

# JMR Technology Demonstration Update: The Road to Future Vertical Lift

By Mike Hirschberg, Executive Director

It's been eight years since the US Future Vertical Lift (FVL) initiative began, and, as with all things, sometimes it is hard to remember — even for those following it — what exactly all the moving pieces are and how they all tie together. It's also easy for the Joint Multi-Role Technology Demonstration (JMR TD) to eclipse FVL, since JMR is the biggest and most public component.

This special focus issue of *Vertiflite* is intended to provide a reference for industry, the media and the public on the strategy and progress of what will set the rotary-wing capabilities for the United States and its allies for the rest of the 21st Century. This article follows a mostly chronological timeline; thus there is some back and forth in the discussion between FVL,

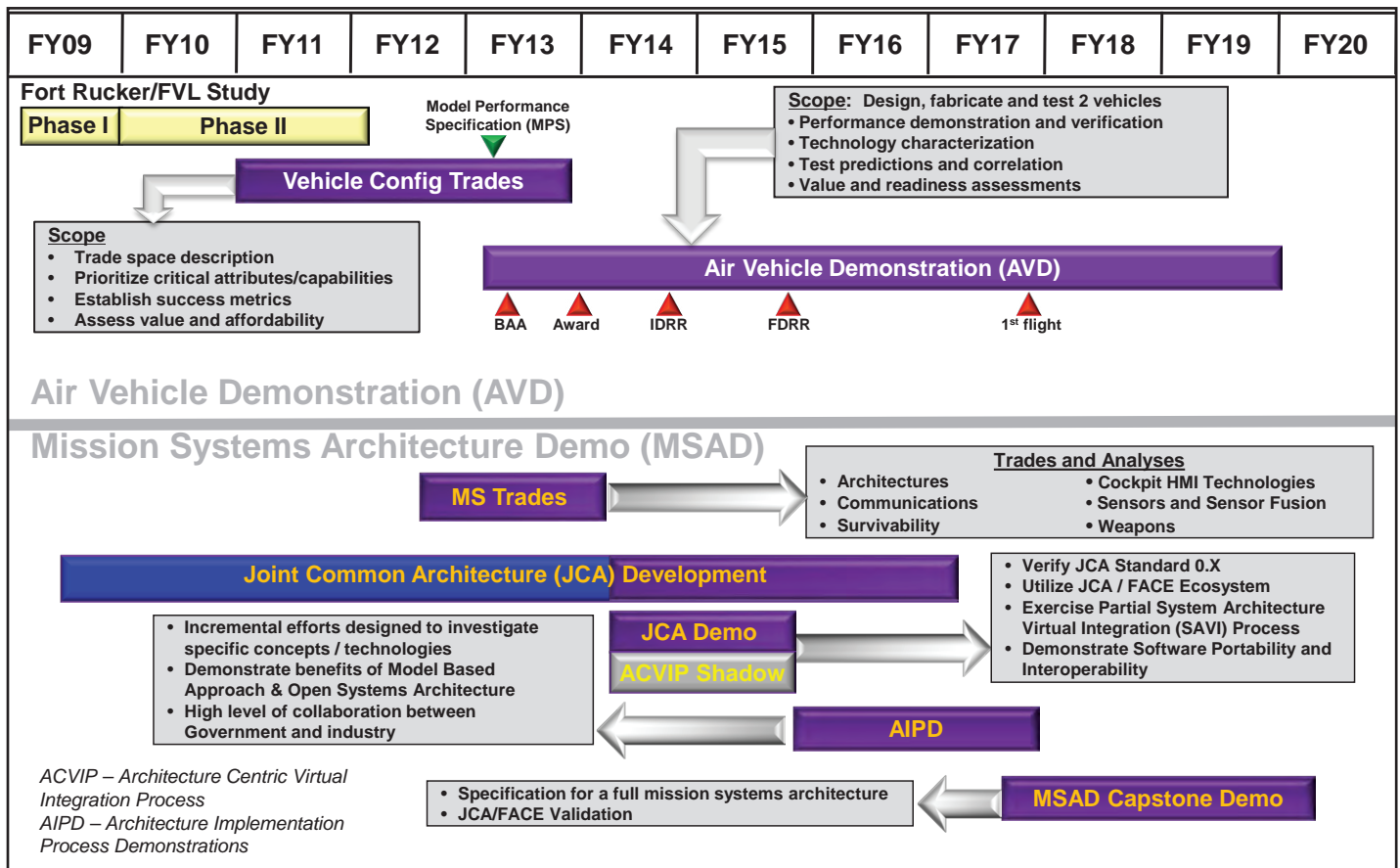
which is the overarching programmatic plan, and JMR, which is demonstrating technologies.

## Background

FVL is an ambitious plan to replace all of the US Department of Defense's helicopters with next-generation rotorcraft. The FVL initiative was born, in part, as a result of increasing concerns by AHS International and its members that DoD was no longer making adequate investments in new rotorcraft programs, and was too focused on upgrades and modernization activities for existing platforms. This reached a crisis point after hundreds of helicopters and lives were lost in the conflicts in Afghanistan and Iraq, and huge gaps were exposed between the legacy

rotorcraft fleet's capabilities and the commanders' needs for speed, range, payload, survivability and maintainability.

In 2008, the Congressional Rotorcraft Caucus, which itself had been initiated as a result of AHS advocacy efforts, directed the Pentagon to create a Strategic Plan for the Department's Future Vertical Lift as part of the Fiscal Year (FY) 2009 National Defense Authorization Act. In 2009, the Secretary of Defense established the FVL Initiative to focus technology development, and the Office of the Secretary of Defense for Acquisition, Technology & Logistics — OSD(AT&L), who was (now Secretary of Defense) Dr. Ashton Carter at the time — partnered with the Joint Chiefs of Staff's J-8 Directorate for Future





JMR schedule (All graphics from slides presented by AMRDEC at AHS Forum 71, except CapSets)

Structure, Resource and Assessment to conduct a Capabilities Based Assessment and develop a Science and Technology (S&T) Plan. Although it took several more years of pressure by AHS, industry and Congress (see [www.vtol.org/FVL](http://www.vtol.org/FVL) for more on FVL and AHS's advocacy work), the Strategic Plan was signed by the Deputy Secretary of Defense and submitted to Congress in October 2012. The Strategic Plan stated:

The Department of Defense will design, develop and field a fleet of next generation air vehicles that will ensure the United States' dominance in the vertical lift domain throughout the 21st century and beyond. The Department will aggressively pursue the most capable aircraft at the best value by minimizing development, acquisition, and life cycle costs through Joint solutions of common core technologies, architectures, and training, emphasizing the ability to conduct safe, reliable and continuous operations world-wide in all environmental conditions.

This was followed in April 2013 by the "Future Vertical Lift (FVL) Family of Systems (FoS) Initial Capabilities Document (ICD)," validated by a Joint Requirements Oversight Council Memorandum (JROCM). Each of the military services developed individual mission-specific Concept of Operations (CONOPS) focused on the FVL-Medium class; in 2014, those were formally approved by the Joint Staff for developing requirements. (Since then, those have been expanded to include the entire family of FVL solutions as well as additional key missions to help shape the initial procurement program.)

AHS has worked closely with the Vertical Lift Consortium (VLC) to continue this advocacy work with Congress and DoD, bringing \$24M in additional funding to FVL (see "FY16 Legislative Successes!" pg. 5), and ensuring that key decision-makers and elected officials are aware of

Bell Helicopter	Sikorsky-Boeing
	
<p>Demonstrating technologies that provide affordable tilt-rotor access to Army capability sets</p>	<p>Demonstrating technologies that provide affordable coaxial, lift-offset compound access to Army capability sets</p>
<ul style="list-style-type: none"> <li>• Full-authority digital fly-by-wire flight control system</li> <li>• Flight envelope protection               <ul style="list-style-type: none"> <li>— Structural load limiting</li> <li>— Conversion corridor protection</li> </ul> </li> <li>• Designed for low-cost manufacturing               <ul style="list-style-type: none"> <li>— Broad goods skin lay-up</li> <li>— Large cell carbon core</li> <li>— Bonded skin assemblies</li> <li>— Broad goods yoke</li> </ul> </li> <li>• Performance               <ul style="list-style-type: none"> <li>— Cruise at 280 kts</li> <li>— Designed to meet Level I Handling Qualities for yaw, pitch and roll quickness</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Full-authority digital fly-by-wire flight control system</li> <li>• Active vibration control</li> <li>• Configuration               <ul style="list-style-type: none"> <li>— Lift Offset Coaxial Rotor</li> <li>— Pusher Prop</li> <li>— Variable RPM drive system</li> </ul> </li> <li>• Performance               <ul style="list-style-type: none"> <li>— 250 knots cruise</li> <li>— HOGE 6K95</li> <li>— Low &amp; medium speed maneuverability</li> <li>— Designed to meet Level I Handling Qualities for yaw, pitch and roll quickness</li> </ul> </li> </ul>

JMR Tech Demonstrator Aircraft Descriptions: Bell Valor and Sikorsky-Boeing Defiant.

the overwhelming need for the FVL program: (1) escalating operations and sustainment costs; (2) the unacceptable number of vertical lift losses; (3) vertical lift fleet accelerated aging due to the high operational tempo; (4) 55 capability gaps identified in the 2008 Capabilities Based Assessment; and (5) the decaying US vertical lift industrial base.

### FVL Strategy

Although the Army has been designated as the Lead Service of this joint initiative, all of the US armed services — including the Navy, Marine Corps, Air Force, Special Operations Command and the Coast Guard — are involved in the leadership and are fully integrated into the working structure of the FVL initiative: the S&T Integrated Product Team (IPT) is led by the Army's AMRDEC; the Commonality IPT is headed by the Navy PEO(A), the Acquisition IPT lead is in the Army PEO for Aviation; and the Requirements IPT lead is from USAACE. The IPTs are guided by the FVL Joint Council of Colonels, who interface with the FVL Executive Steering Group (ESG), which is co-chaired by the OSD(AT&L) and J-8.

Current activities for FVL are focused on the following key elements:

- A decision point-based plan of execution
- Early joint requirements development

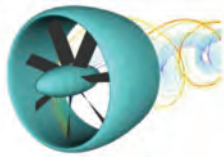
- Developing an S&T plan that aligns technology development with DoD acquisition milestone decision options
- A multi-role family of aircraft
- Exploit common systems and open architecture
- Maximize industry partnership/ interaction

The joint requirements development and initial acquisition planning for the FVL Family of Systems is on track for a Materiel Development Decision (MDD) in Fall 2016. An MDD is the point in time where the requirements analysis has identified capability gaps and the MDD Review has determined a materiel solution is needed. The MDD is the formal point that initiates the Materiel Solutions Analysis (MSA) Phase; the Analysis of Alternatives (AoA) determines the preferred path for a materiel solution that satisfies the capability needs documented in the ICD.

### JMR Air Vehicle Overview

The US Army's Aviation Center of Excellence (USAACE) at Ft Rucker, Alabama, led operational studies in FY09-FY12 aimed at collecting the joint capability needs, and the Army's Aviation and Missile Research, Development and Engineering Center (AMRDEC) awarded "Phase 0" Configuration Trades and Analysis (CTA)

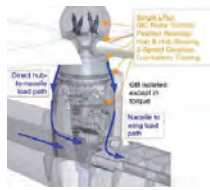
## AVX



Demonstrate technologies that enable an innovative design solution to meet Army capability sets

- Configuration
  - Conventional coaxial compound
  - Ducted fans for auxiliary propulsion
  - Aft ramp
- Effort
  - Scaled wind tunnel testing and CFD
  - Develop and evaluate control laws to reduce rotor loads, vibration, and vertical spacing of rotors
- Aeromechanics Challenges:
  - High cruise efficiency
  - Favorable dynamic characteristics (vibration, rotor blade tip clearance)
  - Handling qualities

## Karem Aircraft



Demonstrate technologies that enable an innovative design solution to meet Army capability sets

- Optimum Speed Tilt Rotor configuration
- Designed for
  - Speed > 300 kts
  - High cruise and hover efficiency
- Enabling technologies
  - Lightweight, stiff rotor design
  - Multi-speed transmission
  - Individual rotor blade control
  - Electromechanical actuation
- Effort: Integrated powered test of all the enabling technologies on a tower

Aircraft (teamed with The Boeing Company). Karem Aircraft's award was a surprise, since it wasn't publicly known that they had submitted a bid. Each of the four teams was given approximately \$6.5M in government funds to work for the first nine months through the planned descope from four to two. In August 2014, the Army revealed that the Bell and Sikorsky-Boeing teams had been selected to continue forward to the flight demonstration; AVX and Karem would continue with lower-level technology maturation, but not to flight.

JMR Tech Demonstrator Aircraft Demonstrations: AVX and Karem.

S&T contracts to four teams in June to Sept. 2011. The AMRDEC execution arm for the industry contracts was the Aviation Development Directorate's Aviation Applied Technology Directorate (AATD) at Joint Base Langley-Eustis, near Williamsburg, Virginia.

The \$4-5M JMR TD CTA contracts were awarded to AVX Aircraft Company for its compound coaxial helicopter; Bell Boeing for an enhanced tiltrotor; the Boeing Company for edgewise and compound helicopters; and Sikorsky Aircraft, who looked at conventional and compound helicopters, as well as tiltrotors. These studies were completed in late 2012.

These Phase 0 Vehicle Configuration Trades completed the trade space description, prioritized critical attributes and capabilities, established success metrics, and assessed value and affordability of potential FVL concepts. A Model Performance Specification (MPS) was developed by the joint service team, which was finalized for the Air Vehicle Demonstration phase in 2013 (see *Vertiflite*, Jan/Feb 2014).

The JMR TD Phase 1 solicitation stated that the companies are to "identify technical approaches and associated risk required to enable meeting desired 230+ kts. along with MPS capabilities and specifications at an aircraft DGW [design gross weight] of 30,000 lbs [13.6 t]." The high speed/long-

range requirements for the operational configuration obviously eliminated pure helicopters from consideration. In addition, the aircraft is expected to operate at high/hot conditions — 6,000 ft/95°F (1,800 m/35°C) — and be shipboard compatible for Navy and Marine Corps operations.

The design size of troops of the future is also significantly increased weighing 335 lb (152 kg) and being outfitted with 2015 Land Warrior equipment; this necessitates a 23 inch (58 cm) seat width and a seated height of 60.5 inches (154 cm), and therefore a much larger cabin volume than today's aircraft.

In mid-January 2013, soon after the final solicitation for Phase 1 was released, Boeing and Sikorsky signed a teaming agreement for the Phase 1 Air Vehicle Demonstration (Sikorsky lead), Phase 2 Mission Systems Demonstration (Boeing lead) and FVL-Medium, as they were known at the time. Boeing eschewed its tiltrotor alliance with its longtime Osprey teammate, leaving Bell Helicopter to balance out its team with new risk-sharing partners, including Lockheed Martin.

In October 2013, the AMRDEC announced it had signed Technology Investment Agreements (TIAs) for its Joint Multi-Role Technology Demonstrator (JMR TD) Phase 1 with four companies: AVX Aircraft, Bell Helicopter, Karem Aircraft and Sikorsky

## Capability Sets

When FVL was initiated, it was envisioned that the Family of Systems would be based on four general weight classes: Light, Medium, Heavy and Ultra. Since the Army's Black Hawk and Apache, the Navy's Seahawk aircraft, and other services' aircraft comprised about 75% of the 6,000 US military rotorcraft, it was decided to focus first on FVL-Medium, and to defer the Ultra heavy class to the ongoing US Air Force-led Joint Future Theater Lift (JFTL). (This effort was then leveraging the prior Army-led Joint Heavy Lift (JHL) program, but the Air Force later declined to proceed and shelved JFTL plans in late 2011.)

Recent refinement of the requirements has led to "Capability Sets" (CapSet), which were approved in January 2015. The CapSets are currently being refined by the joint requirements team, seeking to answer questions such as: Which capability set addresses the most pressing capability gaps; which addresses the most critical joint needs; which optimizes the most advanced technology / commonality; and what addresses the sundown of the legacy fleet?

CapSet 3 is now the lead member of the FVL Family of Systems, roughly analogous to FVL-Medium, but more aligned with the Army and Marine Corps utility/assault missions (CapSet 3 may

or may not include the heavy attack mission currently being fulfilled by the Apache). CapSet 1 could follow next, to fill the requirement that the Army had identified for its Armed Aerial Scout (AAS) missions. CapSet 2 would support missions of aircraft roles like the Navy's Seahawks.

This alignment between CapSets and legacy aircraft is somewhat artificial, but the requirements and design trades completed to date have identified that the future assault mission aircraft can most likely not fit on a DDG guided destroyer for the Navy mission, hence the separation of Black Hawks (CapSet 3) and Seahawks (CapSet 2).

It should also be emphasized that neither JMR nor FVL are "winner-take-all" competitions. JMR is a technology demonstration, showing what capabilities industry has to offer with a clean-sheet aircraft design versus continued modifications and modernization efforts for legacy aircraft — nearly all of which were designed during the Vietnam War. FVL is not planning to take any of the JMR designs directly into the post-MSA phase, despite some industry statements of their desire to do so. Furthermore, FVL is not intending to select a specific team or configuration — e.g. the tiltrotor or compound — for all members of the FVL Family of Systems. Solutions for each CapSet requirements will be highly common on the subsystems level — e.g. engines, avionics, software, etc. —

but may be very different air vehicles. One government official noted that most likely, "No one configuration is the best for all sizes/CapSets." Presumably, each CapSet will have a separate acquisition competition.

**"No one configuration is the best for all sizes/CapSets."**

### JMR Air Vehicle Demo

Against that context of the FVL program, the JMR Tech Demo is also a multi-layered S&T program to demonstrate transformational vertical lift capabilities to prepare the DoD for the acquisition decisions described above regarding the replacement of the current vertical lift fleet. The JMR TD is classified as a "6.3" S&T effort, running from FY11 to FY20, and it is designated as an Army Capability Enabler (ACE); the contracts are managed by ADD.

The exact investment amounts have not been broken out, but the Army's funding request each year is about \$140M for all the service's Aviation S&T projects, including JMR/FVL. It's been rumored that the government's agreements with the Bell and Sikorsky-Boeing teams (through flight testing)

are each just below \$100M in total, but that the two industry teams are each investing four or five times that much, to make it essentially a \$1B demonstration program. The expectation is to exit the demonstration phase at a technology readiness level (TRL) of 5-6, the latter number defined as "System/subsystem model or prototype demonstration in a relevant environment." Other Army S&T investments include analysis and development of technologies and concepts by AVX Aircraft and Karem Aircraft, investments in avionics, structures, engines, transmissions, flight controls, etc.

The four aircraft teams are booked under the JMR Air Vehicle Demo (AVD): "Advanced rotary-wing configurations and enabling technologies are needed to achieve the combination of performance (range, speed, payload, etc.), survivability, reliability and affordability for emerging Future Vertical Lift (FVL) requirements and missions." It includes flight demonstrations of two demonstrator aircraft; implementation of new component and manufacturing technologies; and expanded/improved modeling and simulation (M&S) capabilities for new rotorcraft configurations. The approaches and progress of each of the four JMR Air Vehicle Demo teams are described in detail in the accompanying JMR articles.

### JMR Mission Systems Overview

In parallel with the Ft. Rucker FVL studies, the services also began studying the possibility of a Joint Common Architecture (JCA) in FY09 and working towards development of an avionics reference architecture. The Army awarded six "Phase 2" Mission Systems Effectiveness Trades and Analysis contracts for FY12-13: Boeing for mission scenarios/interoperable-based communications analysis; Honeywell Aerospace, conducting sensor and sensors fusion trade studies; Lockheed Martin for trade studies regarding cockpit human-machine interface (HMI)

Future Vertical Lift FoS				
Light	Medium		Heavy	
<ul style="list-style-type: none"> <li>Cockpit</li> <li>FACE/JCA</li> <li>Training</li> <li>Requirements</li> <li>Reduced overhead</li> <li>Mission flexibility</li> <li>Sustaining</li> <li>Maintaining</li> <li>Repair parts and components</li> </ul> <p>All Air Vehicles have common...</p>				
<p><b>Capability Set 1</b></p> <p><u>Missions:</u></p> <ul style="list-style-type: none"> <li>Reconnaissance</li> <li>Attack</li> <li>Security</li> <li>CCA/CAS</li> <li>Surface Warfare</li> <li>Direct Attack</li> <li>Maritime Interdiction Ops</li> </ul>	<p><b>Capability Set 2</b></p> <p><u>Missions:</u></p> <ul style="list-style-type: none"> <li>Reconnaissance/Attack</li> <li>Security</li> <li>CCA/CAS</li> <li>MEDEVAC</li> <li>Surface Warfare</li> <li>Direct Attack</li> <li>Anti-Sub Warfare</li> <li>CSAR</li> <li>Maritime Interdiction Ops</li> <li>Mine/Counter Mine</li> </ul>	<p><b>Capability Set 3</b></p> <p><u>Missions:</u></p> <ul style="list-style-type: none"> <li>Mine/Counter Mine</li> <li>MEDEVAC</li> <li>Air Assault</li> <li>Logistics</li> <li>HA/DR</li> <li>Amphibious Assault</li> <li>NEO</li> </ul>	<p><b>Capability Set 4</b></p> <p><u>Missions:</u></p> <ul style="list-style-type: none"> <li>MEDEVAC</li> <li>Air Assault</li> <li>Logistics</li> <li>HA/DR</li> <li>Amphibious Assault</li> <li>NEO</li> </ul>	<p><b>Capability Set 5</b></p> <p><u>Missions:</u></p> <ul style="list-style-type: none"> <li>MEDEVAC</li> <li>Air Assault</li> <li>Logistics</li> <li>HA/DR</li> <li>Amphibious Assault</li> <li>NEO</li> </ul>
<p><u>Services</u></p> <ul style="list-style-type: none"> <li>US Army</li> <li>US Marine Corps</li> <li>US Spec Ops Command</li> <li>US Navy</li> <li>US Coast Guard (DHS)</li> </ul>	<p><u>Services</u></p> <ul style="list-style-type: none"> <li>US Army</li> <li>US Marine Corps</li> <li>US Spec Ops Command</li> <li>US Navy</li> <li>US Coast Guard (DHS)</li> </ul>	<p><u>Services</u></p> <ul style="list-style-type: none"> <li>US Army</li> <li>US Marine Corps</li> <li>US Spec Ops Command</li> <li>US Navy</li> <li>US Coast Guard (DHS)</li> </ul>	<p><u>Services</u></p> <ul style="list-style-type: none"> <li>US Army</li> <li>US Marine Corps</li> <li>US Spec Ops Command</li> <li>US Navy</li> </ul>	<p><u>Services</u></p> <ul style="list-style-type: none"> <li>US Army</li> <li>US Marine Corps</li> <li>US Spec Ops Command</li> <li>US Navy</li> </ul>

FVL Family of Systems Capability Sets (provided by AMRDEC).

## FVL Timeline

- Jan 18, 2008: Rotorcraft Caucus letter to Pentagon
- May 21, 2008: SecDef Gates letter concurring with CBA
- 2008: Army completes Capabilities Based Assessment (CBA)
- Oct 14, 2008: NDAA directing FVL Strategic Plan
- Oct 26, 2008: OSD(AT&L) letter establishing FVL Initiative
- Jun 30, 2010: "Report on the DOD Future Vertical Lift Strategic Plan" submitted to Congress
- June 2010: OSD(AT&L) submits joint CBA to Congress
- Sep 19, 2011: AHS, VLC, and CEOs of 5 US OEMs sign letter to Secretary of Defense
- Feb 10, 2012: Army Aviation Caucus letter to Pentagon
- Oct 2012: FVL Strategic Plan signed, submitted to Congress
- Apr 2013: Joint Staff approves FVL Family of Systems ICD
- July 2013: ESG approves analysis plan for pre-MDD studies
- Dec 2013: Business Case Analysis 1 (Framework) signed
- 2014: Joint Staff approves Developmental CONOPS
- 2014: Navy mission-specific CBA completed
- Now thru 1st QTR FY17: Joint requirements development
- Oct 2016: MDD
- Jan 2019: Milestone A for first CapSet
- 2019: RFP release for first CapSet
- 2030: LRIP for first CapSet

## JMR AVD Timeline

- Jun-Sep 2011: CTA awards to AVX, Bell Boeing, Boeing, Sikorsky
- Late 2012: CTA studies completed
- Dec 2012: JMR Model Performance Spec completed
- Oct 2013: Awards for initial JMR design to AVX, Bell, Karem, Sikorsky-Boeing
- Jun 2014: Initial Design & Risk Reviews (IDRRs) with each contractor
- Aug 2014: Bell and Sikorsky-Boeing selected to proceed to flight test
- Apr 2015: TIAs with Karem and AVX re-scoped to demo key technologies
- 2017: First Flight of JMR-TD

## JMR MSAD Timeline

- 4th QTR FY13: Six awards for Mission Systems Effectiveness Trades and Analysis
- 3rd QTR FY14: Two awards for JCA to Boeing-Sikorsky and Honeywell
- Mid 2015: JCA completion
- Nov 2015: AIPD solicitation was released
- 2nd QTR FY16: Anticipate six TIA awards for AIPD
- FY16: MSA Capstone Demonstrations RFI release
- FY18-19: MSA Capstone Demonstrations

technologies, capability based mission equipment packages, weapons vs. targets vs. missions, and battlefield sensing optimization; Rockwell Collins to study mission systems architectures; Sikorsky for survivability optimization analysis; and SURVICE Engineering for lethality and survivability systems trades and analysis tools.

A major outcome of the studies was that a JCA could be based on the Future Airborne Capability Environment (FACE) reusable-software standard developed by government and industry over the past decade. As a result, JCA contracts were awarded in FY14 to Honeywell and a Boeing-Sikorsky team to conduct a JCA Demo and fly the software in a lab environment that was first developed for the RAH-66 Comanche program. The intent was to verify the initial JCA Standard, utilize the JCA/FACE "Ecosystem," exercise a Partial System Architecture Virtual Integration (SAVI) process, and demonstrate software portability and interoperability. The next phase, the Architecture Implementation Process Demonstration (AIPD), will feature incremental efforts designed

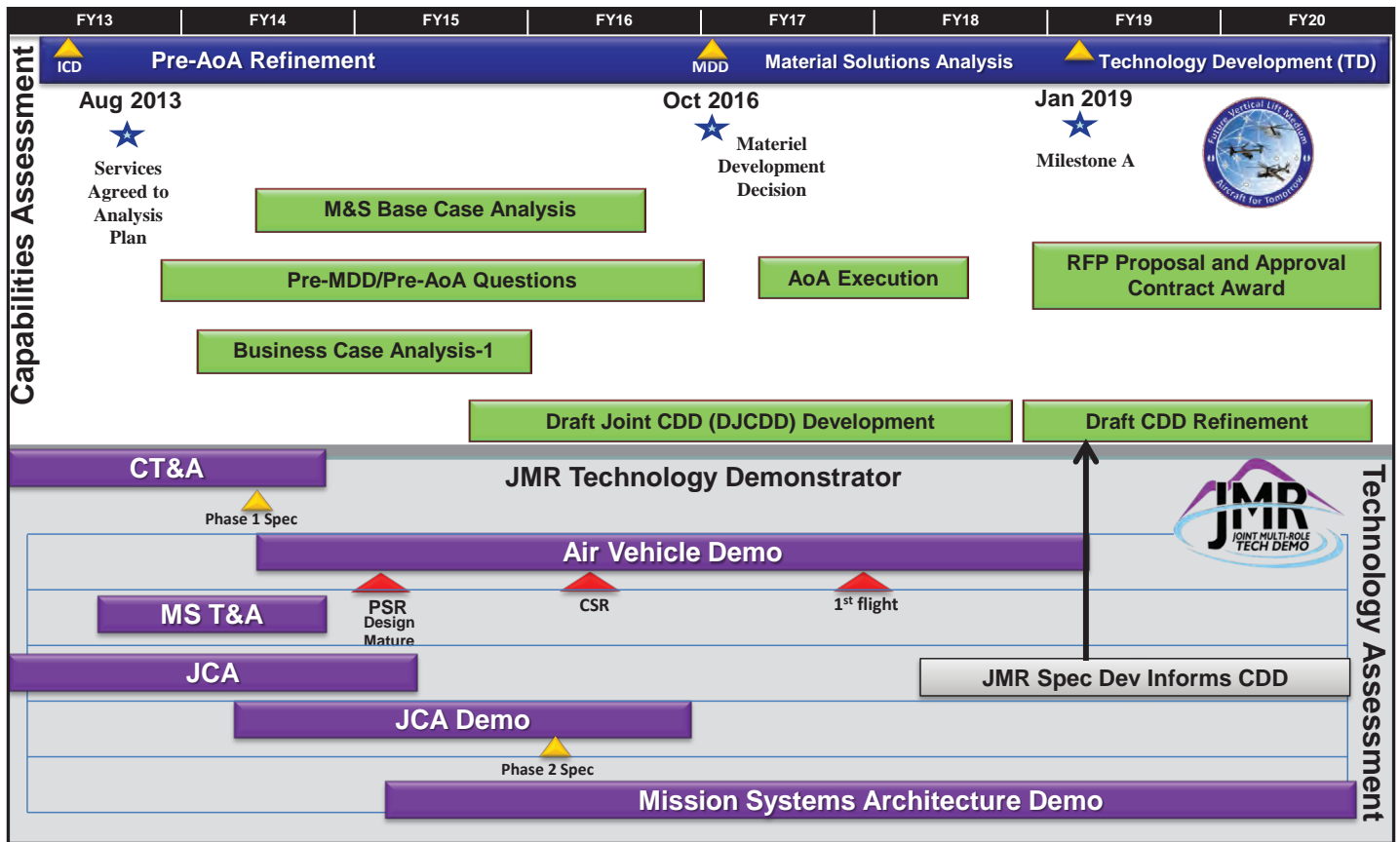
to investigate specific concepts/ technologies, and demonstrate the benefits of Model Based Approach and Open Systems Architecture; later efforts will be adjusted based on results of earlier efforts. The AIPD solicitation was released in November 2015.

A Mission Systems Architecture Demo (MSAD) Capstone Demonstration will be held in the FY17-FY19 timeframe. The output will be a specification for a full mission systems architecture, a program implementation guide, and JCA/FACE validation that collectively produces the enduring, effective, and efficient characteristics of an open architecture.

The MSAD seeks to address the fact that, "Increasingly complex missions systems require advanced tools and techniques to develop and analyze requirements to minimize developmental costs. The MSAD is focused on the development and maturation of the JCA and integration processes and tools; FACE conformant open system architecture (OSA) definition using JCA; and Architecture Centric Virtual Integration (ACVIP)

modeling/analysis of system architectures using modeling languages (e.g., UML, SysML and AADL) and associated tools." The JCA is considered the "digital backbone" by which mission systems will be integrated into the FVL systems.

JCA and FACE are expected to establish methods to reduce the time to develop and field new software capabilities and their life cycle costs for future vertical lift aircraft. These initiatives have numerous partners in industry and academia working alongside to achieve these common architecture goals through JCA and FACE. These players are using these complementary efforts to mature the processes needed to develop modular avionics functions, create a new standard software organizational framework, and define open interfaces that can be used to acquire and field new mission capabilities applicable across a fleet of aircraft. Software development and improvements are one of the most expensive and important components of aircraft development.



Projected Road Ahead for FVL.

## Context for the Future

FVL is envisioned to address the most critical capability gaps and military needs across the joint service community, including maximizing open architectures; providing game-changing speed/range/payload; improving survivability, reliability and maintainability; and creating weapon systems that will “dominate the environment.”

It is easy to get caught up in the excitement of the revolutionary capabilities of the flying JMR Technology Demonstrators. But they are not prototypes for FVL. They are being built and flown to demonstrate the state of the art of the vertical lift industry and to show the pros and cons of the company-specific approaches to meet the requirements of the 2013 JMR Model Performance Specification. The FVL Specification will continue to evolve through the Materiel Solutions Analysis Phase, until the Analysis of Alternatives (AoA) is complete and a Milestone A Decision is issued to enter the Technology Maturation & Risk

Reduction (TMRR) Phase and begin the development of actual weapon systems.

At the end of the demonstration phase, the Pentagon will reach a decision on whether or not to continue with a materiel solution to the FVL requirements. If so, then a development program will be initiated, based on the lessons learned of the entire JMR TD program.

However, beyond Bell Helicopter’s V-280 Valor JMR Technology Demonstrator and the Sikorsky-Boeing SB>1 Defiant JMR TD, two more air vehicle teams, AVX and Karem, are also conducting risk reduction activities that will contribute towards the analysis and decisions. (See subsequent articles on each JMR TD team.) The Mission Systems Architecture Demo is arguably just as important as the Air Vehicle Demo. In parallel, the requirements development and acquisition processes will shape the decisions for the future operational systems.

The DoD leadership for the Future Vertical Lift Initiative intends that FVL remains at the forefront of future vertical lift warfighting by investing in the creation of the next generation

of technology. The services and OSD are working to build consensus by developing and prioritizing joint military capability requirements for the FVL Family of Systems, and leveraging support from a robust science and technology effort.

FVL is a watershed program that will leap ahead of current generation aircraft and establish a new baseline of capability. Future Vertical Lift aircraft — if fully realized — will revolutionize vertical flight for the US military, and there will almost certainly be significant numbers of direct and indirect commercial versions and derivatives of advanced vertical flight aircraft for the rest of the century.

For more on JMR and FVL, go to [www.vtol.org/FVL](http://www.vtol.org/FVL) for resources, including links to past solicitation documents, Vertiflite articles, and papers and briefings presented at recent AHS chapter meetings and technical conferences.

