms Consortium**
POC: Mike Tauber, michael.j.tauber.civ@mail.mil

.....Continued Dialog to Leverage Collaboration Opportunities

Challenges Going Forward



- Sequestration – a reduction of \$490B over the next 10 years
- Furlough
 - 6 days from Jul-Aug 13
 - 3.5 days from 1-6 Oct 13
- Budget/Fiscal
 - Reduction in FY13-14 with expected downturn
 - Reimbursable funding decrease of \$60M in FY13; 35% decrease projected FY14-18
- Pivot to Asia & Pacific and concerns over near-peer threats
 - Outranged by 12 countries – longer range, increased precision in GPS-denied environment
 - Enhanced lethality force multiplier as force structure is reduced
 - Squad overmatch?
- How can you help?
 - Come see me!
 - Team-up: CRADA, TSA, IRAD
 - ??

What can we do collectively to overcome the environment!

“Without *lethality*
it’s just another parade”