



XTI Aircraft Refines its TriFan 600 VTOL BizJet

Computer graphic of the XTI TriFan 600 over the San Francisco Bay in cruise. (All graphics courtesy of XTI Aircraft)

Will the civil air transport sector accept a regional VTOL aircraft that is not a tiltrotor? Vertiflite looks at one company's offering.

By Robert W. Moorman

Vertical takeoff and landing (VTOL) -capable aircraft other than helicopters are not yet part of business and commercial aviation fleets. But that could change someday. Although there is much work going on right now on fully-electric VTOL aircraft for the Uber Elevate mission and other intra-city applications (see “The eVTOL Is in the Details,” pg. 42), larger aircraft and longer distances will require hybrid-electric propulsion solutions in the foreseeable future.

One contender is XTI Aircraft Company, which is well advanced with its TriFan 600, a hybrid-electric VTOL-capable aircraft now expected to enter production in 2022, two years earlier than originally planned, according to XTI CEO Robert LaBelle.

Like many companies, XTI had its challenges early on. It was founded in 2012 by entrepreneur David Brody, who came up with the conceptual design of the TriFan 600 (see sidebar).

Based near Denver, Colorado, the company's initial plan was to develop a more traditional propulsion system for the aircraft with two large turboshaft engines driving two tilting ducted propellers and a third fan in the fuselage. But the aircraft was heavy and expensive with a \$12M price tag and therefore would likely have found a much smaller market.

The program suffered a setback on Feb. 5, 2016, when XTI CEO Jeffrey Pino, the former president of Sikorsky Aircraft (and former chair of AHS International), was killed after his World War II P-51D Mustang crashed near Maricopa, Arizona.

LaBelle became CEO in January 2017. During a lengthy interview with *Vertiflite*, LaBelle detailed changes to the design of the TriFan 600, the path to its certification and the direction of the company.

A New Beginning

One of LaBelle's first priorities as the XTI leader was to come up with an efficient and lighter powerplant for the TriFan 600 that would reduce the unit and direct operating costs of the aircraft. Engineers determined that a hybrid-electric system would produce the most cost-effective and marketable solution.

XTI brought in George Bye as chief engineer for the TriFan 600 program. Bye's Denver-based company, Bye Aerospace, has experience in hybrid-electric propulsion and solar-powered aircraft. Bye developed the hybrid-electric propulsion system for the TriFan 600.

Another key partner in the program is Trek Aerospace, which has unique duct and fan technology. Trek said that its core technology has the highest thrust-to-power ratio in the industry, so its shrouded props require less power, meaning greater range, payload capacity and endurance.

The redesigned TriFan 600 will be powered by a hybrid-electric propulsion system composed of a single 1,000 shp (750 kW) engine, such as the Honeywell HTS900, driving three generators, which, in turn, will provide electricity to the six electric motors that turn the three fans.

In addition, in the vertical flight phase, the aircraft will be supplemented by batteries to provide needed power to the fans. If the batteries fail during the 20 seconds of vertical flight, “the engine has an emergency operating mode that provides for more power,” said LaBelle.

The TriFan will also feature thin-film photovoltaic solar cells embedded in the skin on top of the fuselage and wing, which will

provide up to 4 kW of power, sufficient for ground operations.

The 300-kt (555-km/h) capable aircraft will have a range of up to 1,200 nm (2,200 km) with a short takeoff from an airport and 670 nm (1,240 km) with a vertical takeoff and landing. Cruising altitude of 29,000 ft (8,800 m) will be achievable within ten minutes after liftoff, said LaBelle.

Using the three ducted fans, the TriFan 600 will lift off vertically. Its two wing fans will then rotate forward for transition to climb and cruise. During vertical flight, the aft fuselage fan, part of the TriFan arrangement, will be closed off.

Moving to a hybrid-electric system will reduce procurement cost of the TriFan 600 to \$6.5M, said LaBelle. Direct operating costs will be reduced more than two-thirds from the initial design, to around \$350 per hour. The full operating costs, which include pilot, insurance and fuel will be 20 cents per passenger mile with five passengers. The aircraft is expected to burn around 35–40 gallons (130–150 liters) of Jet-A fuel per hour.

Removing the heavy machinery in the earlier design, which included driveshafts and gearboxes, reduced the empty weight of the TriFan 600 by 3,000 lb (1,360 kg). In addition, removing those items will save nearly 40% in development costs, LaBelle said.

All of the aircraft structure will be carbon fiber composite.

As for avionics, XTI is in discussion with a few suppliers, but LaBelle wouldn't provide specifics. A technical team will help determine what the flight deck will look like. A formal announcement on the avionics package is expected by late Spring 2018, said the chief executive.

XTI will soon begin assembling the 60%-scale model TriFan 600, which will validate the aerodynamics of the aircraft; first flight is slated for September 2018. The full-scale aircraft will fly in November 2019, at which point the ground and flight test program will begin officially. Full cost of the program will be around \$200M, said LaBelle.

Certification flights are planned to begin in 2020. And XTI plans to follow the newly rewritten performance-based guidelines of the FAR Part 23 fixed-wing rule. The TriFan 600 will be certified for single-pilot operations.

"Some challenges remain regarding powered-lift requirements," said LaBelle. "Largely, we will rely on FAR Part 23, which will help us with the [certification] schedule." A certification-related meeting with the US Federal Aviation Administration (FAA) is planned for the near future, he added.

The TriFan 600 configuration is currently being updated with small winglets to provide better performance. The tail will be raised to a T-tail to give the aircraft more stability.

Expansion of XTI Aircraft facilities at Centennial Airport near Denver, or at another yet-to-be-determined location, will begin around October 2018 after first flight of the prototype. As of early 2018, XTI was in the detailed design phase of its flying prototype.

Orders & Capital

XTI announced its initial orders for the six-seat TriFan 600 last summer at the 2017 Paris Air Show and several additional orders



After more than a dozen years leading activities for AgustaWestland in America, Bob LaBelle sees the hybrid-electric TriFan as the most compelling inter-city VTOL aircraft coming to market.

with deposits at the National Business Aviation Association (NBAA) Convention last October under its pre-sales program. Prospective buyers are plunking down a refundable \$25,000 deposit for the aircraft. XTI has secured 58 firm orders with deposits for the TriFan 600 from unnamed customers in Japan, the United Arab Emirates, Australia, India and the US.

"The better economics help make a new business case for the aircraft," said LaBelle. "There are an untold number of uses for this aircraft," he added, particularly in those countries with poor infrastructure and massive traffic jams.

LaBelle said the company has no plans at this time to partner with an established aerospace original equipment manufacturer (OEM). To expand its capital base, XTI in 2016 launched a crowdfunding campaign for unaccredited and accredited investors worldwide. Over 600 people had invested in the program as of this writing.

XTI estimated an initial need for 1,000 TriFan 600s over 15 years, with roughly 60 aircraft assembled per year, at least initially. "I am fairly confident now that there will be a need for more than 2,000 units," said LaBelle.

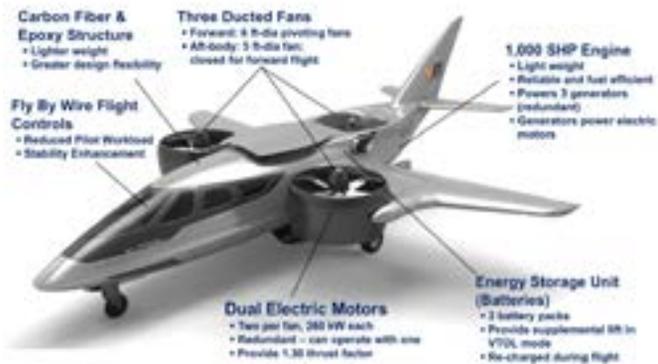
XTI could face competition from Leonardo's AW609 tiltrotor, as well as other electric VTOL aircraft that have begun flying. With a similar design to the V-22 Osprey, the AgustaWestland AW609 aircraft has been flying since 2003, but is finally on track to begin deliveries in 2019. (LaBelle was previously the CEO of AgustaWestland North America.)

Numerous delays in the 609 program, the FAA certification requirements that the aircraft had to meet for both fixed- and rotary-wing aircraft, and a fatal crash during flight tests in October 2015 didn't burnish the AW609's image. The aircraft has picked up orders and Leonardo is marketing its tiltrotor toward corporate, emergency medical services, search and rescue, and military sectors.

XTI has a narrower market segment focus for the TriFan 600, but the company is considering other potential uses for its aircraft.

The basic difference between the AW609 and the TriFan 600 is that the 609 is a tiltrotor aircraft, in which the engines and rotors tilt from horizontal to vertical, and back again, to initiate a vertical takeoff, transition to horizontal flight, and a vertical landing. On the TriFan 600, only the wing-mounted ducted electric motor-driven fans tilt. Both the AW609 and the TriFan 600 have triple redundant, fly-by-wire flight control systems.

XTI's TriFan 600 is the largest of all the electric and hybrid-electric passenger-carrying VTOL aircraft concepts announced to date (see AHS International's "Electric VTOL News" website,



XTI hasn't released any images of its refined TriFan, but this diagram shows the basic attributes of the configuration.



Interior cabin view looking forward at the cockpit and the forward (aft-facing) row of seats.

• www.eVTOL.news, for descriptions of more than 50 other electric VTOL concepts), ranging from the single-seat Airbus Vahana dual tilt-wing to the four-seat Joby Aviation S4 with six tilting propellers (see "Advanced VTOL Demonstrators Accelerate Full Tilt," pg. 12). Although the hybrid-electric TriFan 600 is aiming at the bizjet regional/inter-city market, nearly all of the other electric VTOL aircraft are being developed for missions such as the intra-urban air taxi missions proposed by Uber (see "The Demand for On-Demand Mobility," *Vertiflite*, Jan/Feb 2017).

Asked if Uber's plan to begin service of its fully electric VTOL aircraft by 2023 is affecting XTI's marketing efforts, LaBelle said: "I think it has helped us because it keeps the topic alive. I hope they keep pushing the idea."

Although many analysts still consider electric and hybrid-electric aircraft to be longshots, fraught with technology and regulatory hurdles, others are cautiously optimistic. "It's always exciting to see new ideas come into civil aviation, but developing new technologies like ducted fans and hybrid-electric propulsion for commercial service always takes more money and time than companies expect," said Douglas Royce, a senior aviation and engine analyst with Forecast International. "That's true of even simpler, more conventional aircraft designs."

Royce added: "Based on what I've seen in the past with all-new development programs like this from small manufacturers, the first round of financing is never enough. At some point, someone with deep pockets is going to have to be brought in to commit to financing the program to the end."

XTI maintains that the TriFan 600's appeal could extend far beyond that of a medium-haul transport or urban aerial traffic buster. If it

Founder's View



Before XTI Aircraft Company (XTI), David Brody founded Ft. Worth, Texas-based AVX Aircraft Company in 2005 to develop advanced rotorcraft technology, primarily for military aircraft programs. Brody, an attorney, entrepreneur, inventor and author, introduced civil and military compound helicopter concepts featuring coaxial rotors combined with ducted fans. (The company won contracts for its

Compound Coaxial Helicopter (CCH) under the US Army's Joint Multi-Role (JMR) technology demonstration effort, and development is continuing.)

The ducted fan for propulsion and directional control was one technology, which led to the formation of XTI and a switch to the civil side of the business: when the AVX Board of Directors declined to take on the TriFan 600 concept, the board spun off the subsidiary, AVX Aircraft Technologies Inc. In 2013, the subsidiary's name was changed XTI Aircraft.

Following the initial design of the VTOL-capable TriFan 600 with three ducted fans, Brody recruited a veteran team of executives and engineers. XTI's current board now includes Charlie Johnson, former president of Cessna Aircraft; Robert LaBelle, XTI Chief Executive; and Paul Willard, a general partner at Subtraction Capital and former Boeing aeronautical engineer.

Brody's vision of developing technology for the rotorcraft industry that is "safer, faster and more accessible to the mass transportation market" appears to be catching on with other companies.

Brody offered clarification on the point of competition, which, he said, falls into two categories. The first category includes the growing number competitors in the short-range urban air taxi group. "We're not competing in this category," said Brody. "We're the inter-city answer, not the intra-city answer."

The other, longer haul category, in which XTI will compete, consists of one competitor, Leonardo, with its AW609 tiltrotor. "And, on paper, we have a better aircraft with a fraction of the acquisition and operational costs," he said. "We also will have a longer range and faster aircraft."

In the coming months, the company will step up marketing efforts on the aircraft. Plans include talking to "decision makers in cities for convenient places to land and take off," said Brody. "Through those contacts, we might get the infrastructure expanded."

As to city residents' noise concerns, Brody said the TriFan 600 would be "much quieter than the average helicopter." He expects that claim, and others, will be proven once the ground and flight test phase of the scale model begins, followed by the testing of the full-size prototype TriFan 600.



XTI believes its TriFan 600 will fly 300 kt and achieve a range of 1,200 nm with a short takeoff from an airport, or 670 nm with a vertical takeoff and landing from a rooftop or other vertiport.

gets to market, the TriFan 600 could serve as an effective tool for owner/operators and corporate executives. But it could also find use as a utility and transport vehicle for civil, paramilitary and emergency medical service sectors.

Time will tell.



About the Author

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XTI Aircraft TriFan 600 Technical Data

DIMENSIONS:

Overall length:	11.8 m / 39 ft
Wingspan:	11.5 m / 38 ft
Duct diameter (wings):	1.8 m / 6 ft
Duct diameter (fuselage):	1.4 m / 5 ft

WEIGHTS:

Max vertical takeoff:	2,404 kg / 5,300 lb
Max short takeoff:	2,858 kg / 6,300 lb
Empty weight:	1,588 kg / 3,500 lb

USEFUL LOAD:

Passengers:	5 plus 1 Pilot
Vertical takeoff:	816 kg / 1,800 lb
Short takeoff:	1,270 kg / 2,800 lb

FUEL:

MAX CRUISE SPEED:	555 km/h / 300 kts
RANGE:	(@ 300 kt cruise)

Max payload/vertical takeoff: 1,060 kg / 2,340 lb

Pilot only/vertical takeoff: 1,240 kg / 2,735 lb

STOL max range 2,222 km / 1,200 nm

ALTITUDE:

Max cruise altitude: 8,840 m / 29,000 ft

Achieve max cruise altitude: 11 minutes

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