



# U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND

Innovative Technologies for the Warfighter

BG Vincent Malone  
Deputy Commanding General  
CCDC



## KEY POINTS



**COMBAT CAPABILITIES  
DEVELOPMENT COMMAND  
DELIVERING FUTURE READINESS**

- RDECOM transitioned to the Combat Capabilities Development Command (CCDC) under Army Futures Command (AFC) in Feb. 2019
- Within AFC, CCDC will deliver scientific knowledge for future concepts to define requirements; discover, develop and integrate overmatch capabilities Soldiers need; and provide technology and engineering expertise for Combat Systems to deliver for warfighters
- We are maintaining a stable balance of S&T investments across the near, mid and far time horizons to posture the future force, in support of Multi Domain Operations
- Collaboration with industry, academia, DoD labs, and our international allies is essential



# A UNIFYING VISION TO BUILD THE FUTURE TOGETHER



## ON A FUTURE BATTLEFIELD

...a young company commander looks back to 2018 and thanks the Army's Leadership for having the courage to reorganize the Army and stand up Army Futures Command because he/she was just part of the last battle of a short, sharp, successful joint campaign against a near-peer nation state

And the thing that young company commander is most thankful for is that he/she had the tools necessary to dominate in the unforgiving crucible of ground combat and bring every last Soldier home to the families that trust us with the lives of their sons and daughters.





# CCDC ORGANIZATION



**U.S. ARMY  
FUTURES COMMAND**



**U.S. Army Combat Capabilities  
Development Command  
Commanding General**

**MG Cedric T. Wins**

**Human Systems  
Integration (A)**

**Mr. Jeffrey Thomas**

**Command Sergeant  
Major**

**CSM Jon R. Stanley**

**Deputy  
Commanding General**

**BG Vincent F. Malone II**

**Deputy to the  
Commanding General**

**Mr. John S. Willison**

**CCDC AMERICAS**

**Research Forward Element  
Ft. Sam Houston, TX**

**CCDC ATLANTIC**

**Research Forward Element  
Stuttgart, Germany**

**CCDC PACIFIC**

**Research Forward Element  
Ft. Shafter, HI**



**ARMY RESEARCH  
LABORATORY**

- Extramural Basic Research
- Computational Sciences
- Materials Research
- Sciences-for-Maneuver
- Information Sciences
- Sciences for Lethality and Protection
- Human Sciences
- Assessment & Analysis
- Advanced Computing & Big Data
- Agile Manufacturing
- Synthetic Biology



**C5ISR CENTER**

- Mission Command
- Tactical and Deployed Power
- Tactical Cyberspace Operations
- Electronic Warfare
- Intelligence, Surveillance, Reconnaissance and Targeting
- Network
- Prioritize Position Navigation and Timing (PNT)



**DATA & ANALYSIS  
CENTER**

- Certified Item Level Performance Data
- Models, Simulations, & Tools
- Life-Cycle Systems Analysis
- Vulnerability / Lethality Technical Analysis
- Soldier-Centered Performance Design Analysis



**SOLDIER CENTER**

- Advanced/ Multifunctional Materials
- Biomechanics
- Cognitive & Behavioral Sciences
- Food Science
- Geographic/ Precision Guided Systems
- Soldier Performance Optimization
- Biological Technology
- Neuro-cognition



**AVIATION & MISSILE  
CENTER**

- Airframe Structures
- Rotors & Rotor Systems
- Sensors and Seekers
- Guidance, Navigation, and Control
- Propulsion
- Counter-UAS
- Visualization
- Anti-Access/Area Denial
- Missile Defense



**ARMAMENTS CENTER**

- Munitions Systems & Technologies
- Integrated Weapon Systems
- Energetics, Warheads & Manufacturing
- Guidance, Navigation & Control
- Fuze & Precision Armament Technology
- Cross Domain Fires



**CHEMICAL  
BIOLOGICAL CENTER**

- Chemistry and Biological Sciences
- CB Agent Handling and Surety
- CBRNE Materiel Acquisition
- CBRNE Analysis and Testing
- CBRNE Munitions and Field Operations



**GROUND VEHICLES  
SYSTEMS CENTER**

- Ground Vehicle Survivability
- Autonomy-Enabled Systems
- Vehicle Electronic Architecture
- Ground System Software
- Ground Vehicle Power & Mobility
- Robotics/Autonomous Systems
- Combat Vehicles
- Advanced Protection Systems



# CCDC NATIONAL FOOTPRINT



**CCDC**  
 HQ APG, MD

- CCDC HQ, APG, MD
- Natick, MA
- Arlington, VA



CCDC, NTC Support, Ft. Irwin, CA  
 CCDC, III CORPS, Ft. Hood, TX  
 CCDC, JRTC Support, Ft. Polk, LA  
 CCDC-AMERICAS, USANORTH/USARSOUTH, Ft. Sam Houston, TX  
 CCDC, ARCENT Support Shaw AFB, SC  
 CCDC, USSOCOM & ARCENTCOM Support MacDill AFB, FL  
 CCDC, USSOUTHCOM Support, Miami, FL  
 CCDC, XVIII ABN Corp & USASOC Support, Ft. Bragg, NC  
 CCDC FAST HQ's, ARL, PIF, & ARDEC APG, MD

○ State with CCDC support location

**National reach of supporting locations enables development of materiel solutions**

<p>■ <b>Aviation &amp; Missile Center</b>                      HQ REDSTONE ARSENAL, AL</p>	<p>■ <b>Armaments Center</b>                      HQ PICATINNY, NJ</p>	<p>■ <b>Army Research Lab</b>                      HQ ADELPHI, MD</p>	<p>■ <b>C5ISR Center</b>                      HQ APG, MD</p>	<p>■ <b>Chemical Biological Center</b>                      HQ APG, MD</p>	<p>■ <b>Soldier Center</b>                      HQ NATICK, MA</p>	<p>■ <b>Data &amp; Analysis Center</b>                      HQ APG, MD</p>	<p>■ <b>Ground Vehicle Systems Center</b>                      HQ WARREN, MI</p>
<ul style="list-style-type: none"> <li>• Aviation &amp; Missile HQ w/ PIF, Redstone Arsenal, AL</li> <li>• Ft. Eustis, VA</li> <li>• Moffett Field, CA</li> <li>• Corpus Christi, TX</li> <li>• Ft. Carson, CO</li> <li>• Hampton, VA</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Armaments Center HQ, Picatinny, NJ</li> <li>• Watervliet Arsenal, NY</li> <li>• Rock Island Arsenal, IL</li> <li>• APG, MD</li> <li>• Ft. Sill, OK</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Army Research Lab HQ, Adelphi, MD</li> <li>• APG, MD</li> <li>• White Sands Missile Range, NM</li> <li>• Raleigh-Durham, NC</li> <li>• UARC ICT, Los Angeles, CA</li> <li>• UARC, ISN, Boston, MA</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• C5ISR Center HQ, APG, MD</li> <li>• Ft. Belvoir, VA</li> <li>• Lakehurst, NJ</li> <li>• Ft. Dix, NJ</li> <li>• Ft. Huachuca, AZ</li> <li>• Ft. Sill, OK</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Chemical Biological HQ w/PIF APG, MD</li> <li>• Rock Island Arsenal, IL</li> <li>• Dugway Proving Ground, UT</li> <li>• Pine Bluff Arsenal, AR</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Soldier Center HQ w/PIF, Natick, MA</li> <li>• Ft. Belvoir, VA</li> <li>• Orlando, FL</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Data &amp; Analysis Center HQ, APG, MD</li> <li>• White Sands Missile Range, NM</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Ground Vehicle Systems Center HQ w/PIF, Warren, MI</li> <li>• Selfridge ANGB, MI</li> <li>• New Cumberland, PA</li> <li>• Other</li> </ul>



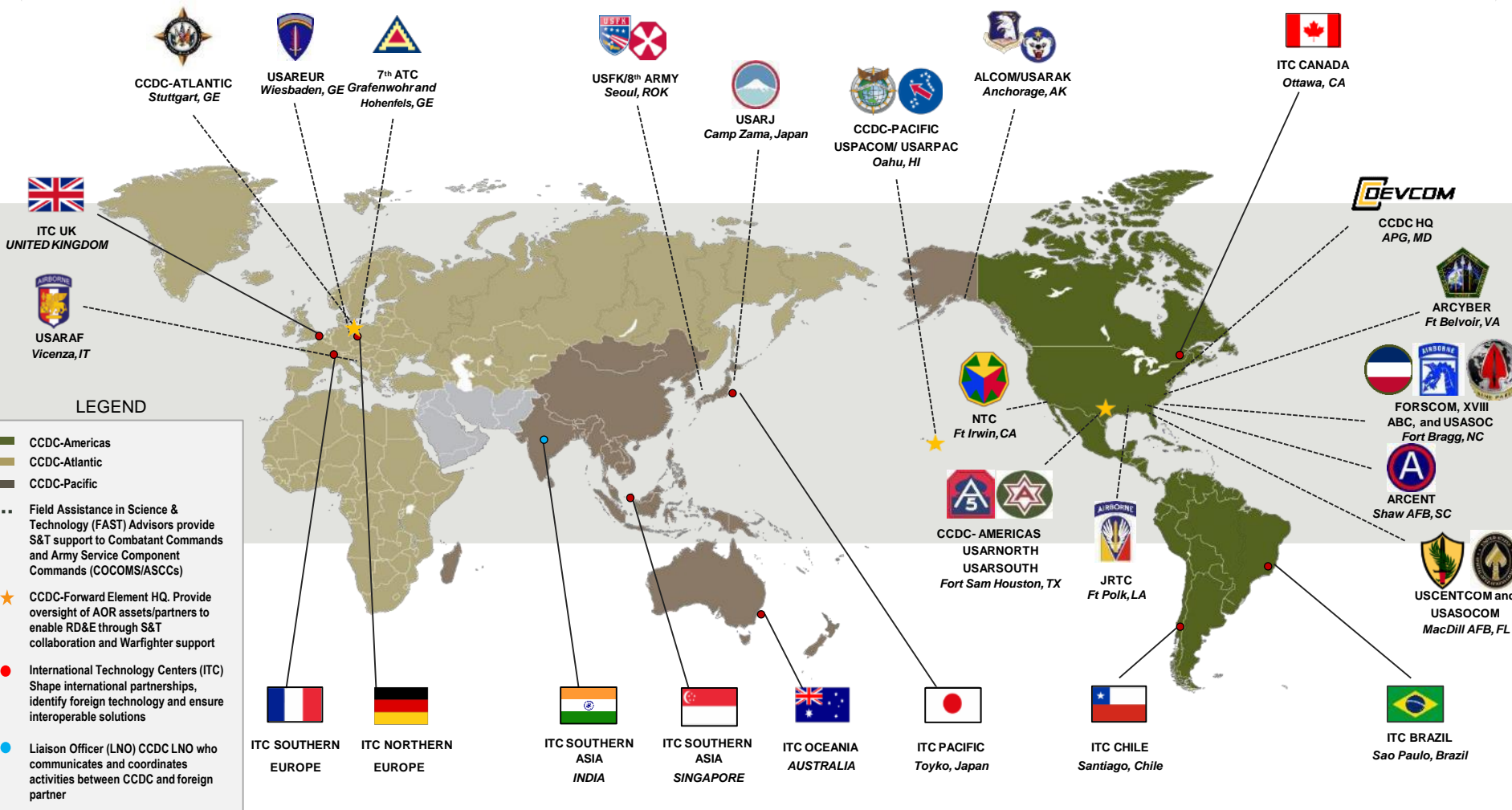
# CCDC GLOBAL POSTURE



## Technology Search

## International Engagement

## Warfighter Support



**Enabling Army Modernization Around the World with Our Service Components, Allies and Partners**



# ARMY MODERNIZATION PRIORITIES CCDC INTEGRATION



ARMAMENTS  
CENTER

C5ISR  
CENTER

AVIATION & MISSILE  
CENTER

SOLDIER  
CENTER

CHEMICAL  
BIOLOGICAL  
CENTER

ARMY  
RESEARCH  
LABORATORY

GROUND VEHICLE  
SYSTEMS CENTER

DATA &  
ANALYSIS  
CENTER

## MODERNIZATION PRIORITIES

LONG RANGE PRECISION FIRES

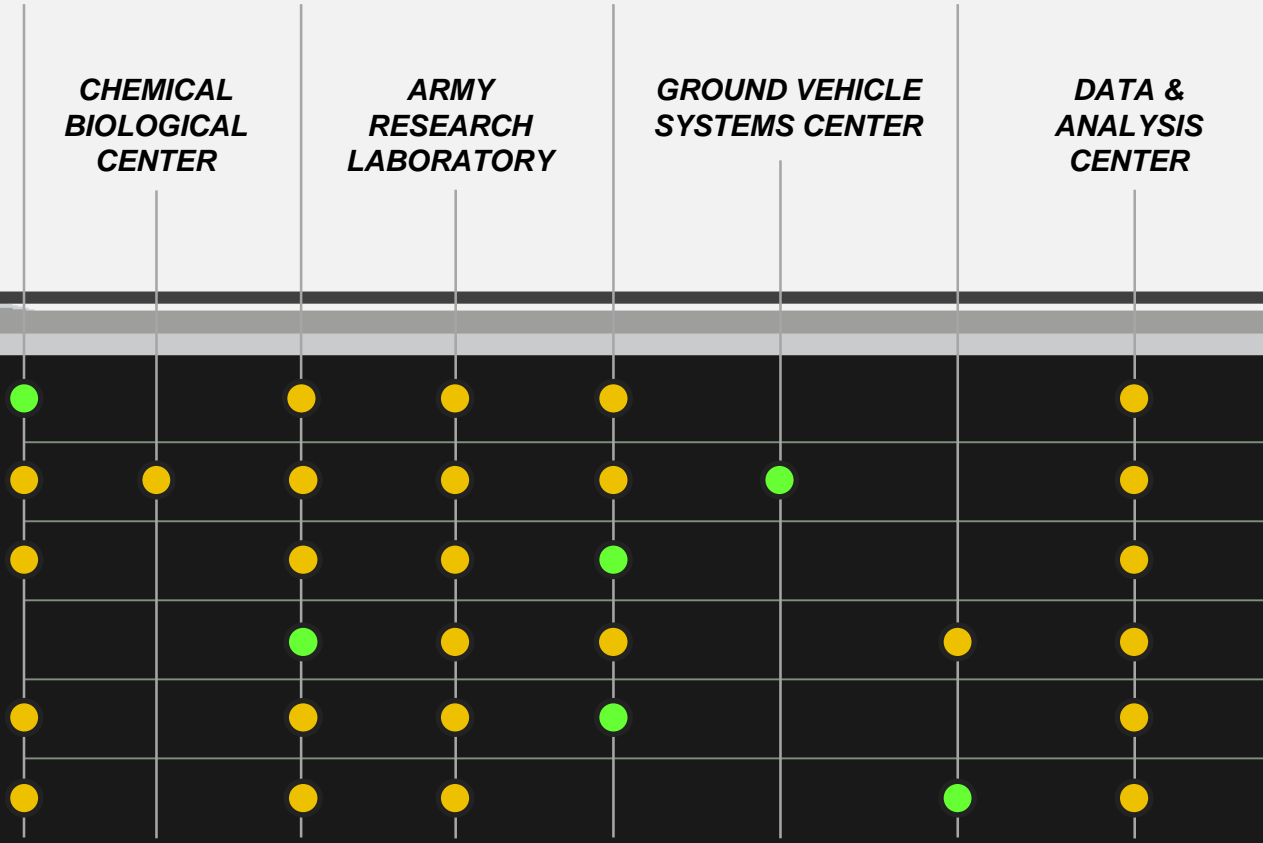
NEXT GENERATION COMBAT VEHICLE

FUTURE VERTICAL LIFT

NETWORK C3I & A-PNT

AIR & MISSILE DEFENSE

SOLDIER LETHALITY



Green dot: CCDC CFT Lead

Yellow dot: CCDC Modernization Priority Investment



# ARMY MODERNIZATION PRIORITIES INVESTMENT CAPABILITY AREAS



## LONG RANGE PRECISION FIRES



- Advanced Propulsion
- Extended Range Cannon Artillery
- Precision and Cooperative Weapons (GPS Denied)
- Advanced Seekers

## NEXT GEN COMBAT VEHICLES (NGCV)



- Autonomy Architecture
- Lethality Architecture
- Vehicle Protection Architecture
- Power Architecture
- Vehicle Electronic Architecture

## FUTURE VERTICAL LIFT (FVL)



- Advanced Rotorcraft
- Advanced Teaming for Tactical Aviation Operations
- Air Launched Effects
- Aviation Survivability

## NETWORK/C3I



- Protected SATCOM
- Cyber Operations
- Electronic Warfare
- Non-Traditional Waveforms
- Network Sensors

## AIR & MISSILE DEFENSE



- Low Cost Extended Range Air-Defense
- Accurate Rapid Controlled Hybrid Effects Round
- Next Generation Fires Radar Technologies

## SOLDIER LETHALITY



- Next Generation Squad Weapon (NGSW)
- Integrated Visual Augmentation System (IVAS)
- Monitoring & Assessing Soldier Tactical Readiness and Effectiveness (MASTR-E)
- One World Terrain (OWT)
- Live training



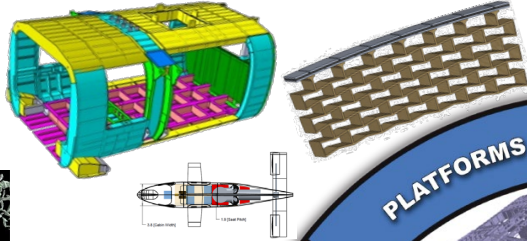
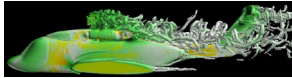


# AVIATION SYSTEMS SCIENCE & TECHNOLOGY INVESTMENTS



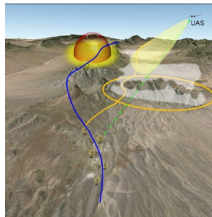
## PLATFORMS

- Structures
- Concept Design & Assessment



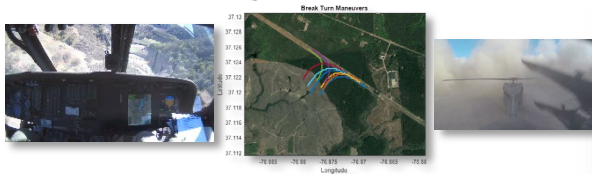
## MISSION SYSTEMS

- Survivability
- Avionics & Networks



## VEHICLE MANAGEMENT & CONTROL AND ROTORS

- Rotors
- Vehicle Management & Control



## MAJOR PROGRAM AREAS

- Joint Multi-Role Technology Demonstration
- Degraded Visual Environment – Mitigation
- Air Launched Effects



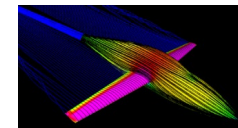
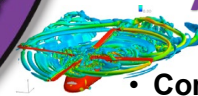
## POWER

- Engines & Other Power Sources
- Drives



## AEROMECHANICS AND BASIC RESEARCH

- Computational Aeromechanics
- Experimental Aeromechanics



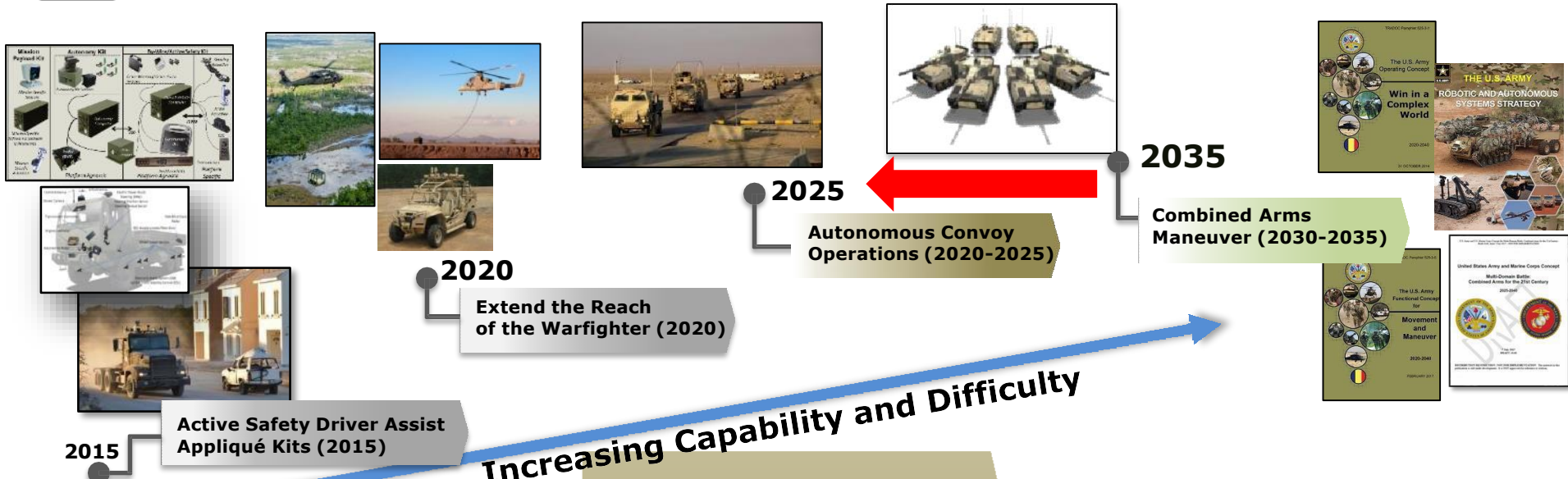
## AUTONOMOUS AND UNMANNED SYSTEMS

- Intelligent Teaming
- Human System Interface





# GROUND AUTONOMOUS SYSTEMS STRATEGIC CAPABILITY PROGRESSION



**Near Term Capabilities**

### Fully Integrated Kitted Solutions

- Fault-Tolerant Architectures
- Enable unmanned cargo delivery
- Enhanced Platoon, Squad, and Soldier situational awareness.
- Autonomy augments the Soldier

**Mid Term Capabilities**

### Autonomy Augmented Legacy Systems

- Remote Lethality
- Semi-Autonomous Mobility
- Man/Unmanned Teaming Capability on legacy systems
- Autonomy as a force multiplier

**Far Term Capabilities**

### Purpose Built Unmanned Platforms

- Advanced machine learning
- Enable manned and unmanned teaming in both air and ground maneuver through scalable sensors, scalable teaming, Soldier-robot communication, and shared understanding
- Autonomous system operates as team member



# EXTENDED RANGE CANNON ARTILLERY STRATEGIC CAPABILITY PROGRESSION



## Purpose:

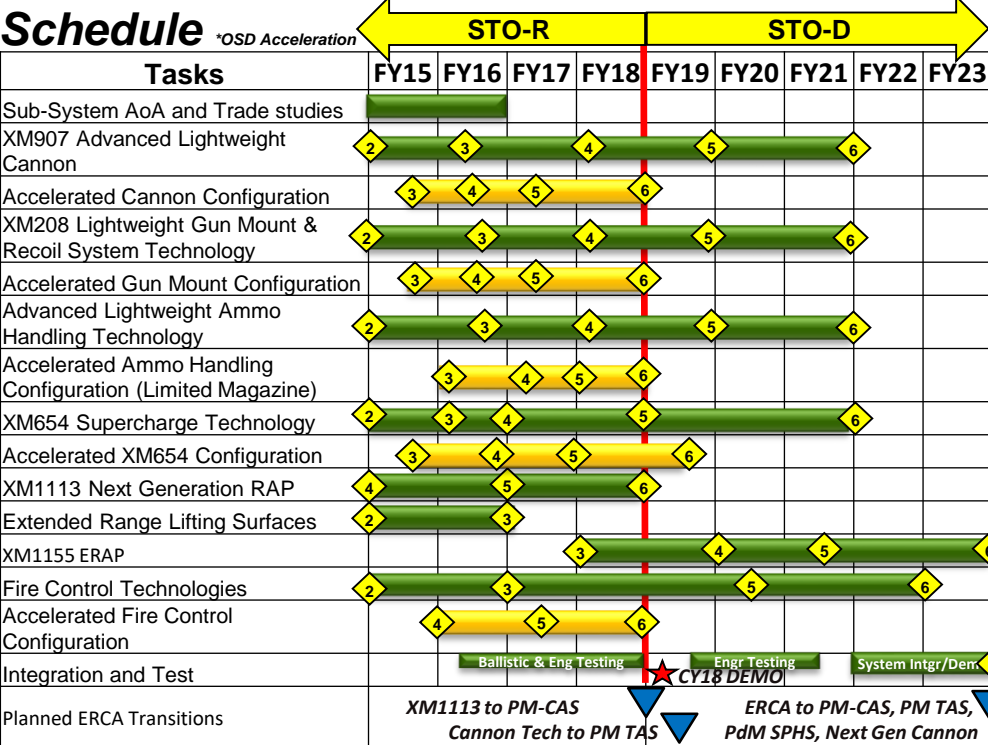
Provide integrated cannon artillery technology solutions to maximize performance at a system level and regain lethality overmatch for U.S. Army 155mm indirect fire systems for operations in emerging battle spaces and near-peer environments.

## Products:

- Extended Range Armament system consisting of the XM907 Cannon, XM208 Mount and partial autoloader integrated into an M109 platform
- XM1113 Next Generation Rocket Assist Projectile – 70km(O)
- Extended Range Propelling Charge (XM654)
- Proven process for domestic source of High Strength Steel (HSS)
- Government Owned IP

## Payoff:

- Lethality Overmatch with Extended Artillery Range out to 70km (Increment 1 & 2) and beyond (Increment 3)
- 300% improvement in area coverage for 155mm artillery
- Burst Rate of fire greater than 6-10 rounds per minute
- 30% Range increase for legacy artillery ammunition
- Extended Range Armament demo accelerated by 4 years
- Presents Early Program Risk Reduction and Transition Options
  - Armament to PM-SPHS
  - Super Charge to PM-CAS (Aligns with XM1113 transition)
  - Limited Magazine Auto-Loader



**AC working with OSD, FCoE, PEO GCS and PEO AMMO on Accelerated Demos, Transitions, & POM Strategies**



# RESEARCH TO STRATEGIC CAPABILITY SCALE-UP OF FEMNAL ALLOY

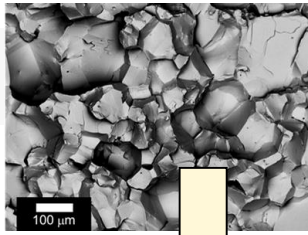
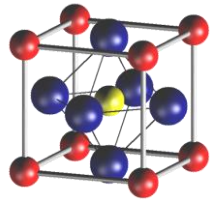


*New material/process enabled development of an armor steel with >10% decrease in density*

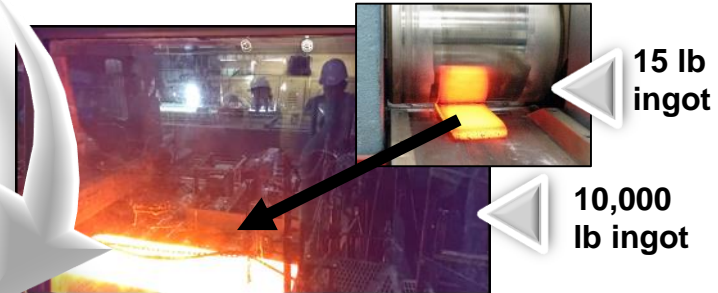
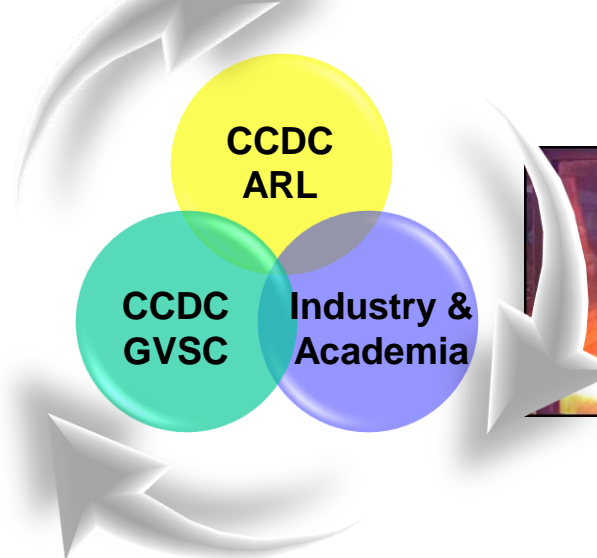
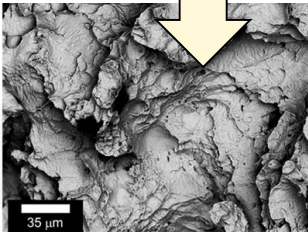


*Teaming with >20 Defense, Industry, and Academic Institutions*

**Brittle Fracture**



**Ductile Fracture**



*Transition from laboratory to industrial scale processing*

**New S&T tools impact near- and long-term Army materiel development**



*Impact on Legacy Systems*



*Lighter Metals for CFTs & Army Modernization Priorities*



*Enabler for Cooperative & Adaptive Protection for MDO*



# TECHNOLOGY TRANSFER AT CCDC



Enables CCDC to accomplish technology transfer objectives for the warfighter while benefiting U.S. industry

Allows R&D collaborations, product development and testing with industry and academia

Enables industry, academia and other organizations to leverage CCDC's unique assets: intellectual property portfolio, S&E expertise, and infrastructure

## Technology Transfer Summary for FY18

### Cooperative Research and Development Agreements

- Newly Executed in FY = 167
- Total Active = 636
  - Large Business ~ 49%
  - Small Business ~ 22%
  - Academia ~ 19%
  - International = 19%

### Invention Disclosures and Patenting

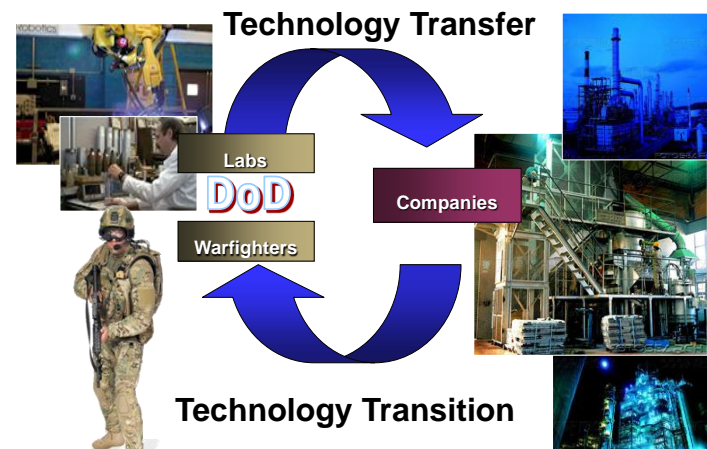
- New Inventions Disclosed in FY = 148
- Patent Applications Filed in FY = 169
- Patents Issued in FY = 112
- Total Active Patents = 915

### Patent Licenses

- New Patent Licenses in FY = 81
- Total Active Patent Licenses = 115

### Other Technology Transfer

- Material Transfer Agreements = 47
- Testing Agreements = 139
- Personnel Exchanges
  - Academia = 25
  - Non-Academia = 11



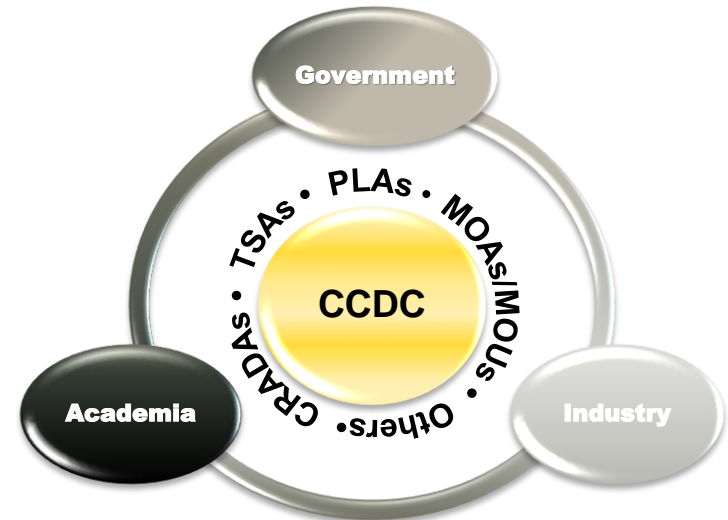
**CCDC transfers technology to the Industrial Base, enabling and accelerating transition to the Warfighter**



# MECHANISMS TO PARTNER



- Open Campus Initiative  
(Austin TX, Boston MA, Chicago IL, and Playa Vista CA)
- Cooperative Research and Development Agreements (CRADAs)
- Patent License Agreements (PLA)
- Joint Ownership Agreements (JOA)
- Technology Support Agreements (TSA)
- Engineering Service Agreements (ESA)
- Education Partnership Agreement (EPA)
- Partnership Intermediary Agreement (PIA)
- ManTech Program
- Small Business Innovation Research (SBIR)/  
Small Business Technology Transfer (STTR)
- Other Transaction Authority (OTA) Contracts
- Broad Agency Announcement (BAAs)



## Contact Information:

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# DISCUSSION

