

NEW ROTORCRAFT 2011

by Thierry Dubois and Mark Huber

The long-standing process by which military programs drive new civil helicopter technology may not be broken, but it is clearly fraying. Expected cuts at the Pentagon and in European militaries, combined with the high-profile failures of recent procurement programs, are driving OEMs to take stronger roles in what traditionally has been a secondary position when it comes to developing new helicopters and rotorcraft technologies.

Paradigm Shift

Sikorsky president Jeff Pino conceded as much in October, when he unveiled the S-97 "Raider" prototype, an outgrowth of the current X2 compound helicopter technology demonstrator. Citing the Pentagon's recent cancellations of several high-profile helicopter programs, a few of which grew into notorious dysfunctional budget-busters, including the Armed Reconnaissance Helicopter, the VH-71 "Marine One" presidential helicopter replacement program, and the Air Force's CSAR, Pino diplomatically posited the obvious.

"At this point in the development cycle, it appears that our biggest customer is unwilling to invest major dollars in future technology. That is the real message that is being sent to us," Pino said, adding that Sikorsky would continue to participate in existing government/industry coalitions that are exploring new technology, but that the company wanted to move faster on the S-97. Sikorsky will largely self-fund construction of two of the aircraft, but it does plan to solicit the participation of risk-sharing partners to contribute 20 to 30 percent of the overall costs. Pino said the aircraft would fly within five years.

Sikorsky's bold move could signal a significant shift in the way new helicopter technology is brought to market. Not since Northrop self-funded the ill-fated F-20 Tigershark jet fighter in the early 1980s has an OEM taken on the development of a new military aircraft without specific Pentagon procurement. In Northrop's case, the \$1.2 billion effort proved unsuccessful and financially disastrous for the company.

Along with other OEMs, Sikorsky has traditionally relied on technology from military programs to birth civil aircraft. Most recently, the airframer incorporated key elements from the venerable Black Hawk into the S-92A Helibus. Before that,



both Bell and Hughes (now MD) used early 1960 scout helicopters developed for the military to launch their civil JetRanger and 369/500 series, respectively.

Sikorsky's gamble might pay off better than Northrop's. Already key Pentagon leaders are decrying what they see as a "rotorcraft gap" over the next 15 years, in part due to the failure of several high-profile helicopter programs to reach fruition, while the existing fleet suffers attrition and continued war losses. This has two important implications for the civil market. First, it could increase the number of existing civil airframes, such as the EC145, that are bought and militarized. Secondly, it could make militaries reliant on the largest helicopter makers—AgustaWestland, Boeing, Eurocopter and Sikorsky—for new-technology airframes as these are the only Western companies with deep enough pockets, thanks to their corporate parents, to fund go-it-alone or majority-share programs of any size and speed. Smaller helicopter companies could find themselves minority participants in these programs or out in the cold entirely.

Improved Performance

As this picture clarifies in the coming years, one thing is certain: both military and civil customers are looking for helicopters with more speed, range and payload capabilities, both on existing and future airframes. The OEMs are addressing this in a variety of ways, most dramatically with Sikorsky's X2 and Eurocopter's X3 compound helicopter technologies, but also with the introduction of better rotor blades, hubs, fins and strakes as well as the ever-increasing use of composite components in the airframes to reduce weight.

Over the last year, Bell has been working on incremental performance improvements via supplemental type certificates for two popular models, the 407 single and the 412EP medium twin.

Bell affiliate Aeronautical Accessories received an STC for the 407 that increases available useful load by 400 pounds or in-ground-effect hover by 3,000 feet. The STC draws on excess power available from the 407's Rolls-Royce 250-C47B to support revisions of the 407's performance charts for in-ground-effect and out-of-ground-effect hover. Specifically, it uses available power for up to 10 percent above minimum-specification

engines for outside air temperatures up to 51.7 degrees C (125 degrees F).

Late last year, Bell announced an STC for the 412EP that features a higher-output engine, glass panel avionics akin to those in the new 429 light twin, and a new tail rotor.

The STC project is expected to be approved this year and will be available for customers beginning next year. It will be available on all new 412EPs and retrofittable on existing helicopters. The kit will include installation of the 2,143-shp Pratt & Whitney Canada PT6T-9, to replace the current 1,800-shp PT6T-3D. The engine change yields a 15-percent increase in shp, improved OEI and high/hot performance, and electronic engine control. The upgrade will yield a 10- to 12-percent increase in Category A/PC1 & PC2 performance and a future path to increase range and payload. A modern glass cockpit with display units common to the 429 will be the centerpiece of the avionics upgrade, which will include three- and four-axis autopilot options. Other upgrades planned for the 412EP platform include a tail-rotor upgrade that eliminates the need for pre-flight visual inspection and a communication system upgrade that will be compatible with civil standard headsets, eliminating the need for military-style, low-impedance microphones and earpieces.

Bell is also working with Rolls-Royce on a possible program to retrofit the new RR500 to existing 206 helicopters.

Beyond these STCs, Bell continues work on developing a new line of rotor blades and heads that are expected to translate into modest forward speed improvements, increased useful load, and substantially better high/hot performance.

Eurocopter, too, is working on new blade technology, mainly to address environmental concerns. This includes changing the shape of the blade using technology called Blue Edge and integration of "intelligent" piezoelectric actuators into the trailing edge of the blade, called Blue Pulse.

Blue Edge is a passive system that features a redesigned main rotor blade that uses a double-swept shape to reduce the noise generated by blade-vortex interactions (BVI), which occur when blade-tip vortices interact with the rotor blades. A five-blade Blue Edge main rotor has logged more than 75 hours

on an EC155 testbed, demonstrating a noise reduction of three to four decibels. Eurocopter says it is ready to move Blue Edge into "serial applications."

Separately, Blue Pulse is an active system that the company says can cut noise and vibration significantly. Blue Pulse uses a piezo active rotor control system designed to reduce noise levels generated by BVI. The system also promises to reduce vibration within the airframe, increasing passenger comfort and extending the service life of sensitive components, such as avionics, but it will not extend the life of the blades themselves. Blue Pulse uses three flap modules located at the trailing edge of each rotor blade. The piezoelectric actuators move the rotor flaps 15 to 40 times per second to completely neutralize the familiar "slap" sound that is typically associated with helicopters during descent. Blue Pulse has been flying since 2005 and produces a measured noise reduction of up to five decibels on an EC145.

The company is also continuing development work on diesel power for light helicopters and a new generation of intelligent avionics called Pilas (pilot assistance system) that provides virtual synthetic vision and intelligence by automatically calculating and displaying routes that avoid obstacles, terrain, weather and other aircraft. The company thinks Pilas is ideally suited for the helicopter EMS and law enforcement markets. The system is dynamic and continually monitors the recommended route in flight for changes such as VFR traffic conflicts and can recalculate the route as required. Eurocopter first flew the system in 2008 on an EC145, and parts of the system could be certified within four years.

The Rotorcraft

AgustaWestland AW169

AgustaWestland announced its long-awaited 9,000-pound medium twin last summer, and will likely provide additional technical information on it at this year's HAI Convention. The multi-role AW169 is aimed at the parapublic (law enforcement, EMS and SAR) and corporate niche between the AW109 and the AW139. Power will come from a pair of 1,000-shp Faded Pratt & Whitney Canada PW210S turboshafts, the same



AgustaWestland AW169

DAVID MENTOSH

powerplants tapped for the Sikorsky S-76D. Avionics will include a digital NVG-compatible cockpit with three 8- by 10-inch large area displays with enhanced graphics capability. A four-axis digital automatic flight control system with dual flight management system is expected to facilitate single-pilot IFR operations and will include IFR LPV capability and terrain awareness warning system (Taws). Fuselage construction is expected to include generous use of composites. The cabin will be large enough for eight to 10 passengers or two medical litters and medical personnel. Plans call for skidded and wheeled versions of the helicopter.

Avic AC313

Last year China flew a new home-grown heavy-lift helicopter for the first time. The AC313 tips the scales at 27,600 pounds, can carry up to 27 people, has a maximum ferry range of 560 miles and was built at state-owned Avic, the same company making Sikorsky S-76C++ airframes. The AC313



Avic AC313

appears to be an outgrowth of the 14,000-pound Chinese Zhi-8. That medium helicopter is based on the 1970s-vintage Aérospatiale SA321 Super Frelon.

Avicopter AC311

China-based Avicopter announced in November the first flight of its first indigenously developed light single-engine helicopter, the AC311, in Tianjin. The helicopter, the design of which probably has inherited some lines from the Eurocopter light models parent company Avic has long produced, has an mtow of 4,850 pounds. Capable of carrying six people, it can be powered by either a Honeywell LTS101-700D-2 or a WZ-8D, a local license-produced Turbomeca Arriel. The AC311 is also said to feature "highly integrated" avionics.

Chinese certification is expected this year, with entry into service to follow next year. Quoted in the Chinese media, Avicopter general manager Wang Bin said that the AC311 offers technology and performance close to international standards at a lower acquisition cost.

Bell/Agusta BA609 Civil Tiltrotor

Spokesmen for both partner companies remain relatively obtuse when questioned about the program's current status.

From Bell: "The Bell/Agusta Aerospace Company is committed to certifying and delivering the world's first commercial tiltrotor. As we have done at different stages of the 609 program, we are evaluating the best way to ensure the success of the BA609. We will continue to do this throughout the life of the program."

An AgustaWestland spokesman would say only, "The program has achieved a total of around 560 flight hours and 280 ground-run hours so far."

Now entering its 13th year of development, the Bell/Agusta BA609 program last year appeared to be headed for a divorce. For years AgustaWestland CEO Giuseppe



Bell/Agusta BA609

Orsi has made no secret that he is displeased with the glacial pace of the 609's development and last year negotiations were held that supposedly would have given AW either a majority interest in or outright ownership of the program. These were supposed to be concluded by last June but there has been no word on their outcome.

The 609 first flew in 2003, and only two prototypes are now flying. Two more prototypes that had been scheduled to join the test program for several years have yet to materialize. Last year an AW spokesman told AIN that both aircraft are under construction and will join the test program in 2011 and 2012. However, commercial interest in the 609 has waned as development deadlines repeatedly slipped and the unit price has climbed from an estimated \$8 million to \$10 million in 1998 to more than \$29 million today, making it considerably more expensive than the 19-seat Sikorsky S-92A or AgustaWestland's own three-engine AW101. Yet, the twin P&WC PT6-67A-powered 609 would seem ideally suited for a less price-sensitive, government-backed role such as overwater search-and-rescue. The Bell/Agusta 609 has an mtow of 16,800 pounds.

Preliminary data indicate the aircraft has an unrefueled range of 700 nm (boosted to 950 nm with auxiliary fuel tanks), a cruise speed of 275 knots (maximum forward speed 310 knots) and a service ceiling of 25,000 feet. In utility configuration it could carry up to 12 passengers plus crew, and in SAR mode it could rescue up to six by hoist.

Eurocopter X³

In a surprise announcement last September, Eurocopter unveiled a compound helicopter demonstrator that had made its maiden flight on September 6.



Eurocopter X³

The helicopter is designed to cruise at 220 knots (about 50 percent faster than today's medium twins), a speed the company predicts should make time savings profitable.

F-ZXXX was built from a Dauphin airframe, with two short wings and two propellers in tractor configuration. A conventional empennage replaces the tail rotor. Under the cowlings are two RTM322s, the same turboshafts that power the NH90 military transport. The main gearbox has been adapted from that of the in-development EC175 medium twin, with two outlets added for the propellers.

The X³'s main gearbox is now being upgraded for the second flight-test phase, for which 220 knots is the target cruise speed. Phase one led, in November, to a speed of 180 ktas in level flight at reduced engine power. The aircraft also had its flight envelope expanded in both altitude (up to 12,500 feet) and bank angle (up to 60 degrees).

Eurocopter believes the 220-knot optimal speed will keep operating costs low. First, says Eurocopter, the design is inherently more efficient than that of a conventional helicopter so, despite the higher speed, fuel burn per passenger-mile is said to be similar to that of a conventional helicopter flying at 140 knots. Second, spending less time in the air for a given trip reduces maintenance costs based on flight hours. The bottom line should be a 20-percent cut in costs per passenger mile.

At acquisition, the price premium should not exceed the price of a conventional helicopter equivalent by more than 25 percent. Hoped-for civil applications for this high-speed, long-range concept include search-and-rescue, border patrol and commercial passenger transport, especially offshore.

Eurocopter X4

Eurocopter is working on a replacement for the AS365 Dauphin/EC155 series. A medium twin in the 9,000- to 11,000-pound category, the X4 is still at the feasibility study stage. As of late December, Eurocopter was waiting for the French government to confirm the program would benefit from a bond, yet to be issued. This confirmation, a prerequisite for program launch, had previously been expected in June last year. The French state's contribution could account for as much as 30 percent of program costs. The extent of innovation in the X4 depends on the contribution of the French government. AIN understands this could include fly-by-wire controls.

Eurocopter EC175

Eurocopter says it is on schedule with the flight-test program of its new medium twin, the EC175, which is slated to receive EASA certification in this year's second half. One prototype has been flying since December



Eurocopter EC175

2009. A second one, configured for offshore operations, first flew last December.

The EC175 features Pratt & Whitney Canada PT6C-67E turboshafts and an entirely new cockpit and man-machine interface, designed by Eurocopter.

So far, maximum altitude attained has been 10,000 feet and the aircraft has achieved its design Vne of 175 knots. Trials tend to confirm the cruise speed will be close to 140 knots. Eurocopter has not disclosed the precise mtow of the seven-metric-ton-class (15,000-pound-class) helicopter. In offshore operations with a maximum load of 16 passengers, the EC175 will have a radius of action of 90 nm.

The program is a 50-50 joint effort with China's Avicopter. The status of the Avicopter prototype is unknown. The Chinese program is designated Z15 and, although the helicopter is jointly designed, other activities (production, certification, sales and support) are kept separate.

RotorWay 300T

Kit helicopter company RotorWay launched a new to-be-certified design aimed primarily at the training market in July 2009, but the company's plan to have a non-conforming prototype ready to fly by last year was "put on the back burner," according to a company executive, who cited the need for the company to concentrate on its core kit business during the recession. The Eagle was to be powered by a Rolls-Royce RR300B1 turbine that is similar—but not identical—to the engine used on the Robinson R66. Preliminary specifications for the 2,050-pound two-seater include a 1,100-pound useful load, 500-pound external



RotorWay 300T

load, 110-knot maximum cruise speed and 13,000-foot ceiling. The Eagle would carry 80 gallons of fuel, for two hours endurance with a 30-minute reserve.

Russian Helicopters Kamov Ka-62

Russian Helicopters announced early last year that it would power the long-awaited Ka-62 medium twin with two Turbomeca Ardiden 3G engines. A

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commercial version of the military Ka-60, the Ka-62 can accommodate 14 passengers or carry up to 5,500 pounds as a sling load. MtoW stands at 14,300 pounds, cruise speed at 146 knots and range at 415 nm.

A company spokesman told *AIN*, "There is no provision for certification tests at the current stage of the program." In fact, engine options are still being considered—Arden 3G, NPO Saturn RD600V, Motor Sich TV3-117VMA and a Pratt & Whitney Canada turboshaft. The program is thus at the "marketing analysis" stage.

Russian Helicopters Kamov Ka-226T

Since 2009, Russian Helicopters has been developing a new version of the Kamov Ka-226 light twin, powered by Turbomeca turboshafts (two Arrius 2G1s) and thus dubbed the Ka-226T. Russian AP-29 certification of the helicopter, which features coaxial contra-rotating rotors, is pegged for this year. Tests took place in Russia and India last year. The defense ministry of India could be the first customer.

MtoW stands at 7,900 pounds and maximum payload at 2,200 pounds. Maximum speed is said to be 135 knots and operational ceiling 23,000 feet.

Russian Helicopters Mil Mi-38

Russian Helicopters announced in December that the second prototype of the Mi-38, a 34,400-pound-mtoW twin, had entered flight-test—an indication the program is resuming after a hiatus of several years. Production is now scheduled to start in 2013.

In December, the second prototype

performed 16 hover and low-speed flights, logging a total of five flight hours. The longest sortie was 430 nm, from Kazan to Moscow.

The first prototype flew in 2003, and involved Russian Helicopters subsidiaries Moscow Mil Helicopter Plant and Kazan Helicopters; no updates have been provided since the helicopter first flew. Construction of the second prototype has taken into account lessons learned from the first prototype's 80 flights, according to a source at Russian Helicopters. The hydraulic and fuel systems have been upgraded and the main rotor blades modified, resulting in improved handling and stability, according to the company.

The Mi-38 is powered by two 2,500-shp Pratt & Whitney Canada PW127/TS engines; Klimov TV7-117Vs will be offered, too. The glass cockpit features Tranzas IBKV-38 avionics. Formerly involved in the program, Eurocopter and avionics specialist Thales have since walked away from it. The aircraft, pitched at civil markets such as aerial work, executive transportation and offshore operations, has seating capacity for 30.

Operational range is specified as 480 nm. Service ceiling is said to be 16,700 feet. Maximum payload is estimated at 11,000 pounds (internal) or 15,400 pounds (sling load). Cruise speed is expected to be close to 150 knots.

Russian Helicopters Mi-34S2 Sapsan

Russian Helicopters is working on a turbine version of the Mi-34 light single, the Mi-34S2 Sapsan, but a source at the company recently told *AIN* that the manufacturer is reconsidering this decision, as a piston option (Mi-34S1) has been proposed. The -S2, still officially in Russian Helicopters' plans, is to be powered by a Turbomeca Arrius 2F. The holding company under which the Russian helicopter industry operates plans to apply for European and U.S. certification. Arsenyev Aviation Company Progress's N.I. Sazykin factory will be responsible for final assembly.

The Sapsan (Russian for peregrine falcon) can seat a pilot and four passengers. With the 504-shp Arrius 2F, maximum speed is anticipated to be 143 knots, cruise speed 120 knots and range 460 nm. Service ceiling should be 19,600 feet and hover ceilings, in and out of ground effect, 12,800 feet and 14,300 feet respectively. MtoW is said to be 3,200 pounds.

The first delivery is pegged for this year's fourth quarter. Initial production plans call for five Sapsans to be manufactured this year, with a rate increase to 40 per year in 2016. However, production will start only if the company receives enough orders.

The \$1 million aircraft is aimed initially at markets such as Russia, CIS countries, Asia, Africa and Latin America, with entry into the EU and U.S. markets beginning in 2016.

Sikorsky S-76D

Final assembly of the first production Sikorsky S-76D medium twin has begun in Coatesville, Pa. The first copy is scheduled to be delivered next year.

In November, the program entered the "certification flight status" stage. This is the final phase of testing, and the company anticipates receiving full FAA VFR/IFR sea-level certification by the fourth quarter. Some options, including the rotor ice protection system, will be certified later. Two prototypes are flying at Sikorsky's development flight center in West Palm Beach, Fla., and a third was scheduled to join them early this year.

The S-76D program has encountered repeated delays (in 2009, certification was still planned for 2010); the company has not been specific about the root causes of the delays. The S-76D features a dual-speed main rotor with a quiet mode, Pratt & Whitney Canada's new PW210S turboshafts, a digital four-axis autopilot and a Thales TopDeck avionics suite.

Sikorsky S-434

Sikorsky has started certification testing on the S-434 light single, an improved Schweizer 333. FAA certification of the four-seat helicopter has been postponed to December. Deliveries are scheduled to begin next year.

The two aircraft allocated to the certification flight test program will undergo an estimated 75 to 100 hours of trials to evaluate endurance, flight strain, flight handling qualities, performance, engine installation and noise levels. Sikorsky had previously logged some 50 hours of development flight testing with non-conforming aircraft.

The S-434 sports a four-blade main rotor, a new tail-rotor blade design, a structurally enhanced landing gear, a new trim system and an improved Kaflex driveshaft. The main rotor and its transmission come from the unmanned Fire Scout. The S-434 and the S-333 use the same Rolls-Royce 250-C20W turboshaft, which provides 320 shp.

The four-blade main rotor allows the mtoW to increase by 300 pounds, to a maximum of 2,850 pounds. This translates into a useful load of "more than 1,400 pounds." The new tail rotor can generate some 20 percent more thrust than the tail rotor on an S-333, improving handling and controllability, despite the increased weight, according to Sikorsky.

Once the S-434 is certified, Sikorsky will determine whether to continue production of both the S-333 and its derivative.

Sikorsky X2

Having met its speed target of 250 kts in September, Sikorsky continues to flight test the X2 compound demonstrator at a slower pace. The helicopter features two contra-rotating coaxial main rotors and a pusher propeller.

The X2 has not yet flown with the full complement of hub fairings, which are expected to provide an extra 15 to 20 knots. When the program was launched in 2005, Sikorsky set 250 knots as the primary speed objective. The helicopter has achieved that speed in level flight and reached 260 knots in a shallow dive.

Program officials are happy with the aircraft's aerodynamic performance. Vibration, as hoped, is said to be similar to that of the Black Hawk military transport at its cruise speed of 140 knots. Pilot workload is "on target" thanks to the fly-by-wire control system.

The first application for the compound demonstrator will be military. Sikorsky announced in October that it will build two prototypes, dubbed X2 Raiders, for the U.S. Army to evaluate the benefits of the technology in armed reconnaissance. The X2 Raider, slated to fly in 2014, will have a two-pilot cockpit and space for armament and auxiliary fuel or troops. The proposed commercial helicopter model, to be developed from the X2 Raider, is called the S-97.

