Better than any corporate video, Department of Defense (DoD) footage of Ospreys deploying Marines and Apaches shooting flares around the American Embassy in Baghdad showed the value of US vertical lift. MV-22Bs of Squadron VMM-161 flew a Special Purpose Marine Air-Ground Task Force (MAGTF) from Kuwait into embassy grounds on New Year’s Eve 2019. Overhead, AH-64Es of the Army 1st Battalion, 227th Aviation Regiment, 34th Combat Aviation Brigade helped deter a siege of the embassy on the ground.

Tiltrotors and helicopters developed and delivered by US industry give all the US armed services flexibility and reach. However, with most big production runs in their late stages and conflicting messages on factory helicopter upgrades, sustaining and growing the US rotorcraft industrial base depends heavily on Future Vertical Lift (FVL).

The Army-led FVL vision still scales up to Chinook size and down to unmanned air vehicles in Capability Sets (CapSets). It offers two near-future opportunities for big production programs of record. The Future Attack Reconnaissance Aircraft (FARA) to fight alongside the Apache is sized around CapSet 2, a notional 14,000-lb (6.4-metric ton) armed scout to replace 300-odd retired Kiowa Warriors — 10 countries have already adopted OH-58Ds divested by the US Army. The CapSet 3 Future Long Range Assault Aircraft (FLRAA) is a 30,000-lb (13.6-t) tiltrotor or compound helicopter to replace around 2,000 Black Hawks and ultimately about 800 Apaches. Both FARA and FLRAA promise spinoffs to replace Marine Venoms and Vipers, Navy Seahawks and Coast Guard Jayhawks and Dolphins.

Future force structure and budgets are nevertheless subject to politics and acquisition decisions. As of January 2020, the five FARA Competitive Prototype (FARA CP) “performers” had delivered preliminary design reports and data to the Army. The service’s Combat Capabilities Development Command (CCDC) Aviation & Missile Center (AvMC) expects briefings in February to support a downselect to two teams by the end of March. Chosen players complete final design and report to the government in November 2020. The Army makes a go/no-go decision to build and fly two FARA solutions in Fiscal 2023; flight test data will support a single vendor decision for FARA fielding in 2028. The Army cancelled upgrades for 368 OH-58F armed scouts to equip attack-reconnaissance squadrons; just how many bigger, better-connected, more expensive FARAs do the job is yet to be determined.

Innovative FARA solutions include the Bell 360 Invictus with articulated main rotor and shrouded tail rotor, the AVX/L3 soft-in-plane Coaxial Compound Helicopter with reversible pitch thruster fans, and the Karem-Northrop Grumman-Raytheon AR-40 with Optimum Speed Rotor and thruster propeller; all three have lifting wings for speed and range. Sikorsky’s wingless S-97 rigid coaxial rotor demonstrator with thruster propeller is the basis for the Raider X FARA with the maneuverability, enhanced hover performance and level acceleration of the Advancing Blade Concept (ABC) that the company now calls X2 Technology. Last September, Sikorsky patented tip-clearance measurement technology to gauge separation of high-speed coaxial rotors. Though Boeing keeps FARA features secret, the one-time Comanche partner has ample experience with fly-by-

**By Frank Colucci**

When big military programs of record run out, will Future Vertical Lift be ready to sustain and grow the US rotorcraft industrial base?

When big military programs of record run out, will Future Vertical Lift be ready to sustain and grow the US rotorcraft industrial base?

First flight of the Bell Boeing CMV-22B Osprey gives the US Navy a Carrier On-board Delivery aircraft capable of vertical resupply on smaller ships. (Bell Boeing)
wire controls and agile rotors for a helicopter meant to top 180 kt (333 kph) and remain small enough to fit urban canyons.

Meanwhile, FLRAA answers different requirements. The science and technology of the fast squad carrier have been modeled by two Joint Multi-Role Technology Demonstrators (JMR TDs). The Bell V-280 Valor continues testing under a JMR TD extension granted in late 2019. By early 2020, the third-generation tiltrotor had logged more than 160 flight hours and topped 300 kt (555 km/h) true airspeed. It had also showed it could hover over a ground effect at 6,000 ft and 95°F (1.8 km and 35℃), attain altitudes around 11,500 ft (3.5 km) and demonstrate some pilotless autonomy. According to a company spokesperson, Bell has over 300 operational transmission hours and more than 800 hours of laboratory gearbox testing, mirroring much of a production qualification effort.

Still early in flight test, the Sikorsky-Boeing SB>1 Defiant topped 100 kt (185 km/h) in January. The big compound helicopter with its coaxial rigid rotors and tail propulsor is a different approach to a highly integrated FLRAA to attain speeds greater than 230 kt (426 km/h) and combat radius over 229 nm (424 km).

Both JMR TDs prove fly-by-wire flight controls, large composite structures and innovative dynamics. A modular open system architecture (MOSA) is supposed to emerge from the separate mission system architecture demonstration. Still missing from the FLRAA equation is a modern turboshaft with needed power and fuel economy. The Army AvMC ground-tested two General Electric 7,500 shp (5,600 kW) class T408-GE-400 engines on an NCH-47D Chinook at Fort Eustis last November and plans to fly the Marine Corps CH-53K engine this fiscal year. Though the Army has no formal plan to re-engine the Chinook, AvMC acknowledges all of its efforts “support the lines of effort related to the Future Vertical Lift modernization priority.”

### Industrial Issues

FLRAA production is supposed to start around 2030, and the DoD has stretched some programs of record to mesh. Sikorsky UH-60M deliveries to the Army now conclude in 2029. AH-64E V6 Apaches keep coming until 2027. Congress is questioning the industrial base impact of delaying CH-47F Block II. Boeing Philadelphia opened a new facility to continue Osprey production and recycle Marine Corps MV-22Bs through Common Configuration – Reliability and Modernization (CC-RAM). However, pending FVL, international sales remain important to keep the US rotorcraft production rates viable and preserve a unique workforce. Sikorsky, for example, finished Black Hawk deliveries to Slovakia early this year but has Foreign Military Sales (FMS) pending with Croatia, Latvia, Saudi Arabia and Thailand. Boeing Mesa continues new-build Apache Guardian deliveries to India and last year announced orders to remanufacture Apaches for three unnamed countries.

Down the street in Mesa, Arizona, MD Helicopters Inc. has orders for armed MD530s from Kenya, Lebanon and Malaysia and hopes to close other foreign deals before the end of the second quarter 2020. The company is finalizing cockpit design for the armed, ballistically tolerant MD969, and it is collaborating with Israel’s Elbit on new MD530 weapons capability and live-fire demonstrations this year. Though Boeing renounced commercial helicopters long ago, it now buys MD530s from MDHI to integrate AH-6i armed scouts. Thailand last year requested US State Department permission to buy eight of the Hellfire-armed Little Birds; a contract is still in

The US Department of Defense meanwhile champions competing, even if it benefits foreign manufacturers. The US Army helped Airbus Helicopters weather the oil industry slump with orders for more than 400 UH-72As fabricated in Europe but assembled in Columbus, Mississippi. With Lakota production near done, Congress is looking for a long-term support plan that

Oil industry demand for commercial helicopters still crawls. Lockheed Martin last year planned to close the Sikorsky S-92 line in Coatesville, Pennsylvania, and relocate Presidential VH-92A production to another facility. Presidential intervention saved the Pennsylvania plant and a skilled workforce. The VH-92A program completed a Milestone C review in May and began its production and deployment phase in June. The first low-rate initial production (LRIP) lot includes six helicopters, spare parts and support equipment. The Marine One program ultimately buys 21 operational helicopters and two test aircraft. Initial Operational Capability (IOC) with squadron HMX-1 is expected in 2021. The Naval Air Systems Command (NAVAIR) says the VH-92A will enter Presidential service as determined by the White House Military Office.

The Bell 360 Invictus is one approach to the Future Attack Reconnaissance Aircraft (FARA) expected in service around 2028. (Bell)
may harden the Franco-German helicopters in National Guard service. The DoD has meanwhile found more “best value” deals in Italy with orders for Leonardo MH-139As (AW139s) for the Air Force and TH-73As (AW119s) for the Navy. Both helicopters are assembled by AgustaWestland Philadelphia Inc. with high-value blades, transmissions and aerostructures from Italy.

The Trump administration continues to press Italy and other NATO allies to increase their defense spending. Leonardo concluded deliveries of 16 Italian-assembled ICH-47Fs to the Italian Army in 2018, but a reported contract for four “fat tank” Special Forces Chinooks from Philadelphia has yet to materialize.

Meanwhile, Sikorsky and Boeing delivered CH-53K and CH-47F proposals (respectively) to Germany in January for the Schwerer Transporthubschrauber (STH) competition. The precise number of heavy-lift helicopters and their delivery schedule is to be determined. Israel is competing the same heavy-lift helicopters to replace its early-model CH-53s.

Airbus Lakota

Airbus Helicopters, Inc. delivered the 200th purpose-built UH-72A/EC145 trainer to the Army Aviation Center of Excellence at Fort Rucker, Alabama, last August. The 8,000-lb (3.6-t) Lakota was originally bought as a general support utility helicopter, largely for National Guard and Reserve units, plus the few active duty units supporting training and test ranges. The first Lakotas built for Initial Entry Rotary-Wing training arrived at Rucker in 2015, and the last Bell TH-67 Creek trainers retired at the end of Fiscal 2019. The US sent 60 TH-67s to Columbia in August.

The Army has received 443 UH-72As against an acquisition objective of 463 Lakotas. The Navy Test Pilot School took five UH-72As. Six Lakotas delivered to Thailand completed the one FMS sale to date. Airbus delivered 24 Lakotas to the US Army last year and will wrap up deliveries with the current contract this June. The only upgrade now planned adds cockpit voice and flight data recorders. The House Armed Services Committee has ordered an Army report on UH-72A mid-life sustainment and product improvements, including possible aircraft survivability equipment and ballistic protection for National Guard aircraft that were originally non-deployable helicopters.

All UH-72As are based on the BK117 C2 with conventional tail rotors (unlike the Fenestron-equipped military H145M assembled in Europe). Airbus continues production in Mississippi for the commercial market and delivered the first “made in USA” EC145e in September 2019.

Bell H-1 Yankee/Zulu

Bell in Amarillo, Texas, gave expeditionary Marine Corps light-attack helicopter squadrons (HMLAs) two new aircraft with common dynamics, structures, propulsion and avionics. HMLAs deploy detachments of up to five AH-1Z Viper attack and four UH-1Y Venom utility helicopters. Yankee deliveries to the Marines concluded last year with the last of 10 remanufactured and 150 build-new helicopters. Deliveries of 189 Zulus to the US Marine Corps wrap up in early 2022 when reserve squadrons complete transition from the AH-1W to the AH-1Z.

Significantly, the AH-1Z and UH-1Y are the only aircraft that play in all six functions of Marine Aviation — offensive air support, anti-air warfare, assault support, air reconnaissance, electronic warfare and aircraft and missile control. Marine plans for both include upgraded electronic warfare systems, digital interoperability, including Link-16 datalinks and full-motion video capability, navigation upgrades and new weapons, including the AGM-179 Joint Air-To-Ground Missile (JAGM) and AIM-9X Sidewinder air-to-air missile.

Pakistan has 12 new-build AH-1Zs and, according to NAVAIR, the H-1 program continues to seek international customers. An order from the Czech Republic last year for four Zulus and eight Yankees was the first international sale of a mixed H-1 fleet. All Czech aircraft should be delivered in 2023.

Bell Boeing Osprey

First flight of the Navy CMV-22B in December at the Bell Amarillo, Texas Military Aircraft Assembly Center began a new chapter in tiltrotor aviation. The Navy plans to replace fixed-wing C-2A Greyhounds with 44 new Ospreys in two fleet logistics support multi-mission (VRM) squadrons. The tiltrotors potentially expand traditional carrier on-board delivery (COD) to vertical resupply for a range of Navy ships, hauling up to 6,000 lb (2.7 t) of cargo and personnel over 1,150 nm (2,415 km).
With the benefit of more than 500,000 flight hours on Marine Corps MV-22Bs and Air Force CV-22Bs, two CMV-22B developmental test (DT) aircraft will focus on flight envelope segments and capabilities unique to the Navy tiltrotor. The first DT aircraft will be turned over to the Navy in early February. The second is scheduled for delivery in mid-2020. The first operational squadron, VRM-30 at North Island, California, will receive the Ospreys this summer for training, operational test and first carrier deployment. IOC is expected in 2021. Under current plans, CMV-22B deliveries continue through 2025.

The Marines still plan a total of 360 MV-22Bs in 18 active and two reserve squadrons, plus one fleet replacement squadron. The last reserve squadron, VMM-212, is due to stand up at New River, North Carolina, in fiscal 2021. MV-22B Block C production runs through 2024. Air Force SOCOM will have received 54 CV-22Bs by the end of 2024, including attrition replacements. CV-22 Block 20 upgrades are ongoing, including a heads-up display, new mission computer, and navigation and communications improvements.

Late last year, the Marines flew the first MV-22B Block C aircraft to emerge from the Common Configuration—Readiness and Modernization (CC-RAM) overhaul. The work standardizes 75 different fleet Osprey configurations with collected improvements that promise to increase mission capable rates by 15% and cut maintenance manhours per flight hour by 30%. CC-RAM brings 128 MV-22B Block B aircraft up to the current Block C configuration through 2028. Notional technology insertions every four to six years thereafter will introduce aircraft survivability, digital interoperability and degraded visual environment (DVE) upgrades and more readiness and reliability improvements.

Japan remains the only Osprey FMS customer to date. Japan Ground Self Defense Force (JGSDF) pilots and maintainers began MV-22B training with VMMT-204 at New River last year. As of January, seven of the 17 aircraft in the program of record had been produced. Five had completed JGSDF-specific modifications.

**Boeing Apache**

Boeing Mesa delivered 69 AH-64E Apaches in 2019 for the US Army and FMS customers, a mix of new-build helicopters and “renewed” aircraft with new fuselages and digital cockpits. The US Army procurement objective is 473 CH-47F Block I helicopters. Under current plans, Block I deliveries to the US Army conclude next year, but FMS cases are in process for Spain, the Netherlands and Saudi Arabia. At the end of last year, the United Arab Emirates received permission to order 10 new-build Chinooks to supplement its early buy of 16 CH-47F Block I helicopters.

CH-47F Block II aims to reclaim high-and-hot payload lost to survivability equipment and other Chinook add-ons. Advanced Chinook rotor blades with multiple airfoils across the span, twist on the trailing edge and dihedral-anhedral tips generate 1,750 lb (800 kg) more lift at 4,000 ft/95°F (1.2 km/35°C). Ferrium C61 steel gives Block II improved drivshafts to handle more horsepower without a new transmission. Composite sponsons save weight and increase capacity vs. Block I metal fuel cells. Weather radar, updates to Collins Aerospace’s Common Avionics Architecture System (CAAS) and changes to make the digital automatic flight control system (DAFCS) compatible with the active parallel actuator subsystem (APAS) should improve situational awareness and safety.
Fiscal 2024 and 2028 and sustain production at 12 aircraft per year through fiscal 2030 to maintain fleet readiness. It added money to the 2020 budget for advanced procurement to support Block II production and ordered further study including the impact of delays on the rotorcraft industrial base.

Separate from the cargo helicopters, the Special Operations MH-47G Block II with APAS, DVE, and airborne mission networking capability is scheduled to fly this year. Plans give the Army 69 modernized MH-47G special operations aircraft by Fiscal 2028 with Advanced Chinoor Rotor Blades and drivetrains compatible with more powerful engines. The first 15 MH-47Gs are under contract; two are already on the Philadelphia line and will integrate Block II improvements pending CH-47F Block II testing. “Fat tank” CH-47ER Chinos are in negotiation for the United Kingdom would likewise incorporate Block II improvements. There are as yet no formal plans for the Block II Chinos to adopt the CH-53K’s T408 engine now being tested by the Army.

The Sikorsky HH-60W Combat Rescue Helicopter for the US Air Force is now in development testing. (US Air Force)

Boeing Grey Wolf
AgustaWestland Philadelphia Company celebrated delivery of the 300th US-assembled AW139 helicopter in January — an MH-139A for the US Air Force. The Air Force Global Strike Command (AFGSC) selected the 15,320-lb (7-t) commercial-of-the-shelf helicopter over the 22,000-lb (10-t) Sikorsky Black Hawk in 2018 to replace the 10,500-lb (5-t) UH-1N. The service plans to buy 84 aircraft over the next 10 years to protect Northern Tier nuclear sites, taxi VIPs around the National Capital Region, provide search-and-rescue in the Pacific Northwest, support US test ranges and shuttle command staff around Japan. The Air Force named the Boeing-led MH-139A the “Grey Wolf” in December 2019, and according to AFGSC commander Gen. Timothy Ray, the name “strikes fear in the hearts of many.”

Boeing trumpets $1B in life-cycle cost savings of the Grey Wolf versus its much larger Black Hawk competitor. The Air Force noted the MH-139A is the first rotary-wing asset acquired in recent history not previously used by another branch of the US military. Test pilots from the 413th Flight Test Squadron at Eglin Air Force Base, Florida, were consequently type-rated at the CAE Northeast Training Center in New Jersey. Maintainers also trained at the civil helicopter facility. The first aircraft was ferried from Philadelphia to Duke Field near Eglin for testing. AFGSC stood up Detachment 7 of the dedicated rotary-wing test squadron with pilots and special mission aviators to test four aircraft. The detachment will eventually relocate to Malmstrom Air Force Base, Montana, for later testing and evaluation.

Leonardo TH-73
The Navy announced in January that Leonardo, via AgustaWestland Philadelphia Company, would supply the first 32 TH-73A helicopters for the Advanced Helicopter Training System (AHTS). Total procurement objective is 130 helicopters to train rotary-wing aviators for the Navy, Marine Corps and Coast Guard through 2050. The first batch of helicopters will be delivered from 2020 to 2024 to replace the long-serving Bell TH-57 at Whiting Field, Florida. TH-57 “sundown” begins in Fiscal 2022 and concludes in Fiscal 2024.

The TH-73A is the commercial twin-engine AW119 with dual controls, three-axis automatic flight control system, and a four-screen Genesys integrated cockpit that enables one aircraft configuration to provide both basic and instrument flight training. The cockpit proposed by Leonardo includes a 3D Synthetic Vision System with highway-in-the sky navigation, helicopter terrain avoidance warning system (HTAWS) and traffic collision advisory system (TCAS) functionality. Leonardo credits the 6,200-lb (2.8-t) trainer with better than five hours endurance and ample power margins. The current AHTS contract includes support equipment and initial spares. NAVAIR is expected to release a request for proposal in the second quarter of this fiscal year for contractor logistics support, instructional services and training devices. Airbus Helicopters offered the H135 for the Navy AHTS and has filed an award protest charging “technical misunderstandings” by the government.

Sikorsky Hawks
Sikorsky’s ninth H-60 multi-year procurement contract (MYIX) runs through 2022. The US Army took delivery of 43 UH-60M utility and 17 HH-60M Medevac Black Hawks in 2019. The Sikorsky factory in Stratford, Connecticut, also turned over another 22 UH-60Ms to the Army for FMS customers. The proposal for MYX was submitted last July. Under current plans, Black Hawk deliveries to the US Army conclude in 2029 and give the service a fleet of 884 UH-60Ms and 419 HH-60Ms, ultimately with the T901 improved turbine engine.

Now in process are UH-60M FMS aircraft for Taiwan (six of 60 UH-60M still to be delivered), the Saudi Arabian National Guard (two batches totaling 48 aircraft), the Royal Saudi Land Forces Aviation Command (nine UH-60M), Latvia and Thailand (four UH-60M each).

To those UH-60M FMS orders, direct commercial sales of the US-built S-70M and Polish-built S-70i are added. Poland has received four S-70i Black Hawks for Polish National Police special operations. The Philippines Air Force will reportedly take 16 S-70i helicopters from the third quarter of 2020 through 2021. Polish-built S-70i helicopters completed by United Rotorcraft in Colorado have meanwhile become Fire Hawks with the Los Angeles County Fire Department, City of San Diego Fire-Rescue Department and the California Department of Forestry and Fire Protection. The United Arab Emirates began operations with the armed S-70M last year, and at least one South American country is shopping for armed helicopters.

In addition to new-build, wide-blade Mike-model Black Hawks, the US Army plans to recapitalize 760 analog-cockpit UH-60Ls
into digital UH-60Vs. In the cockpit, the UH-60V pilot-vehicle interface is near identical to that in the UH-60M. Redstone Defense Systems flew the first UH-60V in 2017 and Northrop Grumman delivered limited user-test software in 2018. The Victor-model Black Hawk completed initial operational test and evaluation (IOT&E) in September 2019 at Joint Base Lewis-McCord, Washington. Low-rate initial production is underway at Corpus Christi Army Depot in Texas. A full-rate production decision is expected in the first quarter of Fiscal 2021 and the first unit equipped in April 2021.

Army Special Operations Aviation (ARSOA) has 72 MH-60M aircraft with YT706-GE-700 engines, terrain avoidance radar, CAAS cockpit, and other mission equipment. The common helicopter is fielded in either assault or defensive armed penetrator versions. The primary mission of the MH-60M assault helicopter is to conduct overt or covert infiltration, exfiltration and resupply of special operations forces. The armed DAP version provides armed escort and fire support. The MH-60M Block 1.0 upgrades will field the tactical mission networking system and may introduce the degraded visual environment pilotage system (DVEPS).

The powerful, ballistically tolerant UH-60M with its digital cockpit is also the basis of the air-refuelable HH-60W combat rescue helicopter (CRH) in development for the US Air Force. Sikorsky is on contract for 113 Air Force HH-60Ws to replace hard-flown HH-60G Pave Hawks. The Air Force plans IOC in 2021 when it has four training and four operational helicopters with their necessary training systems and support equipment. The new model nearly doubles internal capacity and integrates a mission suite with weather radar, electro-optical sensor, survivability equipment and datalinks.

Sikorsky flew the first CRH last July, followed soon after by the 413th Flight Test Squadron — the first Air Force-piloted flight was made at the Sikorsky Development Flight Center in West Palm Beach. Seven aircraft are in the developmental test fleet. Two are currently at Eglin Air Force Base’s Duke Field in Florida with the Air Force. Sikorsky has four at West Palm Beach and one in Owego, New York. Under the current contract, production ramps up from 10 aircraft per year in initial LRIP to 20 aircraft per year in later lots, dependent on funding. The first lot of LRIP aircraft will be assembled in Stratford, Connecticut.

The United States Navy will complete its program of record for 288 MH-60R Seahawks delivered by the end of 2020 from Owego, New York. The Royal Australian Navy has 24 MH-60Rs, Saudi Arabia 10 and Denmark nine. Last year, the US State Department approved the sale of 24 MH-60Rs to India, up to seven for Greece and 12 for the Republic of Korea. There is no current service life assessment or extension program (SLAP/SLEP) for the MH-60R Romeo Seahawk. A SLAP on the MH-60S Sierra will run through 2022, and findings will help determine the scope of a SLEP at either depot or factory.

Sikorsky King Stallion

The Marine Corps heavy-lift replacement helicopter entered low-rate initial production with the first two of 38 LRIP aircraft now on the production line in Stratford, Connecticut. Three LRIP lots totaling 14 King Stallions are on contract for deliveries from 2021 to 2023. Three more LRIP lots are expected to run through 2025. Full-rate production should start in 2025 and run through 2032. The Marine Corps still plans 200 King Stallions to equip eight active-duty squadrons, one training squadron and two reserve units.

Four King Stallion engineering development model aircraft and three system development test articles have flown more than 1,600 hours so far. When developmental testing uncovered exhaust gas re-ingestion from the three GE T408 engines, an industry-government team ran trade studies including computational fluid dynamics analyses to characterize and identify fixes. Solutions included changes in exhaust ducts, engine bay air flow, heat shields and engine software. Four test flights totaling about 13 hours validated the fix. One King Stallion has been modified and tested to validate the production package for IOT&E and subsequent aircraft.

Live fire testing with the CH-53K Ground Test Article begins this spring. Shipboard tests start this summer, and King Stallion IOC will be achieved in late 2021 when the first squadron is ready to deploy with four aircraft, trained and certified personnel, support equipment and technical publications, and initial spare parts. The Marine Corps will determine which squadron will receive the aircraft for the first fleet deployment in 2023 or 2024.

The CH-53E Super Stallion is set to sundown by 2032. Still to be determined is the replacement for Navy MH-53E airborne mine countermeasures helicopters. The Navy is studying new AMCM solutions. Under current plans, the mission will be transferred from the MH-53E to other platforms, including manned MH-60S and unmanned MQ-8 Fire Scout helicopters.

About the Author

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