# Capitalizing on the Miraculous eVTOL Gold Rush

By Mike Hirschberg, VFS Executive Director

For the past two years, I have included a discussion about the "Five Key Challenges" of electric vertical takeoff and landing (eVTOL) aircraft in my public briefings. I initially referred to them (tongue in cheek) as "five simultaneous miracles" necessary to have urban air mobility (UAM) air taxi in service by the Uber Elevate goal of 2023.

VFS has long been saying that there is an "Electric VTOL Revolution" underway, but have cautioned people not to get carried away. There is sometimes a bit of mass hysteria about eVTOL that gives some the false impression that eVTOL is easy. Instead, VFS has been leading activities that focus on the critical challenges and how to tackle them.

There has been tremendous progress in eVTOL over these past two years, with more than two dozen companies flying large-scale, multi-passenger eVTOL aircraft, and several others expected to join this elite status in the coming year. Suddenly (for the public, anyway), the Uber Elevate mantra — "It's closer than you think" — is becoming a reality.

**The Five Simultaneous Miracles**

While there are still countless obstacles to surmount, years of effort and a confluence of many factors indicate that these five key challenges are being overcome.

Technology: Flight tests of these demonstrators — in addition to endorsements by the US Air Force's Agility Prime, NASA's Advanced Air Mobility (AAM) National Campaign and the due diligence required for the multi-million-dollar investments — show that several companies have developed approaches that will likely deliver. But just completing development of an aircraft is not sufficient.

In order to provide a return on investment, it requires low operating costs and significant profit margins for the developers, operators and others in the ecosystem. This means efficient operations that deliver compelling capabilities to the marketplace with significant advantages over competing solutions — be it driving one's own car, taking public transportation or commuting by helicopter. The conflict between high-performance and high-complexity versus lesser performance and greater simplicity is well-known to all aircraft designers. The economics will ultimately decide which will survive to see initial operations and beyond.

Infrastructure: VFS kicked off an initiative in September 2019 with the first of now four semi-annual solution-focused Workshops on eVTOL Infrastructure for UAM (www.vtol.org/infrastructure). The workshop series has been plotting out a plan of action — in collaboration with the US Federal Aviation Administration (FAA) and state, regional and local governments — to advance eVTOL infrastructure development. Infrastructure is recognized as a potentially lucrative investment, with a number of announcements being made recently, including Ferrovial's plans to develop a network of at least 10 vertiports in Florida (see "Electric VTOL News," pg. 70). NEXA Capital and UAM Geomatics have predicted billions of dollars in revenues and investment-grade returns from UAM vertiport operations.

With the departure of Uber, there is no longer an integrated real estate investment movement towards developing vertiports across eVTOL developers. This fragmentation has created a new risk that could set back the industry as each eVTOL company must now develop their own solution, partnering with development consortiums on a city-by-city basis. The VFS infrastructure initiative helps ameliorate this risk by providing a greater understanding of the needs and constraints.

Meanwhile, NASA's Unmanned Aircraft System Traffic Management (UTM) and related efforts have shown potential solutions to managing the potential for large-scale operations in crowded urban skies. Again, city-by-city development consortiums may be expected to pay for UTM installation and operation.

Pilots: It's not hard to imagine that at some point in the future, aircraft will not need pilots and can be flown more safely if fully autonomous. Before the pandemic hit, air travel was booming and pilots were in scarce supply, creating a crisis of not enough pilots to meet the constant expansion of the airlines. When air travel suddenly fell off a cliff last March, the situation quickly reversed itself. While most people expect flying to rebound soon, it may be years before airline travel hits pre-pandemic levels, particularly with the ease and popularity of video conferencing tools.

For the foreseeable future, eVTOL aircraft will need pilots. But having high degrees of automation via simplified vehicle operations (SVO) will allow lower-time pilots to safely operate air taxis.

Regulations: The FAA has made tremendous progress in its move to performance-based airworthiness standards. Part 23 Amendment 64 went into effect in August 2017. ASTM International and other standards developing organizations have been extremely busy over the past several years extending and expanding standards to cover the unique qualities of electric aircraft.

The FAA has taken the approach that no new regulations would be necessary to certify eVTOL aircraft, and has repeatedly stated that there are now dozens of AAM companies working through certification. Joby announced on Feb. 9 that it had agreed to the certification basis (the "G-1") for its aircraft with the FAA. This is an important step and other companies are close behind.

Timeline: Joby Aviation — which was the farthest ahead of any eVTOL aircraft developer and had been flying its full-scale S4 demonstrator (now referred to as its Generation 1.0 aircraft) since 2017 — was not an Uber Elevate partner, nor were any of the other companies that were flying aircraft at the time. Now, Joby's five-seat, pre-production Generation 2.0 air taxi has been flying since late 2019.

The COVID-19 pandemic and other factors slowed things down slightly, but Joby announced in early February that it still planned for airworthiness certification in 2023 and operations in 2024 with precisely the type of service imagined by Uber. In January, Joby took over Uber's Elevate intellectual property and key personnel (see "Joby

relationship with the ride-hailing company, including plans to offer Joby's air taxi service on the Uber app.

**eVTOL Gets SPAC'd**

For more than 100 years, history has proven that developing a successful vertical flight aircraft is hard — and no one should undertake it lightly — but access to capital has always been a limiting factor. For decades, nearly all of the money needed for aircraft development came from governments (either via military contracts or financial assistance) or from internal corporate funding from profits of past successful aircraft developments.

Now, for the first time, substantial funding for vertical flight is coming from outside of aerospace. Trillions of dollars have been made in the "app economy" over the past decade and the millionaires and billionaires are looking for the next big bet that will change society. The founders of Google, LinkedIn, Pinterest, Skype and similar companies are investing in the emerging eVTOL industry.

A series of Special Purpose Acquisition Company (SPAC) investments have injected billions of dollars into UAM companies, including Blade, Archer and Joby, as of press time, with several more expected (see "SPACtacular Financing: Billions Coming for eVTOL," pg. 48). Thus, proceeds from the "Digital Revolution" are now funding the "eVTOL Revolution."

One of the charges that had been levied against starry-eyed eVTOL developers over the past decade was that the cost of aircraft development through certification — generally estimated as around $1B — was a major roadblock that would temper the eVTOL dream. Beyond certification was an equal financial hurdle of scaling up to production and commercialization. Where was all that money going to come from? The SPACs have now answered that.

**Return on Investments**

The "five simultaneous miracles" — while not yet complete — do appear to be happening on schedule.

In addition, the seemingly impossible $1B fundraising barrier has now been removed for some companies and offers great promise for others. Third-party analysts are doing their "due diligence" and seeing the potential for not only technical success, but also for profitable operations — the obvious goal of any commercial development.

Combined, the progress in each of these five key challenges — plus the unbelievable amount of cash now available to overcome the remaining hurdles — prove the adage (often attributed to Nelson Mandela) that "It always seems impossible until it's done."

*What do you think? Let me know at* **director@vtol.org.**