Bottom Line Up Front

- Aviation 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 the 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
Empower a preeminent, distributed, collaborative Aviation workforce that:
- Discovers new technologies and approaches
- Develops advanced concepts
- Demonstrates technical maturity
- Delivers the Warfighter capabilities to dominate the battlefield
TEST FACILITIES AND WIND TUNNELS
FT. EUSTIS, VA | HAMPTON, VA | MOFFETT FIELD, CA

Ballistics Test Range
Ft. Eustis, VA
Fuel Tank Testing up to 30 mm Ammunition

Countermeasures Test Facility
Ft. Eustis, VA
Acoustic/Infrared Radiation Testing of Turbine Engines

Structural Test Facility
Ft. Eustis, VA
Rotor-Blade Test Fixture for Loads and Fatigue Testing

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

Transonic Dynamics Tunnel
Hampton, VA
Helicopter Performance, Loads, and Stability Testing
Aviation S&T Portfolio

+ Basic Research

Rotors & Vehicle Management
- Improved Vehicle Performance
- Reduced Vibrations
- Reduced Acoustic Signature
- Adaptive Vehicle Management

Engines & Drive Trains
- Increased Fuel Efficiency Engines
- Lightweight Drive Trains
- Improved Reliability and Durability
  - Reduced Weight/Vibration

Unmanned & Optionally Manned Systems
- Common Human Machine Interface
- Increased Levels of Autonomy
- Manned-Unmanned Intelligent Teaming

Aircraft & Occupant Survivability
- Reduced Vehicle Signatures
- Threat Warning Sensors
- Active Jammers & Decoys
- Opaque & Transparent Armor
  - Energy Absorbing Seats & Landing Gear
  - Weapons Integration

Maintainability & Sustainability
- Reduced Maintenance Actions
- Improved Reliability
- Improved Mission Readiness
- Reduced Spares Logistics

Platform Design & Structures
- Advanced Air Vehicle System Concepts
- Joint Multi-Role Technology Demonstrator
- Rotorcraft Airframe Technology
- Platform Durability and Damage Tolerance
- National Rotorcraft Technology Center

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.
The future operational environment demands:

- Simultaneous, distributed, non-contiguous operations
- Worldwide, full-spectrum operational capability
- Greater range/endurance and improved responsiveness
- Smaller logistics footprint
- Increased reliance on force sustainment by Aviation

High elevations
Mountains and deserts
Jungles and dense forests
Poor infrastructure
Degraded visual environments
Heavy payloads

Strategic deployments and long logistics tails

Complex demographics

Occupant Survivability

Manned-Unmanned Teaming
The DoD rotary wing aviation fleet is aging and upgrades do not provide the capabilities required by the future fleet.

Congress places emphasis on future vertical lift.

The User recognizes the need and is planning for FVL.

OSD, USAACE and Joint community are defining the attributes to provide required capabilities.

The current op tempo in-theater is 5X the peacetime rate, further taxing an already aging fleet.
## FVL Emerging Attributes

<table>
<thead>
<tr>
<th></th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
<th>Ultra</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed</strong></td>
<td>&gt;170-300+ kts</td>
<td>&gt;170-300+ kts</td>
<td>&gt;170-300+ kts</td>
<td>300+ kts</td>
</tr>
<tr>
<td><strong>Combat Radius</strong></td>
<td>~424 km</td>
<td>~424 km</td>
<td>~424 km</td>
<td>~462 km</td>
</tr>
<tr>
<td><strong>Payload (Int)</strong></td>
<td>~2.5k+ lbs</td>
<td>~5k - 20k lbs</td>
<td>~20-30k lbs</td>
<td>~40-72k lbs</td>
</tr>
<tr>
<td><strong>Payload (Ext)</strong></td>
<td>~2.5k+ lbs</td>
<td>~13k - 23k lbs</td>
<td>~30k lbs</td>
<td>~40-72k lbs</td>
</tr>
<tr>
<td><strong>Passengers</strong></td>
<td>~4-6</td>
<td>~13-24</td>
<td>~33-52</td>
<td>~100-120</td>
</tr>
<tr>
<td><strong>High/Hot</strong></td>
<td>6k/95 HOGE w/500fpm VROC</td>
<td>6k/95 HOGE w/500fpm VROC</td>
<td>6k/95 HOGE w/500fpm VROC</td>
<td>(Ultra being worked under different effort)</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td>Crew/passengers 12.7mm -50%</td>
<td>Crew/passengers 30mm -50%</td>
<td>Crew/passengers 30mm -50%</td>
<td></td>
</tr>
<tr>
<td><strong>Survivability</strong></td>
<td>Fully Integrated</td>
<td>Fully Integrated</td>
<td>Fully Integrated</td>
<td></td>
</tr>
<tr>
<td><strong>Reliability/Maintain</strong></td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td></td>
</tr>
<tr>
<td><strong>Manned/Unmanned</strong></td>
<td>LOI 5 Optionally manned Multiple UAS control</td>
<td>LOI 5 Optionally manned Multiple UAS control</td>
<td>LOI 5 Optionally manned Multiple UAS control</td>
<td></td>
</tr>
<tr>
<td><strong>Shipboard</strong></td>
<td>Extended operations (above/below deck)</td>
<td>Extended operations (above/below deck)</td>
<td>Extended operations (above/below deck)</td>
<td></td>
</tr>
<tr>
<td><strong>Transportability/Deployability</strong></td>
<td>Rapid load/unload operational w/15min</td>
<td>Self deploy 2100nm Aerial refueling</td>
<td>Self deploy 2100nm Aerial refueling</td>
<td></td>
</tr>
<tr>
<td><strong>Network Enabled C2</strong></td>
<td>Integrated network</td>
<td>Integrated network</td>
<td>Integrated network</td>
<td></td>
</tr>
</tbody>
</table>
| **Sensors/DVE**  | Multi-Spectral Multi-Function High resolution | Multi-Spectral Multi-Function High resolution | Multi-Spectral Multi-Function High resolution | **Requires unique expertise**
**Takes years to develop workforce**
**Must be smart buyer**
- In-house S&T
- Retain expertise
- Maintain working relationship w/ PM
- Tech. collaboration

Distribution Unlimited
JMR TD is the culmination of a comprehensive technology development plan.

Leverages resources from across the DoD community.

Responsive to the needs of, and the capabilities expected from, the Joint Rotary Wing fleet.

Advances the technology readiness level of the ultimate FVL family-of-vehicles.
FVL describes a family of vertical lift aircraft
- Includes multiple sizes/classes of vehicles
- Considers the vertical lift needs across the DoD
- Achieves significant commonality between platforms
- Addresses the capability gaps identified in the Army Aviation Operations CBA, and the OSD-sponsored Future Vertical Lift CBA

Objective vehicle attributes
- Scalable common core architecture
- Integrated aircraft survivability
- Speed 170+ kts
- Range 424 km (combat radius)
- Performance at 6,000 feet and 95°F (6K/95°C)
- Shipboard Compatible
- Fuel Efficient
- Supportable
- Affordability
- Optionally Manned
- Commonality
### Joint Common Architecture

**Scope**
- Establish architecture design criteria
- Evaluate architecture function and performance via Systems Integration Lab (SIL)

### Vehicle Trades

**Scope**
- Trade space description
- Prioritize critical attributes/capabilities
- Establish success metrics
- Assess value and affordability

### Phase 1 – Air Vehicle Development

**Scope**
- Design, fabricate, & test 2 vehicles
- Performance demonstration and verification
- Technology characterization
- Test predictions and correlation
- Value and readiness assessments

### Phase 2 – Mission Systems Development

**Scope**
- Management and presentation of controls, displays, and man/machine interface
- Integrated mission system processing, network structure, integration of hardware and software components

### Rucker/FVL Study

**Phase I**
- JMR Spec Dev

**Phase II**
- Vehicle Trades

### Scope
- Trade space description
- Prioritize critical attributes/capabilities
- Establish success metrics
- Assess value and affordability

### Phase 1 Spec

### Phase 2 Spec

### AoA start

### AoA finish

### Phase 1 – JCA Demo

### Phase 2 – CSR

### Phase 3 – PSR

### 1st flight
Design Industry Efforts

Bell-Boeing

Wing & Tail
- Wing Loading, Planform, Thickness, Span, Wingspan
- Tail Type (H, T, V), Tail Volume

Engines
- Engines, Rotors, Location, Tilt

Propulsion
- Propeller, Pitch, Helitank, Tilt, Thrust

Drive System
- Rotor RPM, Interconnected Drive Train, Mid-wing Control, Transmission, Configuration

Airframe & Landing Gear
- Pressurization, Ramp, Stairs, Doors, Landing Gear Retraction, Fuel Location, Ballistic Protection

Boeing

Sikorsky

AVX

Process is underway
**Design**

**Government Efforts**

**Dismounted Soldier Egress**

- **Armor layout**
- **Dismounted Soldier Seated Space Volume**

**Survivability Assumptions**

- Redundant hydraulic systems
- Redundant flight crew - pilot and copilot
- Armored Crew Seating
- Self-sealing, crashworthy fuel bladders
- Suction Feed Fuel System
- Fire detection suppression system
- Fly-by-wire flight control system

**Excursion Matrix and trade space**

- Primary Design Mission
- Drop P/L Loiter Pickup P/L
- 30 min @ $V_{BE}$ (Loiter)
- HOGE 1 min
- Dash
- HOGE 1 min
- Cruise @ $V_{BR}$

**Altitude (ft)**

- Best [ISA]
- 6,000 [95°F]

**Radius**

- 0
- 324
- 424 (km)

**Mission**

- Advanced Helicopter
- Big-Wing Compound
- Advanced Tilt Rotor

**Concept Design for Dismounted Troop Accommodation**

**Dismounted Soldier Egress**

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**
What Will FVL Look Like?
AMRDEC Role is twofold:

– Provide best S&T available to support the current fleet

– Lead the technology development effort for a new family of aircraft