2015 Futures Brief to Industry

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

1 December 2015

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Welcome

- **AMRDEC Directorate exhibits in lobby.**
- **Briefings and a survey will be posted on the conference site**
  - **https://conference.redstone.army.mil/**
- **Questions after event – strategicplanning@amrdec.army.mil**

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Our Role in the Army Enterprise

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Director's Intent

- **Taking Care of Our People:** Collectively mentor, sustain and care for our integrated technical and non-technical workforce using deliberate, pro-active supervision approaches.

- **Developing and Transitioning Enabling Technologies:** Continue to execute to cost and schedule of our wide variety S&T, formal development and rapid response activities, in firm coordination with TRADOC, PEO, and PM stakeholders, and Customers.

- **Affordability and Cost Consciousness:** Work to minimize overhead and direct costs, in careful balance, to sustain Customer focus and degrees of best-practice. Centralize operations and give respectful latitude in the support Directorate-run missions and functions.

- **Increased Strategic Alignment with Our Partners:** Think on enterprise terms – how to support one another and how to do business together in a cohesive, collaborative manner. Systematically communicate with and reach out to the myriad of our Team Redstone, Large Industry, Small Business, Technical Services, DAU, regional University and Research Institute Partners to work toward mutual goals and objectives.

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Strategic Framework

VISION:

Be a Warfighter-focused, valued team of world leaders in Aviation and Missile Technologies and Life Cycle Engineering

Added Value "Warfighter" Perspective

Develop & communicate AMRDEC's true value proposition as a national RD&E leader in order to help DoD make wise & forward-thinking decisions.

- Increase communications of added value to key stakeholders
- Anticipate Warfighter emerging needs

Customer/ Mission Perspective

Develop stronger relationships with customers, other RDECs, OGAs & industry to facilitate change in operational outcomes.

- Demonstrate a collaborative and coordinated effort (products, services) to serve customer needs
- Improve AMRDEC cost, schedule & performance efficiencies to customers

Internal Perspective

Transform business operations to achieve greater organizational effectiveness & efficiencies throughout AMRDEC.

- Deconflict missions & functions across AMRDEC
- Align physical & organizational infrastructure to support current and future mission
- Increase efficiencies in business operations through a unified business plan
- Develop & implement a Human Capital plan

Learning & Growth Perspective

Create a Collaborative Culture throughout AMRDEC that values technical competence.

- Increase awareness of AMRDEC capabilities throughout the directorates
- Create an environment of innovation & continuous improvement
- Improve all employees' technical & leadership/teaming skills

Army AND AMRDEC VALUES AND ETHICS

PURPOSE:

As an innovative workforce, we enable the world's premier aviation systems, missile systems and related technologies to defend the freedom of our nation and allies.

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Key Areas of Activity

- Systems Design, Development and Integration of *Prototypes*
- Applying *Enabling* Technologies (MANTECH, Cyber, etc.)
- Building and Transitioning *Offsetting* Technologies
- Helping to *Modernize* and *Sustain* Fielded Systems
- Enabling *Programs of Record*
- Continue *Rapid Response* Role
- Supporting a *wide Customer Base*
- Building the *Talent* and *Infrastructure*

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WEAPONS DEVELOPMENT & INTEGRATION DIRECTORATE

WDI

WEAPONS WORTHY OF THE AMERICAN WARFIGHTER

MISSILE SCIENCE AND TECHNOLOGY

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AMRDEC S&T Highlights

- **Lethal Miniature Aerial Missile System (LMAMS)**
  - Battery
  - Digital Data Link
- **Maneuver Aviation Fires Integrated Application (MAFIA)**
  - Army Expeditionary Warrior Experiments Participation
  - Video
- **Precision Target Acquisition Seeker (PTAS)**
  - Closed Loop Simulation

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Lethal Miniature Aerial Missile System (LMAMS)

LMAMS Description

- Soldier-carried, soldier-launched loitering precision weapons system organic at the small unit level that allows unprecedented engagement of enemy combatants without exposing the Warfighter to direct enemy fires
- Key Requirements:

  Weight: Launcher, Air Vehicle & Warhead < 5.5lbs Length: Launcher < 22”

Capability Gap

- Direct and indirect fires capabilities are of limited utility against fleeting targets in complex terrain
  - Snipers and antagonists in close urban terrain
  - Insurgents placing IEDs
  - Combatants on ridgelines and in cover of shallow caves and rock overhangs
  - Limited effects needed to mitigate collateral damages

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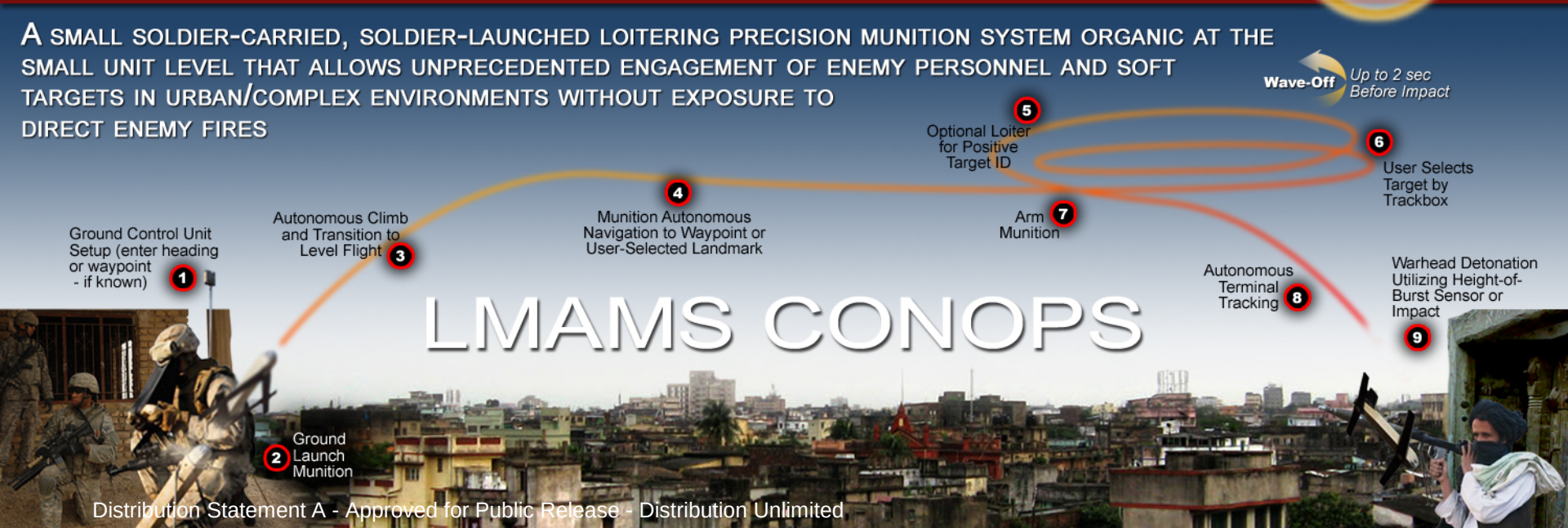
A small soldier-carried, soldier-launched loitering precision munition system organic at the small unit level that allows unprecedented engagement of enemy personnel and soft targets in urban/complex environments without exposure to direct enemy fires



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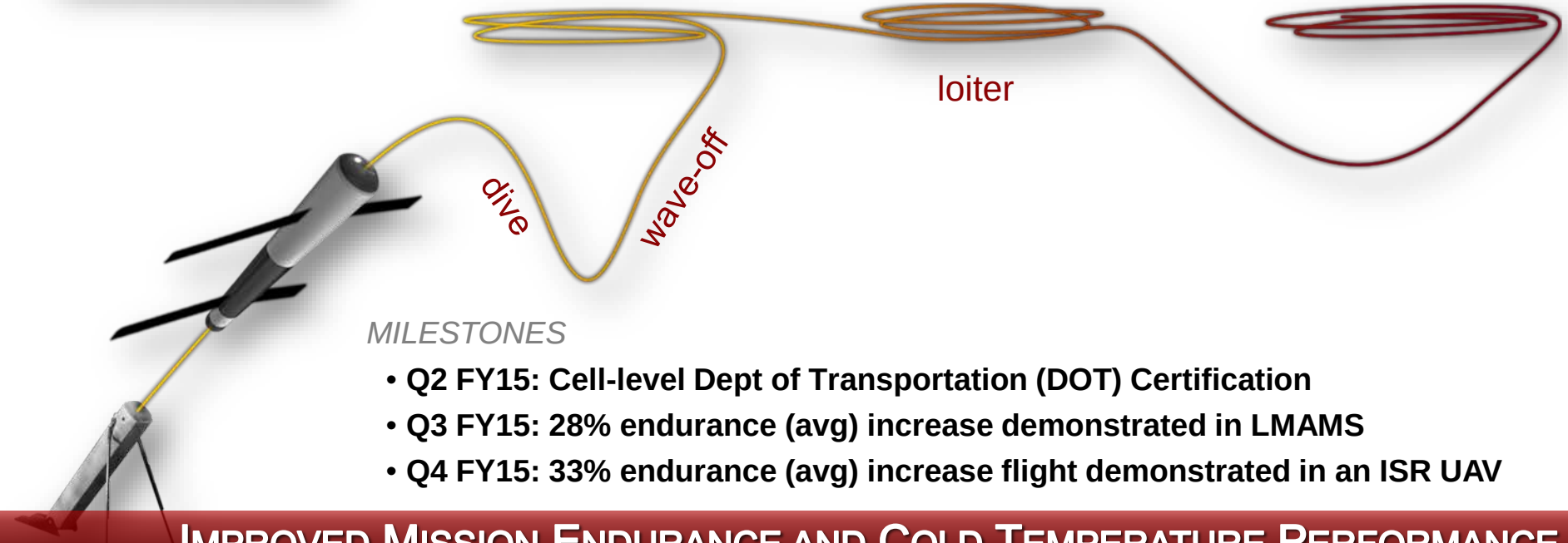
High Performance Rechargeable Battery
for Lethal Miniature Aerial Missile System (LMAMS) Program of Record

- **Form factored prototype battery (6 cells) successfully flight demonstrated (TRL 6)**
- **Operates to -20 ºC (no auxiliary heating)**
- **Up to 33% endurance increase over State-of-the-Art Lithium Polymer batteries**
- **Available from Vendor as a COTS product**



MILESTONES

- **Q2 FY15: Cell-level Dept of Transportation (DOT) Certification**
- **Q3 FY15: 28% endurance (avg) increase demonstrated in LMAMS**
- **Q4 FY15: 33% endurance (avg) increase flight demonstrated in an ISR UAV**

IMPROVED MISSION ENDURANCE AND COLD TEMPERATURE PERFORMANCE

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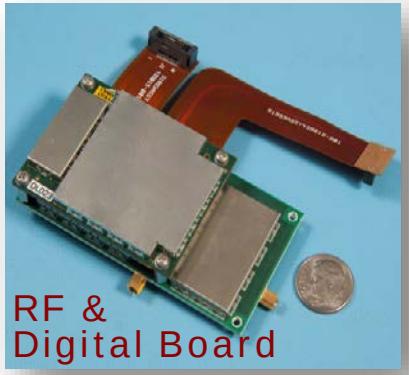
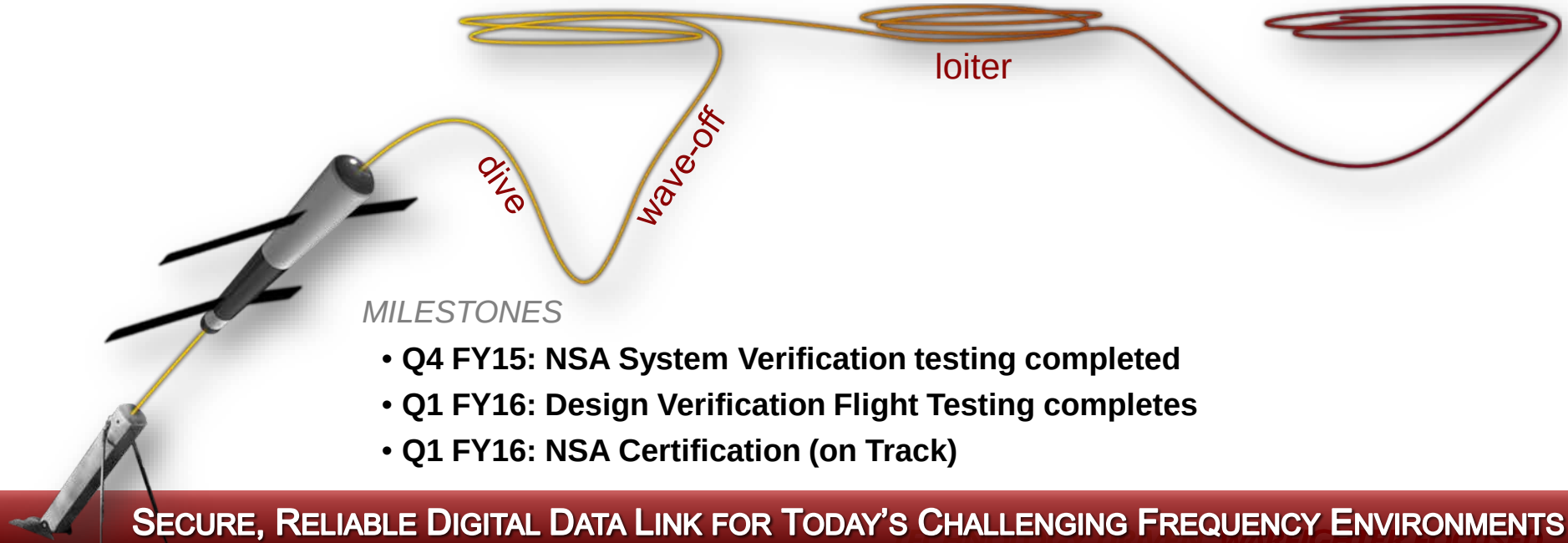
Secure Micro Digital Data Link (SmDDL)

for Lethal Miniature Aerial Missile System (LMAMS)
Program of Record



- **Novel NSA Type I, Suite B encryption that can be handled as unclassified device and is usable by uncleared personnel**
- **Form factored prototype successfully flight demonstrated in an LMAMS platform to required range (TRL 6)**
- **100% Govt funded (Unlimited Data Rights)**



MILESTONES

- **Q4 FY15: NSA System Verification testing completed**
- **Q1 FY16: Design Verification Flight Testing completes**
- **Q1 FY16: NSA Certification (on Track)**

SECURE, RELIABLE DIGITAL DATA LINK FOR TODAY'S CHALLENGING FREQUENCY ENVIRONMENTS

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Maneuver Aviation Fires Integrated Application (MAFIA) and Army Global Engine (AGE)

SENSOR INPUT

UAV - EO

EO / IR Sensors

Radars

COMMAND & CONTROL

MAFIA Increases Speed & Accuracy during the Call for Fires Process

MAFIA employs the Gov't owned and developed AMRDEC Army Global Engine (AGE) software - similar to Google Earth Engine

EFFECTS OUT

LMAMS

120mm

M777

EW

OBJECTIVE: Provide the Small Unit Leader and Forward Observer the ability to quickly generate precision coordinates for accurate, timely, and predictable fires using organic effects. Provides quick application of local Fire Support and generates necessary Fire Mission information for the employment of timely organic immediate precision and non-precision fires while providing increased Situational Awareness.

MAFIA participated in the Manned Unmanned Teaming - Ground (MUM-T (G)) at Ft. Bliss, as part of Network Integration Experiment (NIE) 16.1. The MUM-T (G) assessment served as the proof of concept for future Army Warfighting Assessments (AWA).

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Precision Target Acquisition Seeker (PTAS)

Developing a Government-Owned prototype IR Seeker with Acquisition and Track Processing for the Modular Missile Technologies (MMT) S&T Program

- Fully passive target engagement, no SAL required
- Passive Designation Concept: user selects target from reconnaissance sensor, passes data to missile for "fire and forget" engagement
- Provides enhanced capability to MMT
- Includes Moving Target Indicator (MTI), stationary target acquisition and tracker into an advanced targeting algorithm

MILESTONES

- Q4 FY15: Closed Loop Digital Developmental Simulation
- Q4 FY15: Hardware-in-the-Loop Real Time Demo

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Missile S&T Capability Areas

Protection

Protect the force and selected geopolitical assets from aerial attack, missile attack and surveillance

- Air Defense
- Area Protection
- Platform Protection

Ground Tactical (Close Combat)

Direct fire weapons, supported by indirect fire, air-delivered fires, and nonlethal engagement means to decide the outcome of battles and engagements

Fire Support

Destroy, neutralize, or suppress the enemy by cannon, rocket, and missile fire and to help integrate fire support assets into combined arms operations

Aviation Weapons

Find, fix, and destroy the enemy through fire and maneuver; and to provide combat, combat service and combat service support in coordinated operations as an integral member of the combined arms team

Program Analysis & Evaluation

- **AMRDEC PA&E Teams further the viability and effectiveness of missile science and technology efforts through the timely and coordinated study, synthesis, and evaluation of systems and technologies, both current and future**
- **Champion for Pervasive S&T**

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AMRDEC Technology Area Leads

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AMRDEC Missile S&T Enterprise

CAPABILITY AREA	NEAR-TERM	MID-TERM		FAR-TERM	
GROUND TACTICAL	LETHAL MINIATURE AREAL MISSILE SYSTEM (LMAMS)	LMAMS ENHANCEMENTS	PRECISION SHOULDER-LAUNCHED MUNITION (P-SLM)	NEXT GENERATION CLOSE COMBAT MISSILE(S)	MAMS/SMAM OFFENSIVE/-DEFENSE SWARM
PROTECTION	cUAS AT THE TACTICAL EDGE	LOW-COST EXTENDED-RANGE AIR DEFENSE (LOWER AD)	DIGITAL ARRAY RADAR TESTBED (DART)	NEXT GEN LOWER TIER (EXPEDITIONARY INTERCEPTOR, LAUNCHER, FCS)	
FIRE SUPPORT	TAIL CONTROLLED GMLRS (TCG) TECHNOLOGY INSERTION	LAND-BASED ANTI-SHIP MISSILE (LBASM)	LOW-COST TACTICAL EXTENDED RANGE MISSILE (LC-TERM)	LONG RANGE MANEUVERABLE FIRES	
AVIATION WEAPONS	MMT OPEN ARCHITECTURE ROCKET PROPELLED AND DROP/GLIDE	MODULAR MISSILE TECHNOLOGY (MMT) MULTI-ROLE VARIANT		NEXT GENERATION AIR-TO-GROUND MISSILE	

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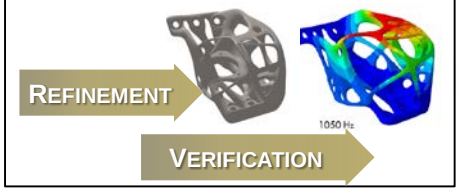
Opportunities with Industry
Missile S&T Focus

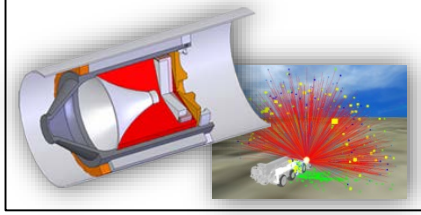
- **Advanced Propulsion, Energetics and Materials Technology**
  - Maximize maneuverability
  - Thermal management
  - Additive Manufacturing
- **Multi-Mode, Selectable/Scalable Fuzing and Warheads**
- **Guidance/Navigation in GPS Degraded/Denied Environments**
- **Seeker, Tracker, Datalink and Comms**
  - Dynamic re-targeting and aimpoint selection
  - All weather, high clutter environments
  - Networked enabled weapons
  - Increased security features (Comms)
- **Fire Control Sensors and Platform Integration - Robotics**
- **Power/Batteries increase in energy density**
- **Modeling and Simulation**
  - Open Architectures
- **Minimize Size, Weight, and Power of all Components**
- **Reduce Costs and Increase Reliability**

ADVANCED PROPULSION AND MATERIALS

ADDITIVE MANUFACTURING OPTIMIZATION

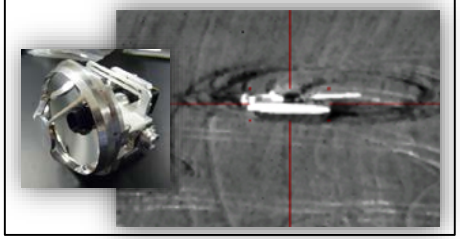


ADVANCED WARHEAD DESIGN/EFFECTS

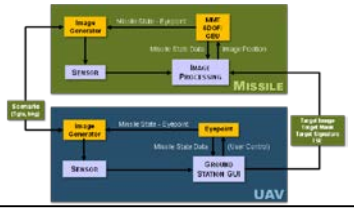


NAVIGATION SYSTEMS PNT TESTBED

SENSOR, TRACKER DATALINK AND COMMS



CLOSED LOOP OPEN ARCHITECTURE SIMULATION



C-UAS DETECTION & TRACKING

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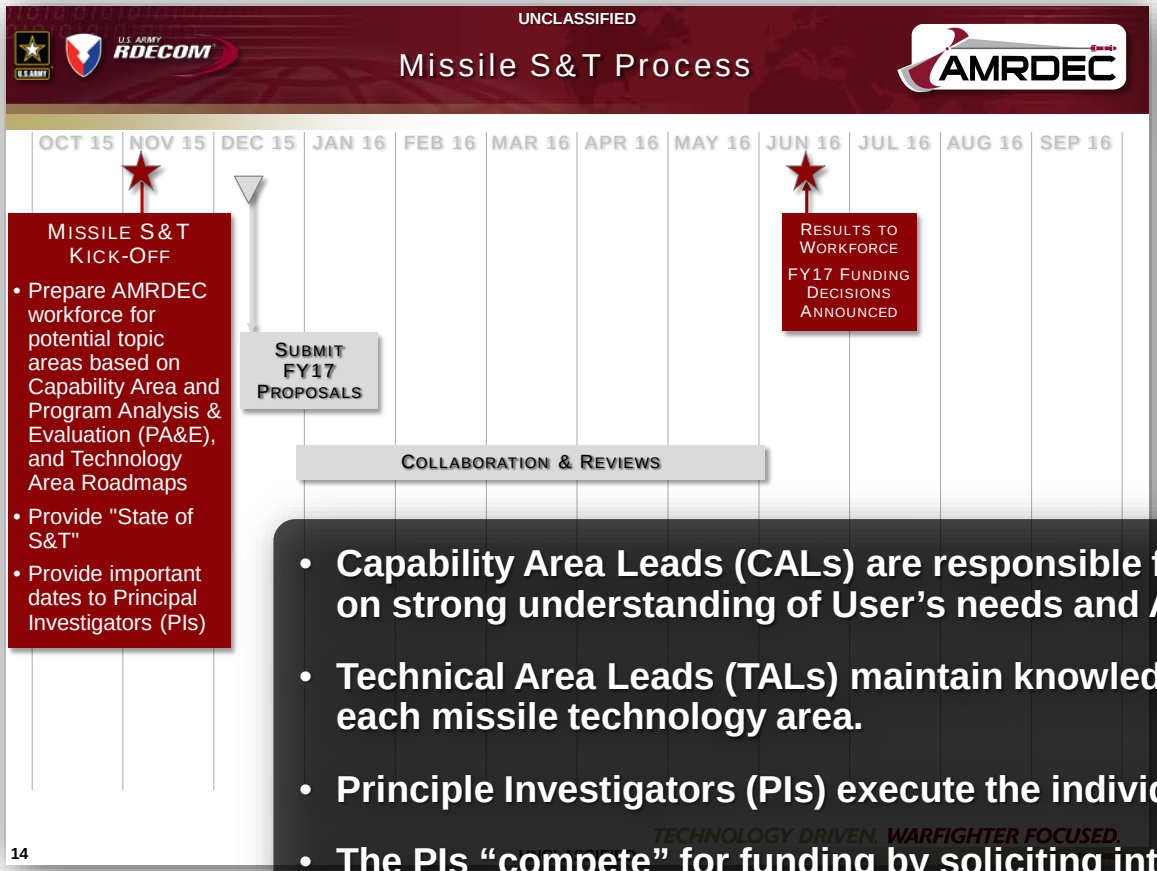
Missile S&T Investment Process

Proposed Timeline



- **Capability Area Leads (CALs) are responsible for developing S&T roadmaps based on strong understanding of User's needs and Acquisition partner's requirements.**
- **Technical Area Leads (TALs) maintain knowledge of the current state of the art of each missile technology area.**
- **Principle Investigators (PIs) execute the individual S&T efforts.**
- **The PIs "compete" for funding by soliciting interest and endorsement in their proposals from the CALs and TALs.**
- **Each proposal is assessed for technical feasibility and for applicability to needs/gaps prior to receiving funding or being added to the S&T roadmap.**

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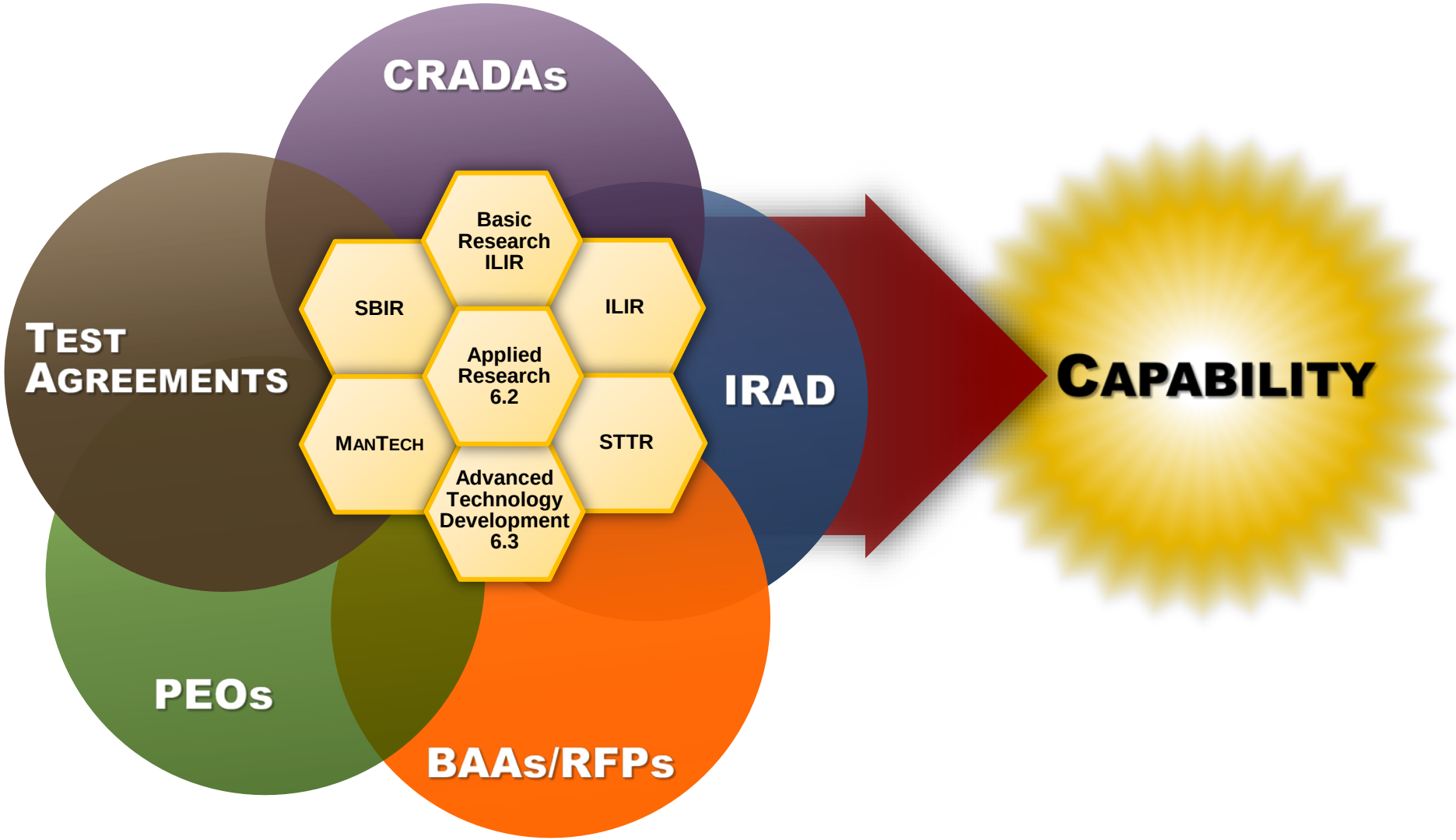
Missile S&T
Collaborative Incubation of Ideas



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AMRDEC Missile S&T Contact Information

Industry and Academia Involvement

The AMRDEC works closely with Industry and Academia to accomplish the desires of the Army. Our internal process welcomes input for our external partners through interaction with the Missile technology Chief and CALs.

Missile Technology Chief

Missile_Technology@AMRDEC.ARMY.MIL

Capability Area Leads	Technology Area Leads
Ground Tactical Capability Area Lead Ground_Tactical_CAL@AMRDEC.ARMY.MIL **Fire Support Capability Area Lead** Fire_Support_CAL@AMRDEC.ARMY.MIL **Protection Capability Area Lead** Protection_CAL@AMRDEC.ARMY.MIL **Aviation Capability Area Lead** Aviation_CAL@AMRDEC.ARMY.MIL **Programs Analysis and Evaluation** PA&E@AMRDEC.ARMY.MIL	Missile_**Launcher_Electronics**@amrdec.army.mil Missile_**Datalinks**@amrdec.army.mil Missile_**Sensors**@amrdec.army.mil Missile_**Electronics**@amrdec.army.mil Missile_**Guidance**@amrdec.army.mil Missile_**Lethality**@amrdec.army.mil Missile_**Propulsion**@amrdec.army.mil Missile_**Reliability_Maintainability**@amrdec.army.mil Missile_**Manufacturing_Affordability**@amrdec.army.mil Missile_**Simulation**@amrdec.army.mil Missile_**Control_Systems**@amrdec.army.mil Missile_**Navigation_Systems**@amrdec.army.mil Missile_**Fuze_Warheads**@amrdec.army.mil Missile_**Materials_Structures**@amrdec.army.mil Missile_**Aerodynamics**@amrdec.army.mil Missile_**Power**@amrdec.army.mil Missile_**Cyber**@amrdec.army.mil Missile_**Radar**@amrdec.army.mil

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ADD

Aviation Development Directorate

AVIATION SCIENCE AND TECHNOLOGY

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ADD Approach to S&T?

Focus:

- **Discover, Mature** and **Demonstrate** technologies that support desired Aviation capabilities
- **Combine technologies** into **capabilities**

Strategies:

- Develop body of technical **knowledge** that supports decisions and develop early versions of **"the system"**
- ADD is **not an** engineer staffing source for existing platforms

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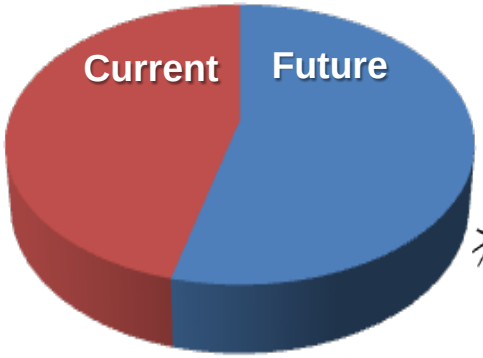
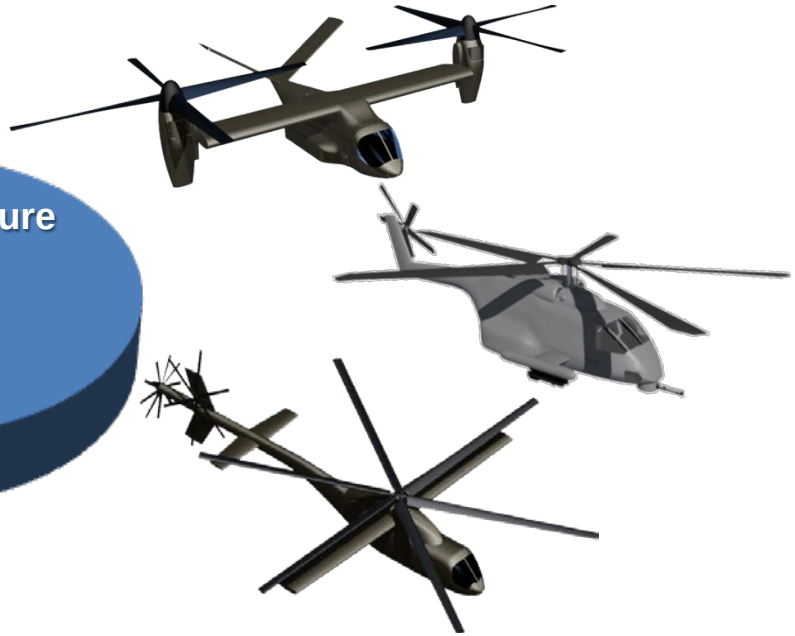
Army Aviation S&T

- **ADD S&T supports both the current helicopter and future rotorcraft fleets in improving survivability, performance, and affordability**
- **Current efforts are focused on platforms, power, survivability, vehicle management, and operations support and sustainment**
- **Future efforts are focused on Future Vertical Lift (FVL)**
  - **Joint Multi-Role (JMR) Technology Demonstrator (TD)**
  - **Focus on Transition to PEO Aviation**





Army Aviation S&T balances the needs of the current and future fleets

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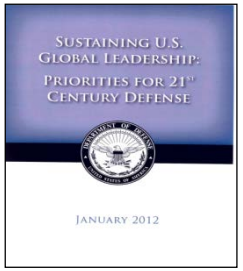
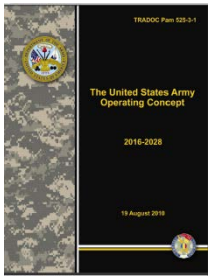
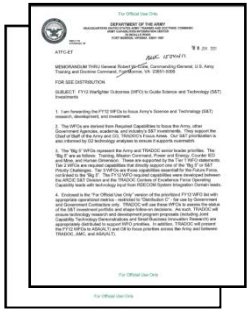
What informs the portfolio?

1. **Stakeholder capability needs and technology objectives (PEO, TRADOC, COCOMs, AMCOM, etc.)**
2. **2014 Aviation S&T Strategic Plan (ASSP 2014)**
3. **Army S&T priorities (ASAALT DASA(RT))**
4. **DoD priorities (OSD)**
5. **Future Outlooks (TRADOC)**
6. **Warfighter Outcomes / Wargaming Exercises**
7. **Future rotorcraft requirements (JMR TD, FVL)**
8. **Legacy fleet requirements (PORs)**







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Army Aviation Challenges

From the Aviation Science & Technology Strategic Plan (ASSP) 2014:

- **Fly faster and farther while carrying more: fully support all FVL initiative capabilities**
- **Operate in complex environments**
- **Develop the next generation of UAS**
- **Demonstrate mature autonomous decision-making capabilities**
- **Refine the interface between pilot and aircraft**
- **Support ultra-reliable designs for no maintenance**
- **Advance engine & drive configuration technologies that move beyond traditional turbo-shaft engine and power transmission architectures**
- **Reduce fielding timelines and improve transition time from S&T to the field**
- **Enhance in-house capabilities: sculpt the government workforce, facilities and equipment to develop diverse in-house capabilities**

Legacy fleet sustainment while leading future rotorcraft development!

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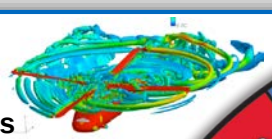
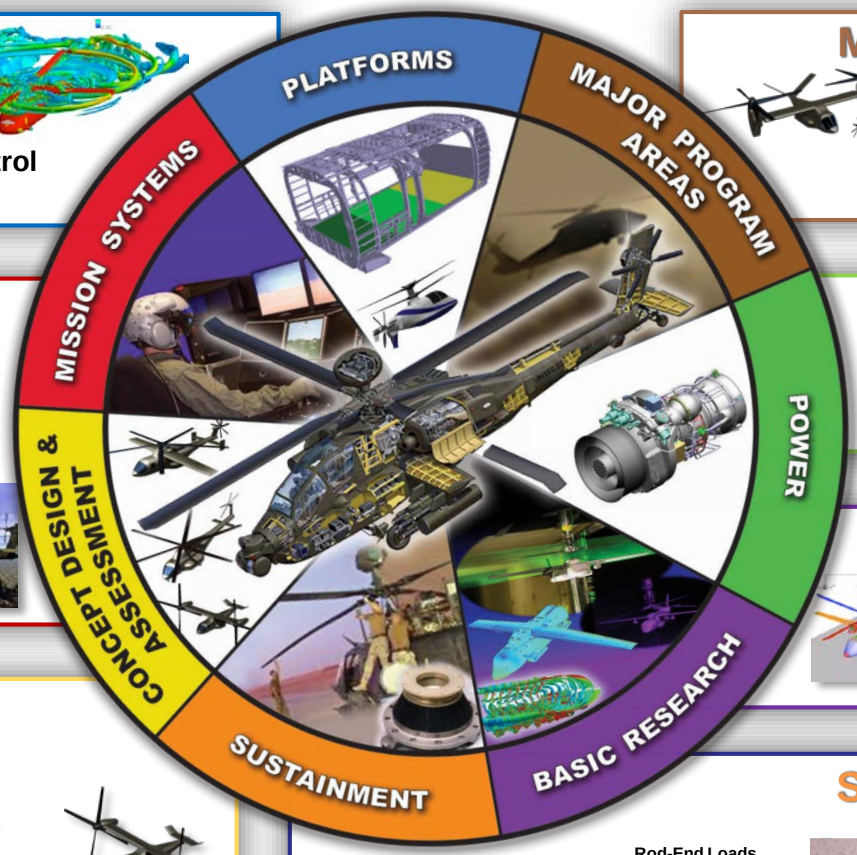
Army Aviation S&T Focus Areas

Platforms
- Structures
- Aeromechanics / Rotors
- Vehicle Management & Control
- Subsystems

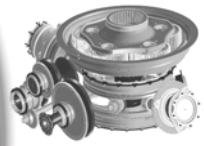


Major Program Areas

Mission Systems
- Engagement and Effects
- Survivability
- Teaming, Autonomy & Information Management
- Human System Interface
- Avionics / Networking



Power



- Engines & Other Power Sources
- Drives

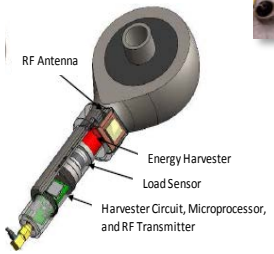
Basic Research

Concept Design and Assessment

Sustainment

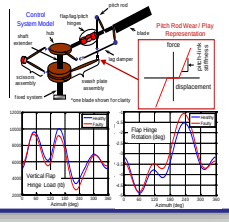
MDOF Main Rotor Motions & Loads

Rod-End Loads



Push-Rod Loads

Rotor Aeroelastic Models



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JMR 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

Products:

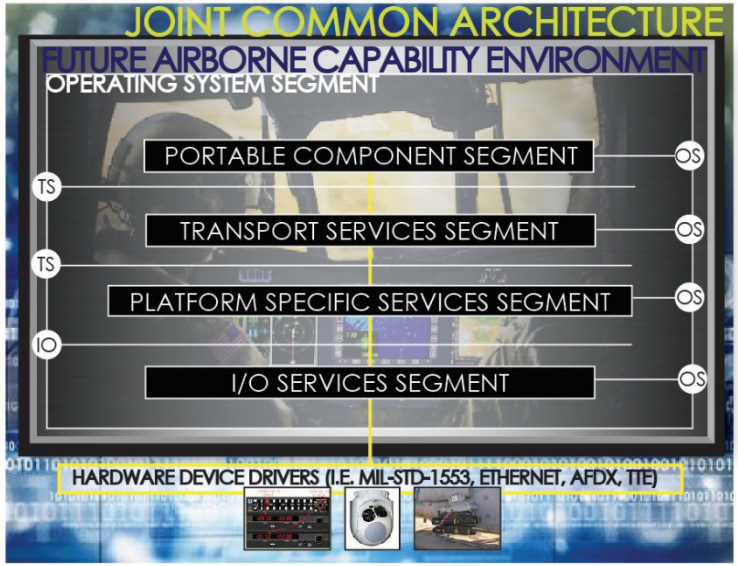
- Two demonstrator test bed aircraft
- Foundation for cost analysis for future capabilities
- Technology maturation plans

Payoff:

- A refined set of technologically feasible and 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)
- Standards, architectures and tools that increase SW reuse and reduce SW costs
- Reduced risk for critical technologies
- Data readily available to support future DoD acquisitions

Air Vehicle Demo (AVD)

Mission Systems Architecture Demo (MSAD)



back to Focus Areas

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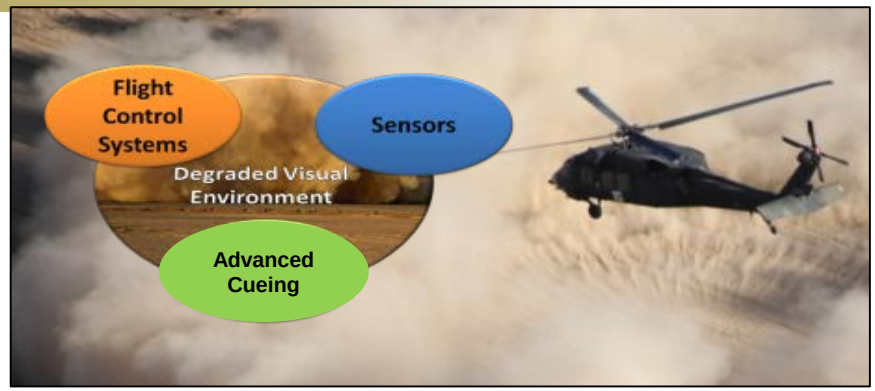
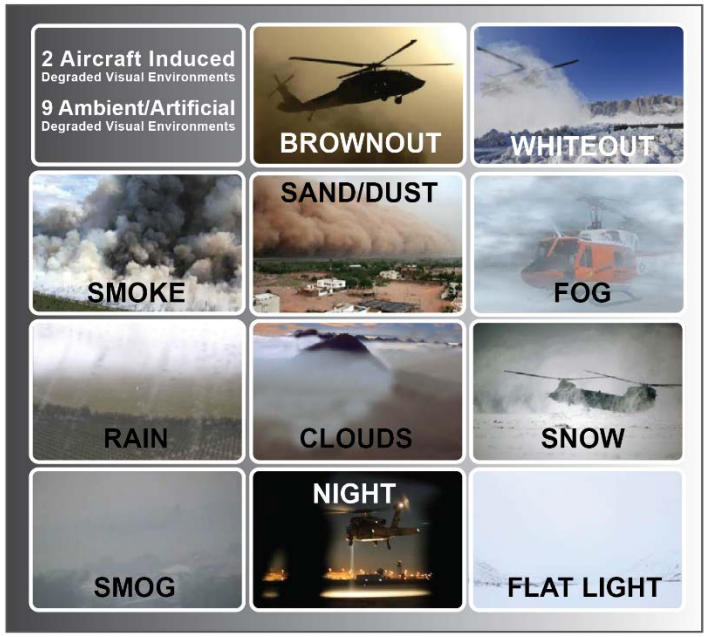
Rotorcraft Degraded Visual Environment Mitigation - DVEM



Purpose:

Establishes a collaborative, synchronized S&T program across RDECOM to realize PEO Aviation sensor increments 2 & 3 capability in the Aviation Fleet. Pursues advanced cueing implementations & develops & demonstrates modernized control laws.

- Pilotage in all DVE's: *clouds, snow, fog, smoke, night, rain, etc*.
- 360º situational awareness (SA)
- SA sharing inside and outside the aircraft formation
- Multi-functionality (potential threat warning, HFI, targeting, etc.)



In the 1980s, IR technology allowed the US military to claim "We own the night!" The RDECOM Rotorcraft DVE Mitigation Program overall goal is to "Own the Weather!"

Product:

Knowledge & Risk Reduction for PEO Aviation, DoD and NATO members for the future. Demonstrated multi-spectral sensor system(s), modernized control laws, and advanced cueing for DVE pilotage and multi-functional attributes for 360º situational awareness that allow implementation of pilot decision aiding (partial autonomy).

Payoff:

- Execute combat rotorcraft operations in degraded visual environments and adverse environmental conditions
- Increased survivability & operational effectiveness of the rotorcraft fleet
- Safety
- Exploiting Adverse Environments for Tactical Advantage

TRADOC DVE Definition (2011) – Reduced visibility of potentially varying degree wherein situational awareness and aircraft control cannot be maintained as comprehensively as they are in normal visual meteorological conditions and can potentially be lost.

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Basic Research Focus Area

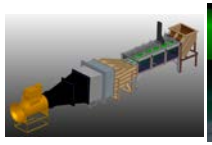
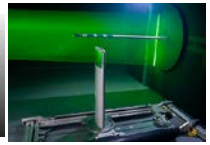
Basic research is a systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and observable facts without specific applications towards processes or products in mind.

Major thrust: Basic research activities are directed at bridging the gaps in our understanding of fundamental phenomena unique to rotorcraft, particularly those scientific gaps that would directly impact the technology objectives in the technical areas and other focus areas. The main thrust areas include advanced flow measurement and control techniques, unsteady aerodynamics and interactional aerodynamics amongst others.

- **enable pursuit of longstanding science & technology barriers and explore potential benefits to future force**
- **focus on bridging capability gaps not specific components/aircrafts**

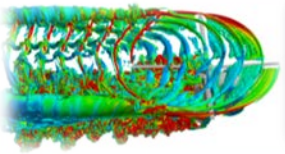
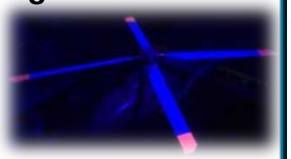
Innovation (ILIR)

Explore new ideas with potential benefits to future force

Aeromechanics

Complements 6.2 aeromechanics
Pursue long-standing barriers

University Research

Vertical Lift Centers of Excellence
Combine fundamental research with graduate education

PENNSTATE 1855
Georgia Institute of Technology
University of Maryland 1856

Collaboration

Coordinate with organizations both within and outside AMRDEC to identify capability gaps
Leverage joint interest areas with other DoD agencies (ARL, ARO, NAVY), NASA. Industry collaborations through Army's SBIR & STTR programs and NRTC. International collaboration through IPAs with France, Germany, and Israel. University collaborations through grants as well as through the VLRCOE

back to Focus Areas

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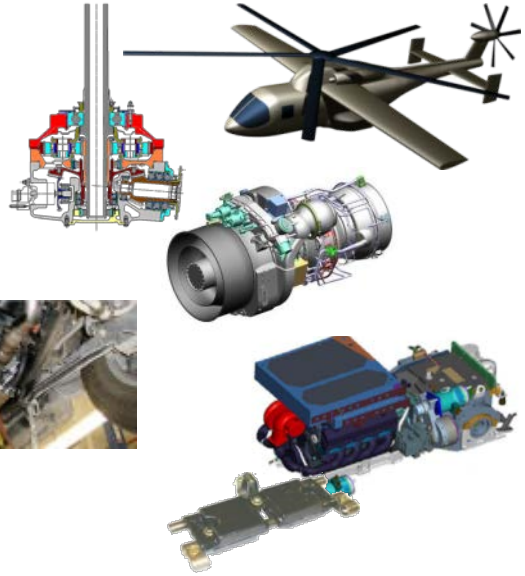
Platforms Focus Area

Technology Enablers

- **High speed rotor systems and air vehicle systems**
- **Advanced engine and drive systems**
- **Vehicle management systems**
- **Improved running gear**
- **Improved power-trains and data and energy management for platforms**
- **Sensors, systems, algorithms and process power for IED/mine detection and neutralization**
- **Advanced landing surfaces, small unit logistics**
- **Advanced airborne insertion technologies**

- **Platform Focus Area's (FA) current execution:**
  - **In-house Applied Research (6.2) capability balanced with Applied Research and Advanced Technology Development (6.3) investments with industry**
  - **Science & Technology focus with near term customer support capability**
  - **Focus on platform *performance, capability gaps* in class 5 & 6 fleet**
  - **Core S&T 6.2 / 6.3 programs augment JMR Tech Demo to enhance the capability of the future fleet**
  - **Depends on NASA / AF collaborative arrangements**



- **Long range strategy is to:**
  - **Maintain and enhance 'core' S&T programs,**
  - **Augment FVL development,**
  - **Grow into classes 0-2, and class 7 as requirements develop**

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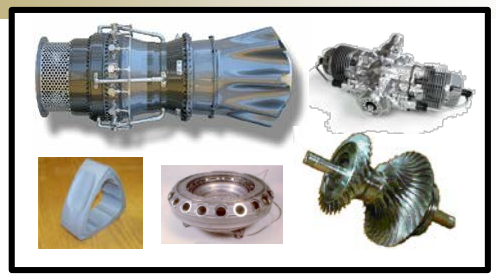
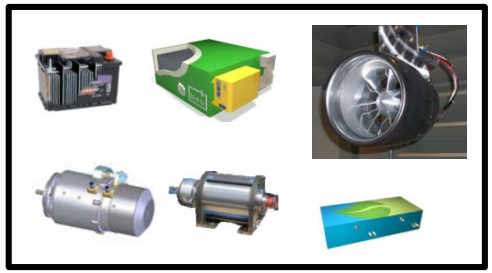
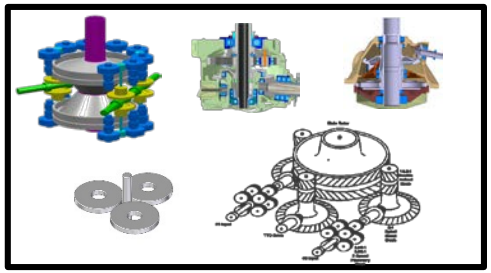
Power Focus Area



Engines and Motors



Other Power Sources



Drives and Power Transmission

Explore, develop and transition critical engine, drive system, and other power technologies that enhance the effectiveness of Army Aviation

Objectives:

- **Improve the power-to-weight ratio, specific fuel consumption, durability, reliability, maintainability and cost of engines & other power sources**
- **Improve the weight, noise, durability, maintainability and cost of rotorcraft drives and power transmission systems**

Payoffs:

- **Increased mission radius/endurance**
- **Increased payload capability**
- **Significant O&S cost savings**
- **Decreased maintenance downtime**
- **Increased readiness / OPTEMPO**
- **Reduced crew fatigue**

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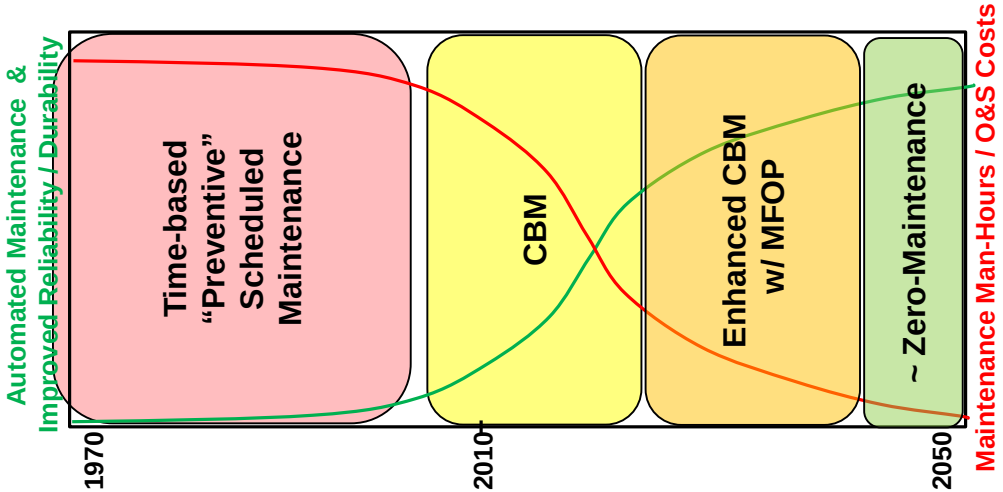
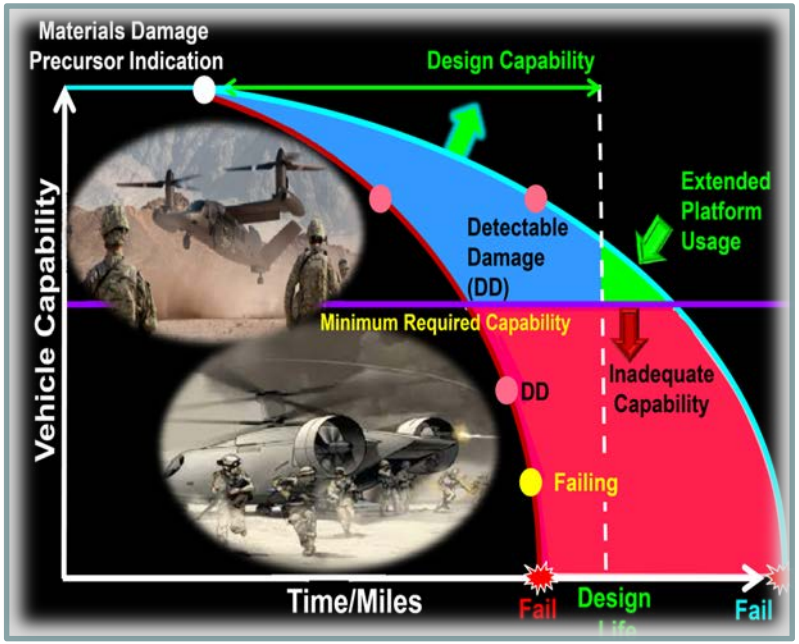
Sustainment Focus Area

- Historically balance design for performance considerations
  - High/Hot Hover
  - Max Speed Cruise
  - Time-based Maintenance
- Today's maintenance based on condition (CBM): Inspection and usage data intensive
- Future Design for Low Maintenance
  - Balance performance with LCC
  - Depends on autonomy of systems / controls, *automated inspections*
  - *Eliminate the need for fatigue repairs*
    - Initial design for reliability & durability
    - Structural monitoring / management of remaining useful life
  - *Extended Maintenance-Free Operating Periods (MFOP)*
  - *Increases Availability*
  - *Transition towards Zero-Maintenance*
- AMCOM Partnership: Supporting AMCOM CG's initiative of embedding sustainment logistician within AMRDEC S&T efforts





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Mission Systems Focus Area

Vision: Develop and deliver integrated capabilities that enable the Warfighter to safely and effectively conduct missions in increasingly complex environments.

The way to get there is through:

- Manned Unmanned Teaming & Mission Autonomy
- Optimizing Work Load to Maximize Human Performance
- Situational Awareness for Complex environments
- Total End to End Survivability
- Advanced Engagements
- Integrated Mission Systems

Payoffs

- Manage workload for aircrews
- Increased survivability
- Multi Purpose/Mode Sensors
- Remote sensor and weapons delivery
- Increased Lethality
- Improved Communications
- Reduced O&S Costs

back to Focus Areas

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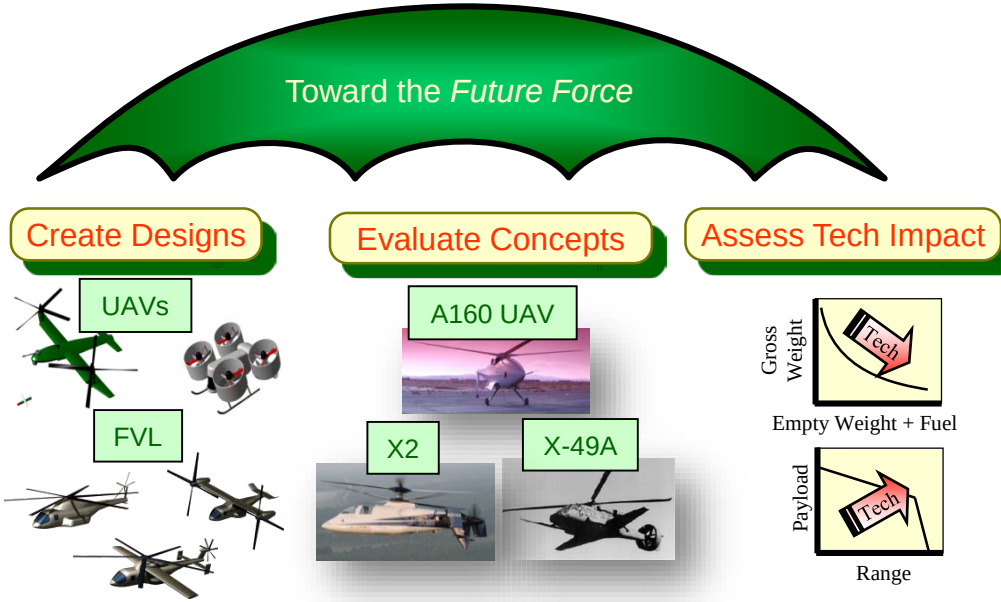
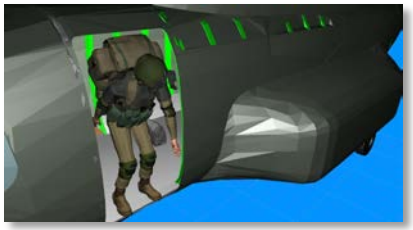
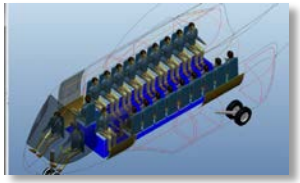
Concept Design & Assessment Focus Area

- **Tool Development**
  - Create design and assessment tools which enable accomplishment of the CD&A Technology Objectives
- **Concept Formulation and Evaluation**
  - Design and assess concepts like JMD-TD and FVL FoS
- **Concept "Deep Dive"**
  - Design and assess advanced concepts chosen by CD&A FA for which there may not be an immediate customer, but which exercise the CD&A capabilities, expand in-house capabilities, and investigate new technology areas and configurations
- **Technology Assessment**
  - Explore which technology (or combination of technologies) provides the most improvement relative to the resource investment made (the bang-for-the-buck)
- **Tech Objectives:**
  - Enhance Certainty of Design Sizing and Performance During Concept Development
    - Metric: Design Confidence Level (i.e., at x% of "truth")
  - Expand Capability for Design Assessments During Concept Development
    (e.g., Life Cycle Cost, Reliability, Mission Effectiveness, Downwash/Outwash)
    - Metric: Capability added to Design Environment
  - Improve Timeliness of Producing Designs and Assessments
    - Metric: Time to reach "final" design







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ADD Opportunities

- Adaptive Vertical Lift Engine Conceptual Design Analysis, BAA 2Q16
- Alternate Concept Engine – Large, RFP 2Q16
- Next Gen Rotorcraft Transmission, BAA 2Q16
- Multifunction Aircraft technologies for Survivability, Open due 3 Dec
- Aircraft and Aircrew Protection, BAA 2Q16
- Compound Test Bed, expect imminent RFI
- Architecture Implementation Process Demonstrations (AIPD), BAA responses due 18 Dec 15
- NVESD RFP on Fusion, RFI already released
- VLRCOE BAA Expected in Late Dec/early Jan (see next Slide)

back to Focus Areas

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Vertical Lift Research Centers of Excellence (VLRCOE)

- Traces back to 1982 ARO program
  - Focus on both research and academics
  - Strengthens academia's contribution to rotorcraft research & technology
  - Educates the next generation of S&Es

- Co-funded by Army, Navy & NASA
  - Annual review, 5 year re-compete
  - Currently three university centers

- "Cooperative agreement" – strong potential for government SME participation
  - Army SMEs closely involved with several tasks (AMRDEC: ADD & AED, ARL: VTD & ARO, NSRDEC)
  - Strong participation in technical review teams from Army, Navy & NASA

Current VLRCOE Program:

35 Project tasks at 3 University teams in focus areas of government interest.

Georgia Tech (w/ Michigan, Ohio St., Wash. U., Utah St., Texas-Arlington) 11 Tasks,

Penn State (w/ PSU App Res. Lab) 12 Tasks,

Univ. of Maryland (w/ Texas, N. Carolina A&T, Wyoming, US Naval Academy) 12 Tasks

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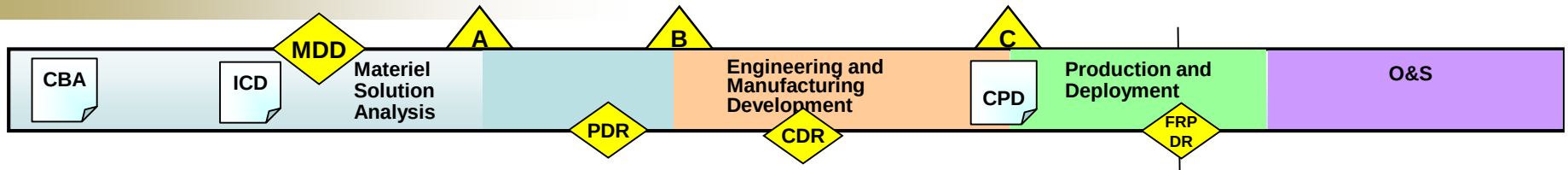
In 10 Core Functions…
ED Works Across The Lifecycle



Engineering Management
(1) Systems Engineering

Mission Assurance
(2)Test & Evaluation
(3) Product Assurance: Quality, Reliability
(4) Configuration Management

Production & Sustainment
(5) Industrial Base Assurance
(6) Production Engineering
(7) Logistics Engineering
(8) Lifecycle Cost Reduction
(9) Manufacturing Technology

(10) Rapid Response / Prototyping (PIF)

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Top 3 Major Accomplishments

- **Value Engineering**
  - **Attained Value Engineering Goal for 30 consecutive years**
  - **Starts with identifying issues that cost resources and using VE to resolve them**
  - **Success measured through savings but many other benefits**
  - **Industry can participate:**
    a. **Through VE clause in your contract (FAR 52.248)**
    b. **Approaching OEM or Partner who has the clause**
    c. **Approaching the PM/Platform manager**
    d. **Submitting proposal to CASL**

- **Logistics Engineering Lab**
  - **Collaborate between Logistics and Engineering Organizations to identify technical capabilities to improve logistics**
  - **Assess Technology Maturation for Supportability**
  - **Communicate Logistics Gaps/Needs to R&D organizations Working with Vertical Lift Consortium on two projects**
  - **Enhanced Maintenance Techniques**
  - **Integrated Product Support Data Analysis Seeking innovations to drive down life cycle costs in all areas of logistics**

- **Multi-Mission Launcher**

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Ongoing Initiatives

More than $50M in Applied Research

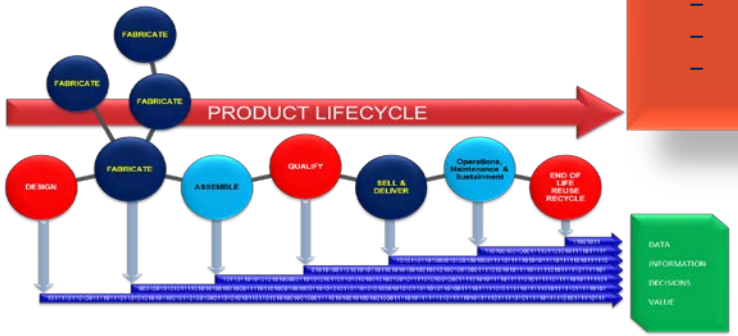
Mission: Digitize American Manufacturing

UI LABS Chicago, Illinois

Federal Funding: $ 70M
Cost Share (UI LABS): $248M

Over 3:1 Industry Cost Share

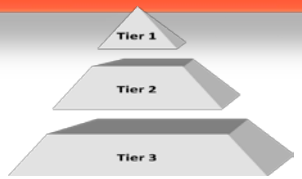
http://dmdii.uilabs.org



The National Network for Manufacturing Innovation

- There are currently 7 Manufacturing Innovation Institutes
  - America Makes (DoD/Air Force)
  - Power America (DOE)
  - Digital Manufacturing & Design Innovation Institute (DoD/Army)
  - Lightweight Innovation For Tomorrow – LIFT (DoD/Navy)
  - Institute for Advanced Composite Materials Innovation (DOE)
  - American Institute for Manufacturing Integrated Photonics = AIM Photonics (DoD/Army)
  - Flexible Hybrid Electronics Manufacturing Innovation Institute (DoD/Army)

Membership
98 Companies
53 Academic/NonProfit
1 State/Local Government
152 Members
111% growth since award



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Ongoing Initiatives

- **Team Redstone Additive Manufacturing (AM) Integrated Product Team (IPT) established May 2014.**
  - **Share AM knowledge and resources across RSA**
  - **Opportunity to propose presentation to AM IPT**

- **Joint Army/Navy/NASA/Air Force Technical Interchange Meeting on Additive Manufacturing expected fall 2016**
  - **Attend or submit paper for presentation**

- **AM Manufacturing Technology Programs**
  - **Corpus Christy Army Depot (CCAD) Asset Reclamation (FY14-18)**
  - **GE Engine Components (FY14-18)**

- **America Makes National Manufacturing Innovation Institute**

Dr. Phil Farrington (UAH) or Dr. Amy Lawrence (BLDG. 5400)

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Aviation ENGINEERING

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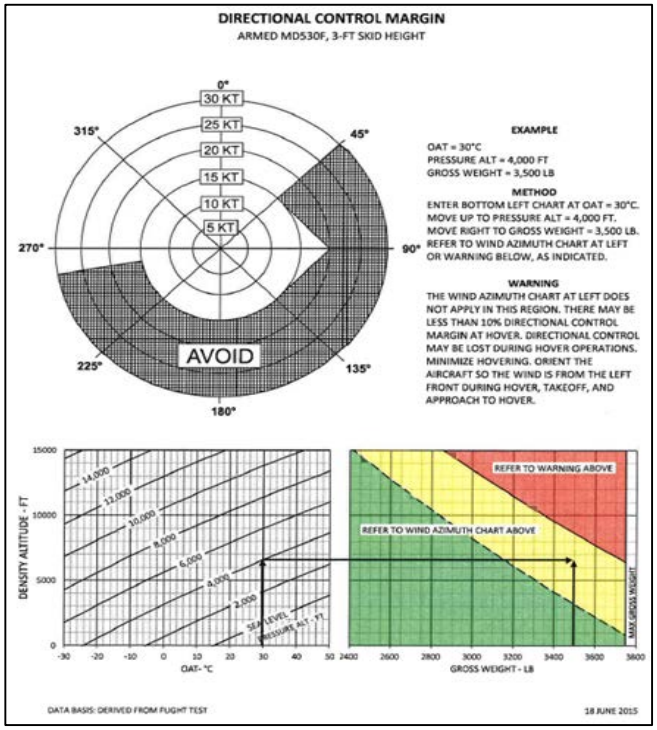
Top 3 Major Accomplishments

- **Directional Control Margin Chart Update for Armed MD530F for Afghanistan Air Force**



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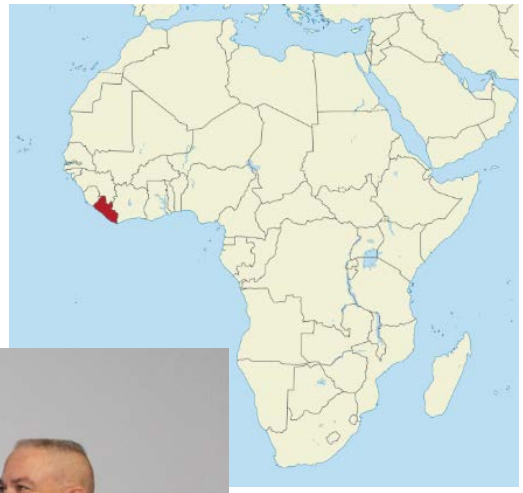
Top 3 Major Accomplishments

- **Support of Operation United Assistance in Liberia in response to Ebola epidemic**



- **Additional Recognition of Foreign Military Airworthiness Agreements (MAA)**
  - **Sweden (02 Mar 15)**
  - **Italy (23 Mar 15)**
  - **Canada (31 Mar 15)**
  - **France (28 Sep 15)**

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Current Projects

- **UH-60V**
  - **Updates analog architecture with digital infrastructure**
  - **Provides enhanced aircrew mission situational awareness, decreased pilot workload, and increase mission safety**

- **Joint Multi-Role (JMR)**
  - **Technology Demonstrator as Precursor to FVL**
  - **Co-Chair Flight Safety Review Board**

- **Future Vertical Lift (FVL) & Improved Turbine Engine (ITE)**
  - **Strategic Advance in Vertical Lift Capabilities for Warfighter**

- **Non-Standard Maintenance Actions**
  - **Engineer "one-time" fixes (Maintenance Engineering Calls) to keep Soldiers safe and aircraft flying**

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Futures Projects – Industry/Academia Support

- **Qualification of Software, Complex Systems, and Cybersecurity**
  - **How do we certify complex software systems in a timely, cost-effective manner?**
  - **How to go beyond traditional Information Assurance (IA) to ensure true Cybersecurity for the *entire* aircraft?**

- **Composite Materials**
  - **How to sustain and repair composite primary structural components while maintaining fatigue and static strength?**
  - **How to create and integrate new tools, processes, and training early in the life cycle?**

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Future Projects – Industry/Academia Support

- **Additive Manufacturing**
  - **How do we ensure repeatability, process controls, material properties, overall quality?**
  - **How to we qualify/certify these parts and processes?**
  - **How do we life these parts?**
  - **How do we repair these parts?**

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Systems Simulation Software & Integration
S3I

SSDD
SYSTEM SIMULATION AND DEVELOPMENT DIRECTORATE

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Major Functions & Customers

- PEO Missiles & Space
  - All PM's
- PEO Aviation
  - All PM's
- Missile Defense Agency
  - DE, DV, DT, DT, SN, BC, AB
- PEO STRI
  - PM ITTS, PM TRADE
- PM Force Protection
- TRADOC
  - TCM-LIVE
- many others

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Major Accomplishments

- **Repurpose of US Army Longbow HELLFIRE missile for use on US Navy Littoral Combat Ship (LCS).**
  - **The weapon originally designed for Armored land targets is being fired from LCS to engage Fast Attack Craft (FAC).**
  - **The missiles are being re-programmed with new software completely built and tested in house at AMRDEC to support this new mission.**

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Major Accomplishments

- **The AMRDEC JAGM simulation team has supported three JAGM ground launched test flights.**
  - **Generated preflight scenarios and detailed analysis of results to assist decision makers in the Joint Attack Munitions Systems (JAMS) Project Office.**
  - **The setup of the selected scenario was provided to the JAGM Hardware In The Loop (HWIL) team to execute on JAGM hardware in the Advanced Multi-spectral Simulation Test Acceptance Resource (AMSTAR) facility.**

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Major Accomplishments

- **Technology Test & Evaluation Center (TTEC) established.**
  - **The TTEC is an AMRDEC Hardware-in-the-Loop (HWIL) facility developed for the Advanced Technology Directorate of the Missile Defense Agency (MDA/DV).**
  - **The TTEC's mission is to integrate and test MDA advanced hardware technologies.**
  - **The TTEC's current capabilities include a HWIL incorporating multiple real-time digital simulations and state-of-the-art synthetic scene generation and projection.**

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Current Projects

- Development of the Redesigned Kill Vehicle (RKV) Development Labs (RDL). The RDL will incorporate software-in-the-loop (SIL), processor-in-the-loop (PIL), and a full hardware-in-the-loop (HWIL) labs in order to provide an independent government capability .
- The Soldier Protection Lab is currently working on Deployment of force protection systems for the Horn of Africa (HOA).
- CUAS targets work – Supporting multiple organizations/agencies with small UAS targets to include SURREY (fixed wing) and organically grown VTOL (Multi-rotor) targets .
- Sustainable Range Program design and review for Army Live Fire Training Ranges.
- Integrated Defense Planner (IDP) capability reached Integration Milestone 2 which consists of integrating IAMD IBCS Integrated Defense Planner to the MDA C2BMC Defense Planner.
- Working with Close Combat Weapon Systems (CCWS) and Redstone Test Center (RTC) to finalize a flight test matrix that will best evaluate the new SSXBT.

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Future Projects – Industry/Academia Support

- **Swarming technology of small UAS platforms**
- **Energy Projects much like last year's Windmill Competition.**
- **Functional programming for simulation frameworks and secure hardware platforms**
- **Integrated Counter UAS ideas to support cooperative detection and tracking of threats using multiple UAVs**
- **Big Data Analytics automation of data collection and layering research**
- **Improvements to Blast models to address lethality**
- **Improvements to RF signature prediction codes**
- **Improvements to IR signature prediction codes**

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Systems Simulation Software & Integration
S3I

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Top 3 Major Accomplishments

- **Completed and implemented the design for the Multi-Mission Launcher (MML) and are actively integrating with three interceptor varieties and two Command Control systems.**

- **Joint Battle Command Platform (JBC-P) fielded to the First Unit Equipped (FUE) in Dec 2014 to Ft Stewart, Second Unit Equipped was delivered, 03 Nov 15 to Ft Drum, 10 MNT DIVARTY training.**

- **The GoArmy Edge product line launched with football on August 6, 2015 in conjunction with the Pro Football Hall of Fame Induction.**

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Current Projects

- **SED completed the development and qualification phase of the High Mobility Artillery Rocket System (HIMARS) tactical software redesign effort. The program is currently in the certification phase to obtain Software Material Release (SMR) for target fielding in FY16.**

- **Materiel Common Operating Picture (M-COP) visualizes the Army's materiel enterprise, including the end-to-end logistics supply chain activities.**

- **The SED performed a successful transition of the High Energy Laser Mobile Demonstrator (HEL MD) from the Prime Contractor. and has established a software development environment for the HEL**

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Future Projects – Industry/Academia Support

- **The AMRDEC has an Educational Partnership Agreement (EPA) with Tennessee Tech University to pursue the development of education content in multiple subject areas applicable to high school teachers and students to enhance U.S. Army and Tennessee Tech Science, Technology, Engineering and Mathematics (STEM) based outreach.**

- **The AMRDEC is currently mentoring future professionals in the area of cyber security through the CyberCorps Scholarship for Service (SFS) Programs at the University of Alabama in Huntsville (UAH) and at the University of South Alabama. The SFS program provides scholarships to students in the area of cyber security in exchange for government service during the summer and upon graduation. Future plans for the AMRDEC's Cyber Intern program include expanding internship opportunities to students at other SFS universities including Auburn University.**

- **The AMRDEC has developed cyber security curriculum for Huntsville City Schools which is currently being taught in multiple high schools. Topics covered include Operating Systems, Networking Fundamentals, and Application, Data and Host Security. AMRDEC will continue to refine the curriculum thereby providing training towards our future cyber workforce.**

- **The Institutional Conduct of Fire (ICOFT) provides realistic institutional training in all areas of the THAAD Enhanced Operator/Maintainer (EOM) operations and maintenance tasks for the THAAD Fire Control and Communication (TFCC), Radar, and Launcher components.**

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CYBER

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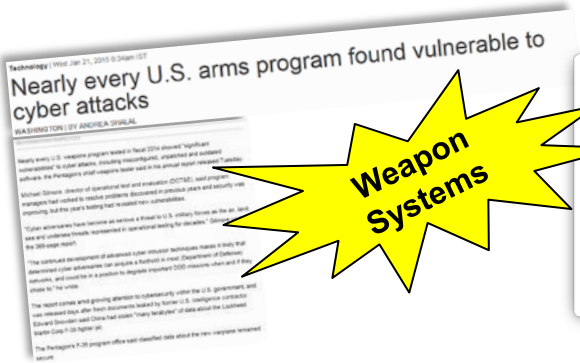
Cyber Threats

Personnel Data

"OPM recently discovered two separate but related cybersecurity incidents…In April 2015, OPM discovered that the personnel data of 4.2 million current and former Federal government employees had been stolen. This means information such as full name, birth date, home address and Social Security Numbers were affected."

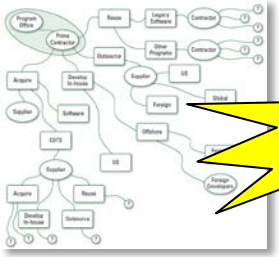
August 9, 2015



Weapon Systems

"Nearly every U.S. weapons program tested in fiscal 2014 showed 'significant vulnerabilities' to cyber attacks, including misconfigured, unpatched and outdated software, the Pentagon's chief weapons tester said in his annual report released Tuesday."

January 21, 2015



Supply Chain

- **USG Has Limited To No Direct Control And Obscured Visibility Of Component Pedigree And Processes Or "Chain Of Custody"**
- **Effects: Steal Critical Data / Technology, Corrupt Systems / Infrastructure, Disable Or Disrupt Mission-Critical Operations**

Cyber Attacks Are Increasing In Frequency, Sophistication, & Number Of People Impacted

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AMRDEC Cyber Vision

- AMRDEC is the authoritative source for **system security engineering for aviation and missile systems** from materiel development through system operation, upgrade, and sustainment.
- AMRDEC has a mature capability to **analyze emerging and evolving threats to aviation and missile systems in the cyber domain** and **rapidly develop and deploy appropriate protections**.
- AMRDEC conducts **research and development of cyber technologies** applicable to aviation and missile systems to maintain the technical advantage over our adversaries.
- AMRDEC actively **collaborates and coordinates cyber activities with Redstone Arsenal industry, academic, and government partners**.
- AMRDEC serves as a resource for materiel developers and tactical units in the reserve component to **integrate advanced technologies and techniques to counter the cyber threat**.

AMRDEC Has A Clear Vision For Where We Will Focus Our Resources In The Cyber Domain

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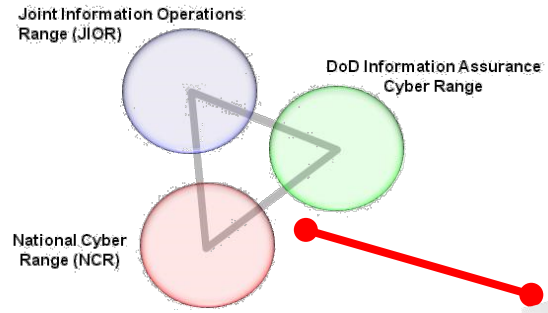
AMRDEC Cyber Vision

- AMRDEC Began A Deliberate Cyber Strategic Approach In 2012
- Initial Cyber Capabilities At AMRDEC Have Been Leveraged To Assist DoD Organizations



WDI Lab

Cyber Solutions Center

CND Lab

AMRDEC Is On Track With 2012 Vision

- Vulnerability Assessment
- Network Defense
- Software Assurance
- Computer Forensics
- Industrial Control Systems

FY 2012 ✓ → FY 2013 ✓ → FY 2014 ✓ → IOC → FY 2015 → FY 2016 → **FY 2017** FOC

IOC - Initial Operating Capability
FOC – Full Operational Capability

AMRDEC Understands The Strategic Value Of Investing In Cybersecurity

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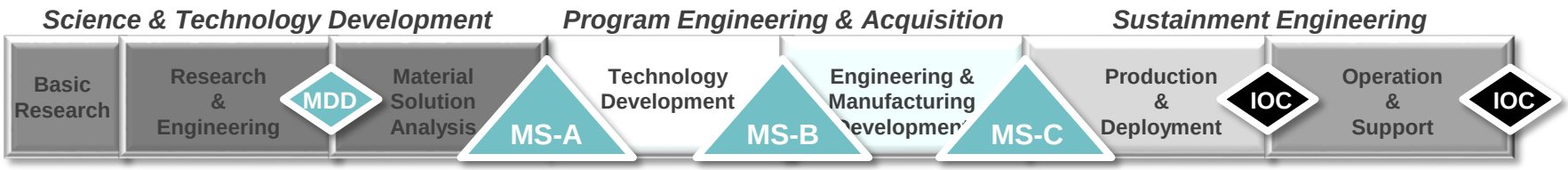
AMRDEC Strategic Pillars



Protecting and Enabling the Aviation & Missile Enterprise Throughout the Life Cycle

- **System Security Engineering**
  - System Owner Support
  - Agent of the Certification Authority
  - Vulnerability Assessment / Blue Team
- **Software Assurance**
- **Computer Network Defense**
- **Protective Technologies**
- **Supply Chain Security**
- **Simulation, Test, & Evaluation**
- **Cyber R&D**
- **Outreach / Training / Education**

AMRDEC Executes Its Vision At The Cyber Campus Through Eight Strategic Pillars

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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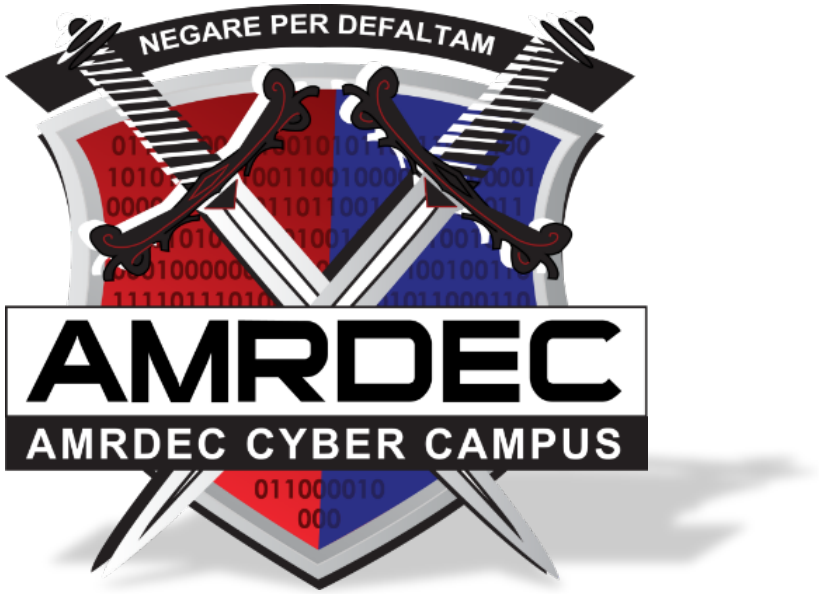
AMRDEC Cyber Campus

- Standing up a cyber campus that supports the AMRDEC vision
- Over 66,000 sq. ft.
- Co-located organizations
- Multi-level security in close proximity
- Connected to key cyber
- Initial operating capability (IOC) FY15
- Fully operational capability (FOC) FY17



The AMRDEC Cyber Campus Will Be An Invaluable Asset For RSA And DoD

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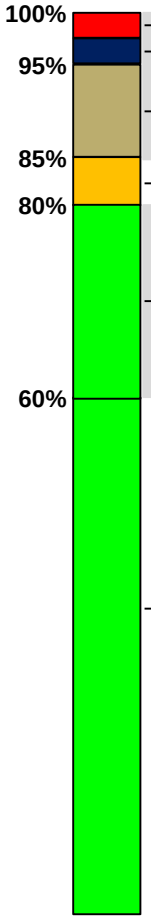
Cyber Spectrum

- There are gaps in current security requirements
- In some cases, requirements are not clear or even defined yet
- The spectrum of system security engineering includes a number of disparate efforts
- Replacing the term "information assurance" with "cybersecurity" is misleading



Activity	Guidance	Tools
Red Team (2.5%) Blue Team (2.5%) Vulnerability Assessment & Engineering	DoDD O-8530.1 DoDI O-8530.2 CJCSI 6510.01	NMap, Nessus, MetaSploit, Burp Suite, PowerShell, Air Crack, Wireshark, Cobalt Strike, etc.
HW/FW Testing	DoDI 5200.44	FIB, SEM, X-Ray, etc.
Software Assurance	2013 NDAA DoDI 5200.39 DISA STIG DoDI 5200.44	Fortify, CheckMarx, CodeSonar, AdaCore, Coverity, etc. Cuckoo Sandbox, FireEye, etc.
Accreditation & Authorization *(Risk Management Framework, Formerly DIACAP)*	DoDD 8500.01 DoDI 8510.01 DoDI 5000.02 DoDM 5200.01 Army BBPs CJCSI 6510.01 CNSSP 22 CNSSI 1253 NIST SP 800 series FISMA OMB Circular 130	ACAS\Nessus, SCAP, CMRS, HBSS, Compliance Checker, STIG Viewer

Addressing The Entire Cyber Spectrum Will Produce Better Acquisition Outcomes

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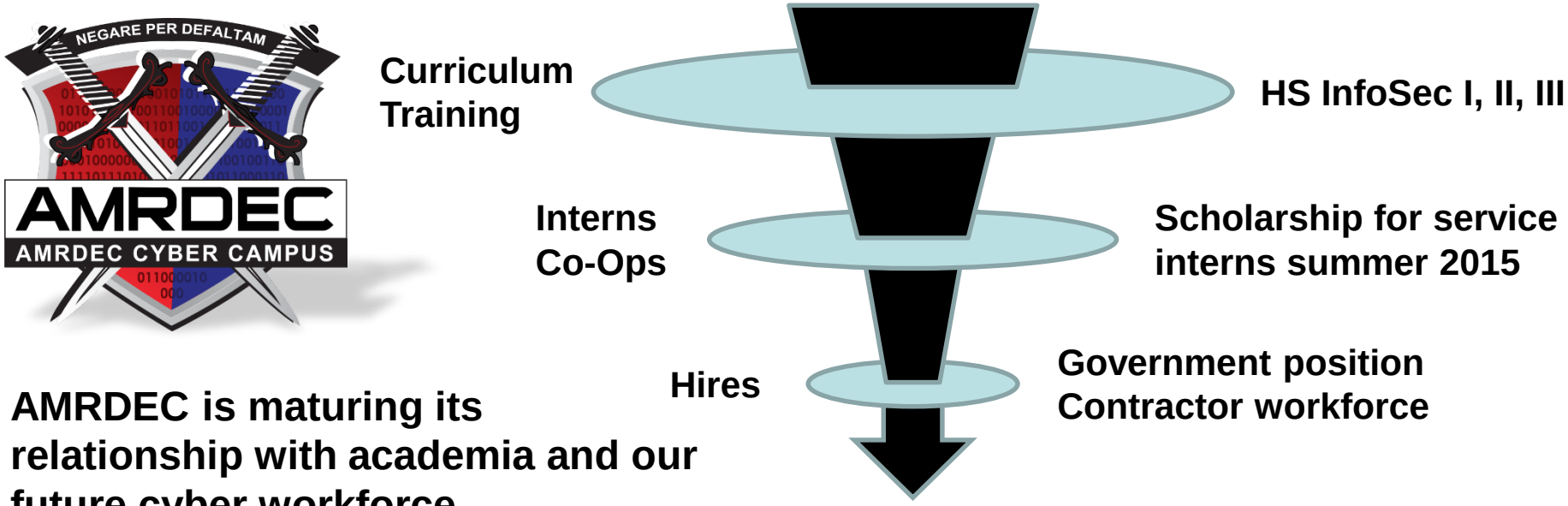
Academia To Workforce



- AMRDEC is maturing its relationship with academia and our future cyber workforce
- Emphasis will continue to be on technical, hands-on talent
- The AMRDEC cyber campus offers diverse cyber career opportunities

- Software/hardware assurance
- Computer network defense
- Information assurance
- Penetration testing
- Advanced vulnerability assessment
- Cyber research & development

AMRDEC Actively Engages Institutions That Shape Our Current & Future Cyber Workforce

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Outreach: Cyber Huntsville

- Chair Of Cyber Huntsville Gov't IPT
- Government Ex Officio Board Member on the Board Of Directors, Executive Committee And Advisory Council
- Key Planner Of Oct 2014 Tabletop Exercise
- Gov't IPT Invitees Include:
  - AMC G6/G3/G2
  - AMCOM
  - AMRDEC
  - MDA
  - City of Huntsville
  - MSIC
  - FBI
  - Huntsville Utilities
  - Inspector General
  - LOGSA
  - SMDC
  - NASA
  - NEC-R
  - PEO Aviation
  - PEO Missiles and Space
  - RTC
  - TSMO
  - TVA

AMRDEC Has Been A Leader In Community Outreach For Cyber Since 2011

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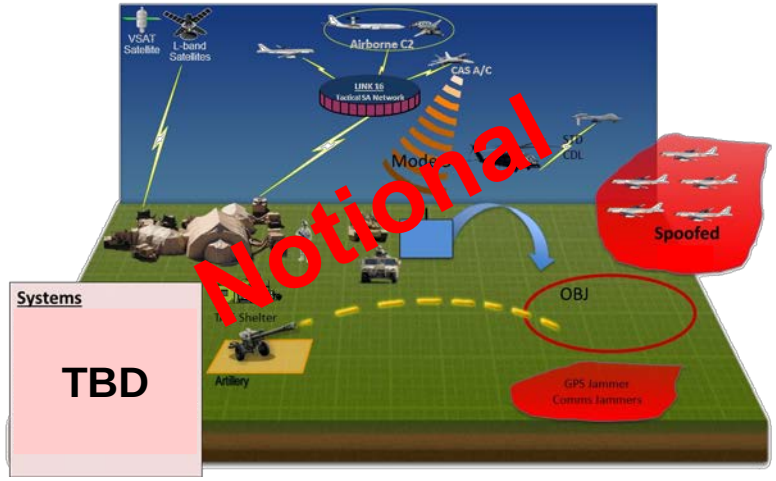
Jan 2017 (tent.) RSA Cyber Demo

DRAFT OV1 – Scenario 1



Participants	Planned Contributions (Tentative)
SMDC	TBD
AMRDEC	TBD
PEO-MS	TBD
PEO-AVN	TBD
MSIC	TBD
RTC	TBD
TSMO/JMETC	TBD

Purpose

- Demonstrate Redstone integrated capabilities
- Develop capabilities to develop, model, and evaluate system vulnerabilities, supply chain risk & performance against cyber attacks
- Identify requirements for weapon and communication systems in cyber contested environments

Results/products

- "Good enough" virtual systems to provide confidence in the data produced
- Processes and procedures in POS and supporting organizations for vulnerability assessment and other cyber-related testing
- Prioritized requirements for fielded and developmental systems
- Development and test tools

Payoff/benefits

- Demonstrate criticality of developing system defense and resiliency against cyber threats
- Demonstrate initial footprint of cyber testbed
- Drive coordination of Redstone cyber investments

Team Redstone Cyber Is Working Towards An Integrated Cyber Exhibition January 2017

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DOING BUSINESS WITH AMRDEC

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Major Non-FAR Mechanisms used by AMRDEC for Partnerships

- **Cooperative Research and Development Agreements**
- **Testing & Engineering Services Agreements**
- **Patent & Intellectual Property Licensing**
- **Education Partnership Agreements**
  - **Limited to educational institutions & non-profits**

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How to Start the Process

1. **Identify technology/lab facility area of interest and AMRDEC Point of Contact**

2. **Reach out to AMRDEC TPOC to set up initial interchange meeting**

3. **If mutual interest exists, contact AMRDEC Office of Research & Technology Applications**

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Technology Transfer Contacts

Dr. Russ Alexander
ORTA@amrdec.army.mil

Ms. Cindy Wallace
ORTA@amrdec.army.mil

PATENTS AVAILABLE FOR LICENSING
http://www.amrdec.army.mil/amrdec/DoingBusinessWith/CurrentOpportunities.aspx

Public Affairs
AMRDEC-PAO@amrdec.army.mil

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Briefings and a survey will be posted on the conference site https://conference.redstone.army.mil/
Questions after event – strategicplanning@amrdec.army.mil

AMRDEC Web Site
www.amrdec.army.mil

Facebook
www.facebook.com/rdecom.amrdec

YouTube
www.youtube.com/user/AMRDEC

Mr. James Lackey's Twitter
@JLackey2

Public Affairs
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