



## Stand on the Shoulders of Giants

By Mike Hirschberg, Executive Director  
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The explosion of interest in electric and hybrid-electric vertical takeoff and landing (eVTOL) technology over the past few years has been overwhelming. The Vertical Flight Society hosted the first annual Transformational

Vertical Flight Workshop on eVTOL in 2014, has held special sessions at the Annual Forum each year, energized our technical committees on the topic, and created the Electric VTOL News website ([www.eVTOL.news](http://www.eVTOL.news)) to promote the incredible promise and progress of eVTOL aircraft.

The Electric VTOL News website now catalogs more than 130 eVTOL aircraft concepts — from the silly to the serious — and is an essential reference for developers and those following this exciting new domain. What information and references are available are included on the website. Concepts are generally publicized to attract interest, investment, talent and/or customers. Some of the innovative eVTOL concepts are backed by extensive research, while others are only notional with their feasibility still to be determined.

The 19th-century aviation pioneer Otto Lilienthal famously observed: “To invent an aircraft is nothing. To build one is something. To fly is *everything*.” The publication of his experiments inspired and informed a generation of engineers and innovators, including the Wright Brothers and Glenn Curtiss in the US, and Louis Blériot and Alberto Santos-Dumont in France. But Lilienthal did not succeed in being first in flight as he was tragically killed when his glider crashed in 1896. As innovators struggled to invent viable new flying machines, the fundamental differentiator between dreamers and achievers is the ability to grasp and integrate all the principles of physics, aerodynamics, structures and control. The essential elements of successful aircraft development are the same today as they were then.

During my decade at the US Defense Advanced Research Projects Agency (DARPA) in the 2000s, I was exposed to a broad spectrum of conceptual aircraft designs. I saw many unique approaches, including some based on dubious principles or a lack of engineering rigor, analysis and empirical development. Slick-looking promotional computer-aided drawings and videos touted concepts that worked like magic, without regard to those pesky laws of physics. But they’re

called “laws” for a reason — they aren’t optional. It’s easy to draw an aircraft that looks good, but it’s hard to develop a robust design that meets certification requirements while still achieving the proposed mission capabilities.

Fantastic air vehicles in science fiction are always capable of vertical takeoff and landing because they don’t require engineering. Drawing (“inventing”) an aircraft is only the first step. While many designs were entertaining, I often had to remark, “It’s easy to design aircraft if you don’t know how.” This adage — which has been referred to as the “Hirschberg Principle” — came to mind independent of Lilienthal but is really just a restatement of his insights from 125 years ago.

The democratization of design has reduced the barriers for entry through the widespread availability of sophisticated modeling and analysis tools, but there’s no substitute for solid engineering. These new tools are all just aids in the iterative process of developing aircraft, which requires domain knowledge, insight and experience.

Many eVTOL concepts have been inspired by the simplicity of small electric drones, and claim impressive performance, but the devil is in the details. Innovators would be wise to leverage the wealth of existing knowledge of vertical flight. While he didn’t coin the phrase, Sir Isaac Newton explained the success of his genius by saying, “If I have seen further, it is by standing on the shoulders of giants.”

### Applications to the Future of Vertical Flight

Safety today is essential, with regulatory certification being a necessary-but-not-sufficient statement on safety. There are also the -ilities: reliability, maintainability, affordability, etc. Truly, to be a viable player in today’s marketplace, a new aircraft must have these attributes in spades and make a compelling value proposition against competing offerings as well.

There is an old adage that I first heard in the 1980s: “If you want to end up with a small fortune in aerospace, you need to start out with a large one.” Developing new aircraft and delivering them to market looks easy but has often been ruinous for small start-up companies. Fortunately, large amounts of money are now being pumped into aerospace — including into VTOL aircraft developments.

Thousands of engineers and innovators are now entering the aerospace industry for the first time with limited understanding or experience. Fresh perspectives can be invigorating and lead to innovative new breakthroughs, but naivety is also resulting in significant loss of productivity towards advancing vertical flight. With scores of new companies in the mix, many age-old lessons are being learned again for the first time. A certain amount of conviction and self-assurance is necessary to bring about a disruptive change, but arrogance, ignorance and an unwillingness to leverage prior work are all ingredients for disaster.

One would think that those looking to develop a revolutionary new vertical flight aircraft would look at

the existing state of the art and all available information resources. Many innovators new to vertical flight do, of course, take advantage of what the Vertical Flight Society has to offer. With 75 years of technical information available — including 12,000 downloadable files in the online Vertical Flight Library — VFS is the global resource for information on vertical flight technology. Equally important, of course, are the living assets: the members of VFS and the attendees at our events. Time and again our members say that the teams they formed for a project (including for eVTOL aircraft development efforts) were from contacts made at the Annual Forum or one of our other conferences or local chapter meetings. Networking and understanding what other organizations are working on are key benefits of being part of VFS: companies find VTOL experts, partners, suppliers and customers at our events.

Those working in the eVTOL field would do well to attend our 6th Annual Electric VTOL Symposium being held in conjunction with the 8th Biennial Autonomous VTOL Technical Meeting, Jan. 28 - Feb. 1 in Mesa, Arizona. Start-ups and others new to vertical flight could potentially save millions of dollars and reduce risk from the insights, contacts and lessons learned at this key event.

#### eVTOL Know-How

Wild predictions about the economic prospects and potential of eVTOL aircraft are now being made (see “The Electric VTOL News,” pg. 50). Morgan Stanley predicts the market could be worth as much as \$1.5T by 2040, while other studies suggest it could be double that.

In addition to the potential financial gain, the explosion of interest in eVTOL — and more conventional VTOL aircraft developments — is being augmented by several

factors, including significant technology advancements, the widespread availability of VTOL drones, and the resulting exposure of aviation to a much greater segment of the population. The democratization of aircraft design tools, increased availability of investment capital and the predisposition towards technology innovations in society are also contributing to the fervor.

But much of this is the “easy” part. All of these assets can be wasted without solid engineering, relevant design and development expertise, robust technology development and maturation plans, and thoughtful consideration of risk mitigation. With today’s technology, building and flying innovative aircraft is much easier than ever before. But to develop safe, successful products for the competitive marketplace, developers must take advantage of available knowledge and expertise to overcome the cheeky truism of the Hirschberg Principle.

Since 1943, the Society has existed to advance vertical flight and has been vigorously leading efforts to support the transformative vertical flight capabilities of electric VTOL workshop since 2014. We have the resources, connections and the demonstrated leadership to accelerate the full realization of the eVTOL revolution.

Taking advantage of our resources and learning from others may be important discriminators in the competition for the future eVTOL market. Those developers who do so improve their chances of success. The opportunities seem tremendous and unprecedented, but so are the risks if not done smartly. To paraphrase Lilienthal, “To fly *safe, efficient and affordable aircraft* is truly everything.”

What do you think? Let me know at [director@vtol.org](mailto:director@vtol.org)



## Electric VTOL Education

### Available to the Public for Free

Subscribe to the Society’s YouTube Channel at [www.youtube.com/VTOLsociety](https://www.youtube.com/VTOLsociety) for educational videos on vertical flight, including:

- eVTOL Workshop, Jan. 2018 (11 hours)
- VFS Briefings on Electric VTOL (4.5 hours)
- CAFE Electric Aircraft Symposium (/9 hours)
- RPI Center for Mobility with Vertical Lift (6.2 hours)

### Available to VFS Members Only

The special sessions and plenary events at Forum 74 were video recorded and are available for free viewing by all current VFS members at [www.vtol.org/videos](https://www.vtol.org/videos):

- The Promise and Progress of eVTOL (3.5 hours)
- Challenges of eVTOL (2 hours)
- Flight Qualification & Certification (2:45 hours)

VFS Members can also purchase PDFs of the individual presentations: [www.vtol.org/library](https://www.vtol.org/library)

### Pay Per View

In addition, the two short courses held at Forum 74 are available on a pay-per-view video-on-demand basis. Check out our Vimeo channel ([www.vimeo.com/VTOLsociety](https://www.vimeo.com/VTOLsociety))

- Electric VTOL Short Course
- Rotorcraft Modeling Short Course

### Upcoming eVTOL Short Courses

Two new eVTOL Short Courses are planned in conjunction with the 8th Biennial Autonomous VTOL Technical Meeting & 6th Annual Electric VTOL Symposium, being held the week of Jan. 28 in Mesa, Arizona. A one-day “**Short Course on Electric VTOL Design**” will be taught by Dr. James Wang. In addition, a day-and-a-half course on “**Electric VTOL Aeromechanics & Acoustic Prediction Software**,” will be led by Dr. Ken Brentner. Go to [www.vtol.org/autonomous](https://www.vtol.org/autonomous) to learn more!