Presented to:

Huntsville Aerospace Marketing Association

Army Aviation S&T Overview

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Science & Technology

Focus:

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

Strategies:

- Develop the body of technical **knowledge** that supports decisions and mature critical technologies
- Develop and validate new technology-enabled operational concepts

ADD
Unique Facilities

Ballistics Test Facility

Ft. Eustis, VA
Component Testing

Countermeasures Test Facility

Ft. Eustis, VA
Signature Characterization of Turbine Engines

Structural Test Facility

Ft. Eustis, VA
Rotor- Blade Test Fixture and Structures Backstop for Loads/Fatigue Testing

14-by-22 Foot Subsonic Tunnel

NASA Langley, VA
Helicopter Aerodynamics, Performance and Configurations

National Full-Scale Aerodynamics Complex

Moffett Field, CA
Advanced Testing of Full Scale Rotorcraft

Large Rotor Test Apparatus

Moffett Field, CA
Full Scale Rotorcraft Component Testing

Tiltrotor Test Rig

NASA Langley, VA
Full Scale Tilt-Rotor Testing

Army Aviation Challenges

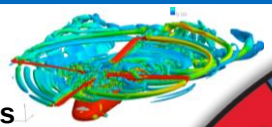
- From the Aviation Science & Technology Strategic Plan (ASSP) 2014:

- **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!

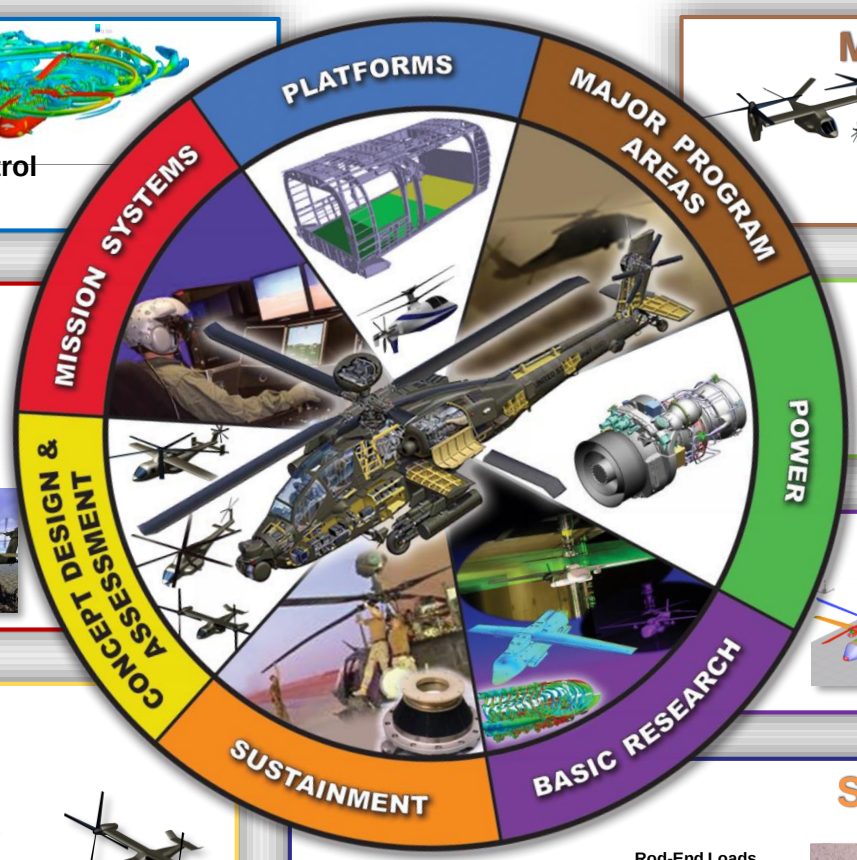
Army Aviation S&T Focus Areas

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

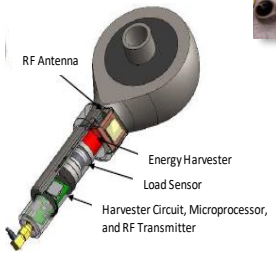
Basic Research

Concept Design and Assessment

Sustainment

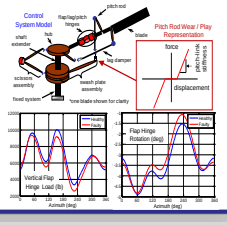
MDOF Main Rotor Motions & Loads

Rod-End Loads



Push-Rod Loads

Rotor Aeroelastic Models



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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:

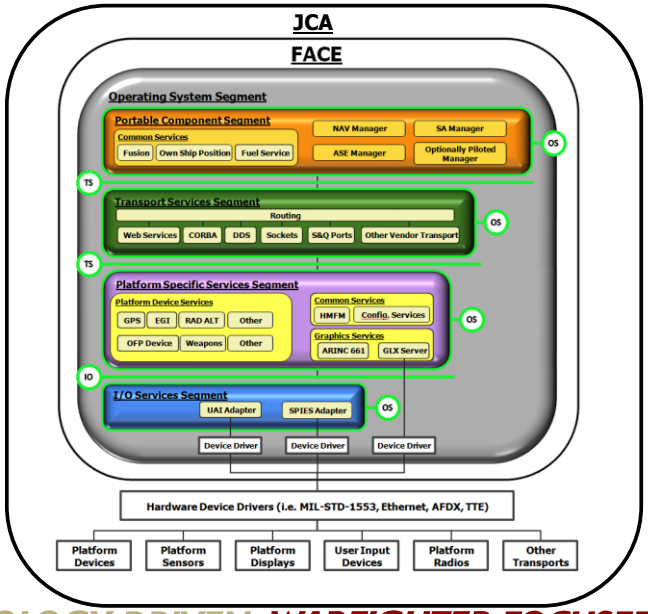
- Two demonstrator test bed aircraft
- Foundation for cost analysis for future capabilities
- Technology maturation plans

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

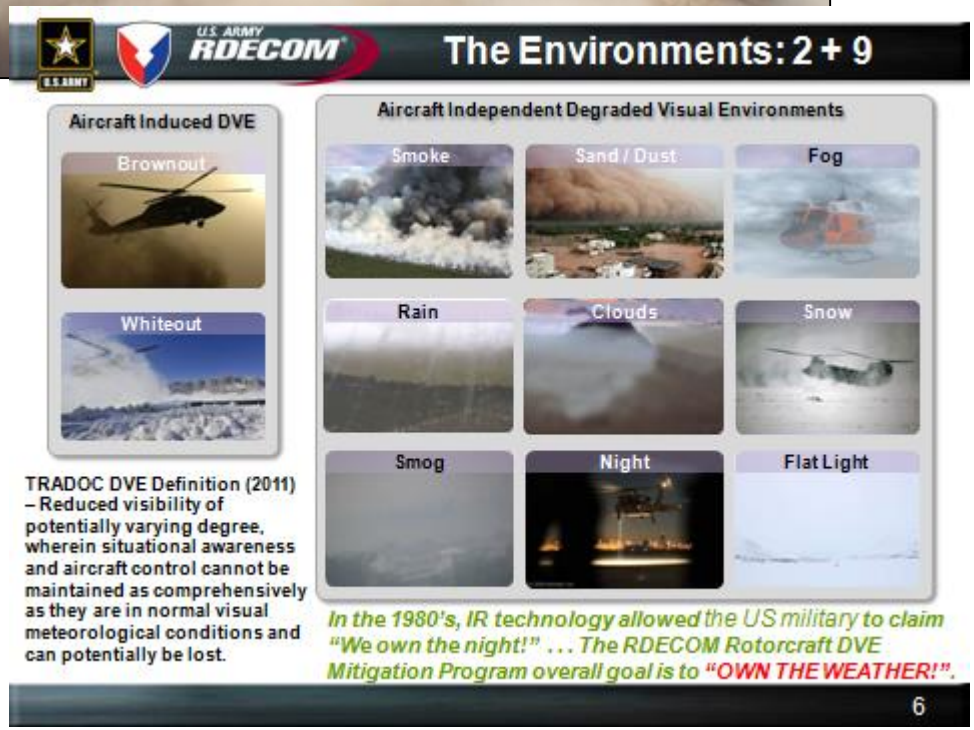
Air Vehicle Demo (AVD)

Mission Systems Architecture Demo (MSAD)



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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.)

Product:

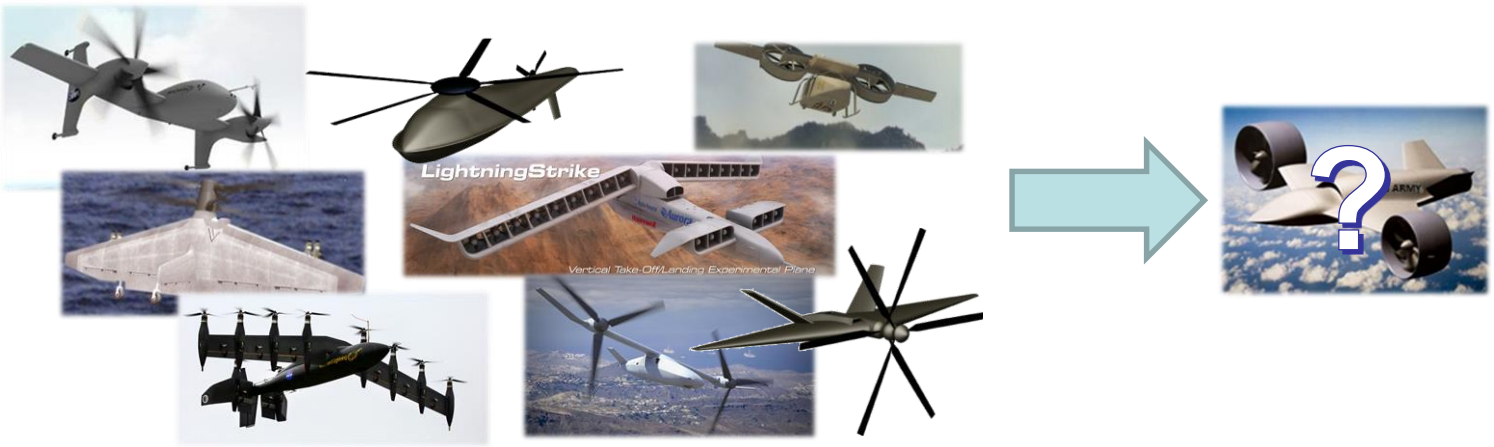
Knowledge & Risk Reduction for PEO Aviation, DoD and NATO members for the future. Demonstrated multi-spectral sensor system(s), modernized control laws, and advanced cueing for DVE pilotage and multi-functional attributes for 360º situational awareness that allow implementation of pilot decision aiding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

Overview

- The Next Generation (NexGen) Tactical Unmanned Aircraft System (TUAS) Technology Demonstration program (NG TUAS TD) is a Science and Technology (S&T) effort supporting the development of a Future TUAS (FTUAS) for a PEO-Aviation Program of Record



- The S&T focus is to mature and demonstrate air vehicle technologies that overcome key barriers preventing desired FTUAS performance
- This enables challenging yet achievable requirements to be defined, and an industry poised to meet the requirements

FTUAS Characteristics

Key Attributes of FUAS:

- Reach
- Protection
- Lethality

The FTUAS is expected to have the following capabilities:

- Expeditionary
- Runway Independent
- Maritime Capable
- GPS/Cyber-denied operations
- Degraded weather environments

The FTUAS will be a multi-role platform. Expected missions include:

- Reconnaissance and Security
- Attack and Armed Escort
- Communications Relay
- Electronic Warfare (EW)
- Counter-UAS
- Counter Integrated Air Defense

Venues

- Broad Area Announcements
- Vertical Lift Consortium OTA
- Small Business Innovative Research
- Technology Investment Agreements
- Cooperative Research and Development Agreements
- Test Support Agreements
- International Collaboration
  - NATO
  - TTCP
  - Bi-lateral

Questions?

Basic Research Focus Area

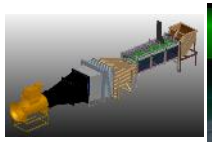
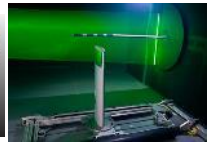
Basic research is a systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and observable facts without specific applications towards processes or products in mind.

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)

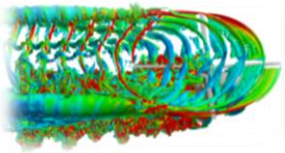
Explore new ideas with potential benefits to future force

Aeromechanics

Complements 6.2 aeromechanics

Pursue long-standing barriers




University Research

Vertical Lift Centers of Excellence

Combine fundamental research with graduate education

PENNSTATE

Georgia Institute of Technology

University of Maryland 1856

Collaboration

Coordinate with organizations both within and outside AMRDEC to identify capability gaps

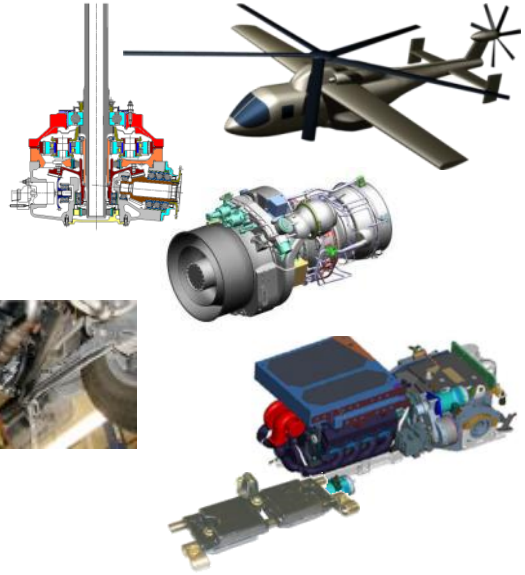
Leverage joint interest areas with other DoD agencies (ARL, ARO, Navy, Air Force), NASA. Industry collaborations through Army's SBIR & STTR programs and NRTC. International collaboration through IPAs with France, Germany, and Israel. University collaborations through grants as well as through the VLRCOE

Platforms Focus Area

Technology Enablers

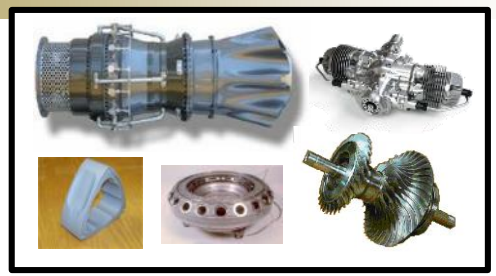
- High speed rotor systems and air vehicle systems
- Advanced engine and drive systems
- Vehicle management systems
- Improved running gear
- Improved power-trains and data and energy management for platforms
- Sensors, systems, algorithms and process power for IED/mine detection and neutralization
- 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

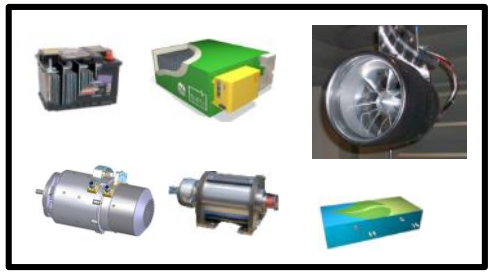


- **Long range strategy is to:**
  - Maintain and enhance 'core' S&T programs,
  - Augment FVL development,
  - Grow into classes 0-2, and class 7 as requirements develop

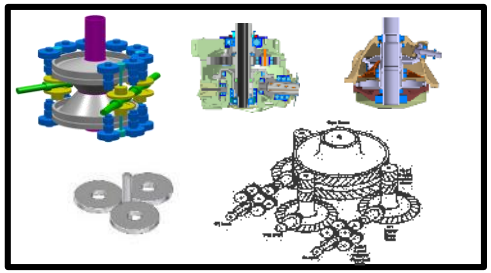
Power Focus Area



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:

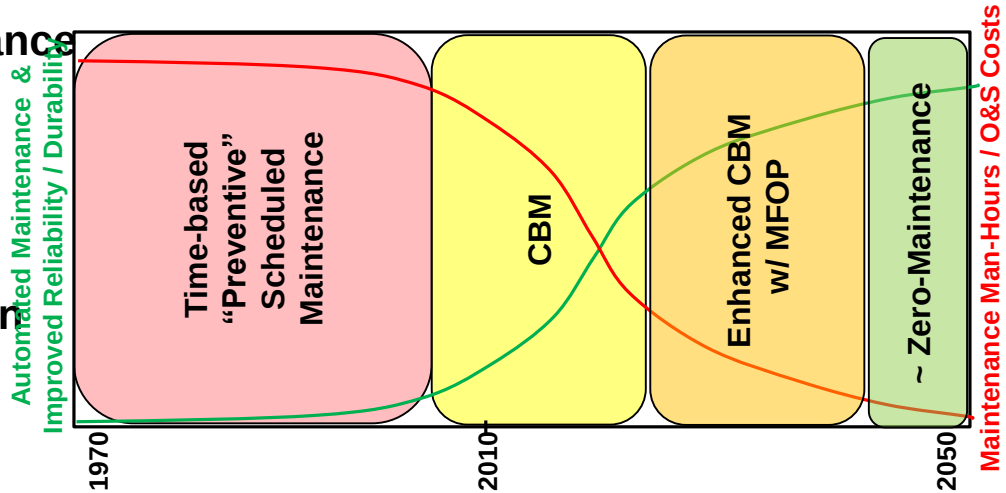
- Improve the power-to-weight ratio, specific fuel consumption, durability, reliability, maintainability and cost of engines & other power sources
- Improve the weight, noise, durability, maintainability and cost of rotorcraft drives and power transmission systems

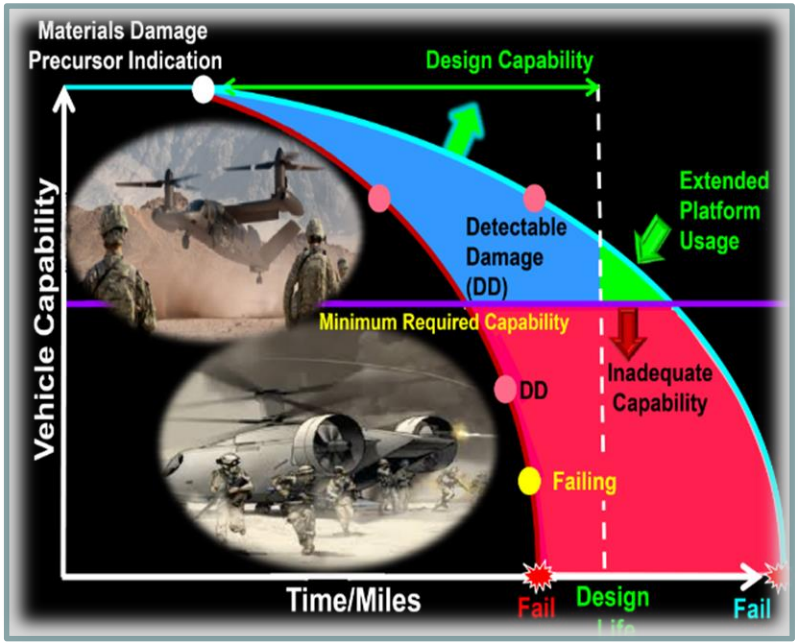
Payoffs:

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

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**





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:

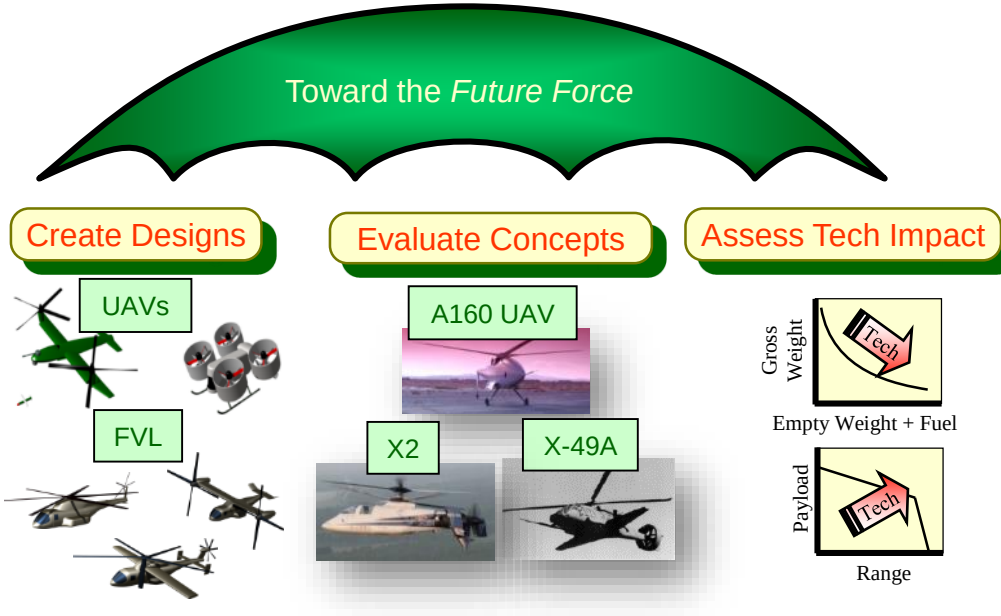
- Manned Unmanned Teaming & Mission Autonomy
- Optimizing Work Load to Maximize Human Performance
- Situational Awareness for Complex environments
- Total End to End Survivability
- Advanced Engagements
- Integrated Mission Systems

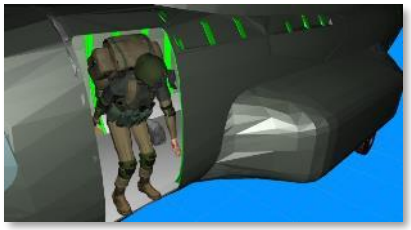
Payoffs

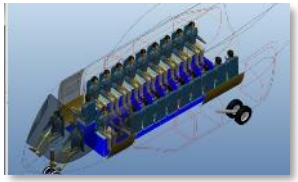
- Manage workload for aircrews
- Increased survivability
- Multi Purpose/Mode Sensors
- Remote sensor and weapons delivery
- Increased Lethality
- Improved Communications
- Reduced O&S Costs

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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