eFlight Journal

Quarterly Vol. 1-2020 www.e-flight-journal.com

Electric Aviation, VTOLS, Multicopter, Fixed wings, Hybrid Technology, Rule making news, Test Reports * Electric Aviation, VTOLS, Multicopter, Rotorwings, Hybrid Technology, Rule making

Exclusive:
Interview Joby boss JoeBen Bevirt

EASA
SC VTOL

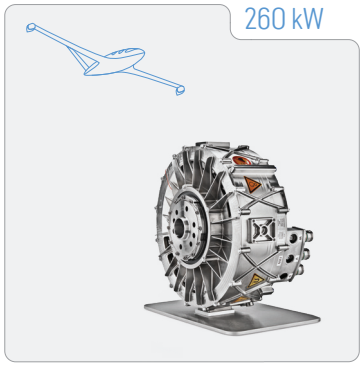
AERO 2020
e-Flight-Expo
e-Flight-Rallye

First Images
Joby's eVTOL

Scan 2 read online

Cover image composed from 2 original images from Joby Aviation

Powering the Future



With air traffic continuously rising, new solutions are needed to increase efficiency and limit environmental effects.

Rolls-Royce is developing electric propulsion systems to power a more sustainable future of aviation and new mobility concepts, with power classes ranging from less than one hundred to several thousand kilowatts.

rolls-royce.com

ROLLS ROYCE

PIONEERS OF POWER

The Races are on

Since Uber introduced its elevate concept eVTOLs and Urban Air Mobility are in the public discussion. In the last years several Manufacturers made their first flights and started test-programs. Most recently, Joby Aviation's 590 Million Dollars new financing cought the headlines around the world in the third week of January 2020. Other companies from the eVTOL sector will likely follow. Some others like Wisk with its shareholders Boeing and Google do not need much external funding. Undoubtly the funding is heavily influencing who will be the first one who can certify an eVTOL and put it into operations. But there are more races at the moment going on than just the one of the manufacturers of the airframes.

There is also the competition of the certification authorities on the certification matters which is as important for the enabling of the operations as the eVTOL design and production. As of today the approaches which FAA and EASA has been taken are fairly different. EASA released and explained its views of its SC-VTOL at the EASA Rotorcraft Symposium in Cologne / Germany last December. Besides EASA and FAA, the Chinese regulator CAAC has its own approach as well.

Another competition is happening between the Countries for test Areas and also the potential early adopter cities is on. Will it be Dallas, Singapore, LA or Paris or a totally different City which can offer the first UAM service? In the background there is another field which also has to be done before the service can start: the development of a common air traffic system for the eVTOLs which has to interact with the conventional air traffic system of airliners and general aviation as well with the growing unmanned sector.

In order to make the UAM dream come true, all the factors mentioned above have to be addressed. But as we can see, global efforts are being made. The races are on and it is exciting to see who will be the first winner. Who will you put your money on?

Willi Tacke
Xin Gou

Cover image composed from 2 original images from Joby Aviation

We the **eFlight Journal (eFJ)** founders are a team of aviation journalists and enthusiasts who created Flying-Pages. Publishing several aviation publications around the world. It started with the interest in electric flying in 2009. We co-founded the e-Flight-Expo in Friedrichshafen/Germany as part of the AERO, and established it as the largest show for electric aviation worldwide.

The eFJ is supported by the GAMA EPIC committee, Rolls-Royce, Rotax and many others.

eFlight Journal
www.flying-pages.com

Publisher, Flying-pages GmbH, Buttersteig 11,
D-16831 Rheinsberg OT Zühlen
• phone: D-033931/80 60 27, Fax.: D-030/34 70 91 24
• info@flying-pages.com • www.flying-pages.com

ADVERTISING
Worldwide Willi Tacke, • phone :+49 (0)8841 / 487 515,
mob:+49 (0)171 69 808 71, fax:+49(0)8841 / 496 012,
US Cell: +1 920 385 8495 • willi@flying-pages.com
Germany & other Countries, Rosi Berkemeier
• phone: +49 (0)33931/80 60 27 • Fax +49 (0)30 / 3470 9124
• rosi@flying-pages.com
USA, Bettina C. Larrarte • phone.: +1 970 310 1410
• bc@flying-pages.com

EDITORIAL
Robby Bayerl, Marino Boric, Greg Bowls, René Coulon, Dimitri Delemarle, Jan Fridrich, Mike Friend, Xin Guo, Martin Hardung, Dan Johnson, Klaus Köhmstedt, Germán Larrarte, Werner Pfändler, Peter Raab, Jan Otto Reimers, Torkell Saetervade, Christian Tacke, Julia Tacke, Willi Tacke, Dave Unwin, Qinyin Zhang, Markus Villinger, Jean-Marie Urlacher (Photo).

Managing Editor, Design: Bettina Cosima Larrarte

Technical Proofreader/USA: Renée Larrarte

Online: Achim Holzmann

Hyundai and Uber unveiled UAM solution

Hyundai Motor Company and Uber Elevate displayed a complete urban air mobility (UAM) electric vertical takeoff & landing (eVTOL) concept vehicle called S-A1, autonomous pods, and a hub ecosystem at the Consumer Electronics Show (CES) in January 2020. Hyundai also revealed its Purpose Built Vehicle (PBV) concept, capable of adapting to specific lifestyle needs of passengers and reducing time wasted on congested highways. Hyundai is the first Uber Elevate partner with automotive manufacturing capabilities to mass produce such electric aircraft and autonomous pods. S-A is designed for a cruising speed up to 180 miles/hr (290 km/hr), a cruising altitude of around 1,000-2,000 feet (300 - 600 mt) above ground, and to fly trips up to 60 mile (100 km). Hyundai will produce and deploy the S-A1 using its automotive manufacturing capability. Hyundai set up a dedicated UAM department and recruited Jaiwon Shin, the former NASA associate administrator, as the Head of Hyundai's Urban Air Mobility (UAM) Division last year.

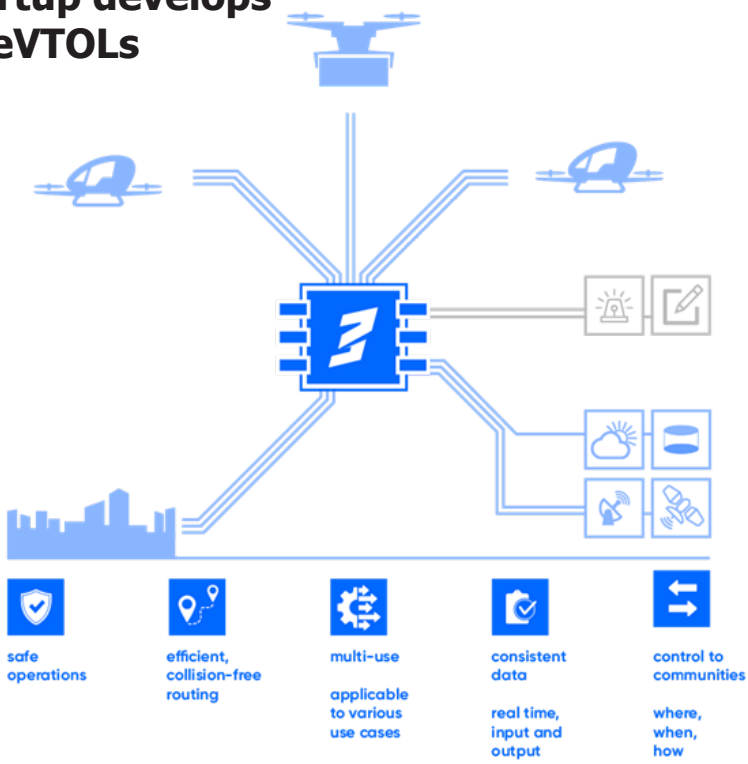
CityAirbus Makes First Untethered Flight

Airbus' all-electric, four-seat multicopter demonstrator, CityAirbus, made its first untethered flight in December 2019 in Donauwörth, Germany. Eight pitch rotors are powered by eight specially designed Siemens SP200D direct-drive 100 kW units relying on four 140 kW batteries developed by Airbus' Defense and Space arm. The CityAirbus will carry up to four passengers with a cruise speed of 75 mph (120 km/h). The model currently will have 15 minutes of flight time. The vehicle is designed to fly autonomously. The four carbon fiber ducted co-axial propeller configuration will contribute to a low acoustic footprint. Each duct provides 881 lb (400 kg) of thrust for a payload of up to 551 lb (250 kg).The first unmanned tethered flight of CityAirbus took place in May 2019 at the Airbus Helicopters flight test facility in Donauwörth, Bavaria, Germany.

D3: New German startup develops ATM for Drones and eVTOLs

The problem is clear, next to Certification and the developing of the physical and electrical ground infrastructure the Challenge for bringing eVTOLs into service is developing an Air Traffic management (ATM) - system that connects the conventional ATM-System for the airliners and GA together with the new vertical traffic of drones and manned eVTOLs. D3 is the name of a new German start-up from Munich which wants to solve this problem. Several eVTOL manufacturers like Volocopter or Embraer and also the taxi ride share company UBER are working on such a system; buts it's unlikely that the system from one of the competitors can be the system for everybody. Cities and countries probably will look for a system from a neutral developer which will be open for all manufacturers.

This is the part of the market where D3 searches his place. "We have a strong team of developers and programmers" says CEO Corvin Huber, "and we see an openness as well on the sides of the manufacturers and the operators and countries".



European Helicopter Association and EASA to launch EUROPEAN ROTORS fair in November 2020

The European Helicopter Association (EHA) and the European Union Aviation Safety Agency (EASA) will organize the first EUROPEAN ROTORS fair in Cologne in November 10-12 2020. It will also integrate the renowned EASA Rotorcraft and VTOL Symposium. The fair will include both conventional helicopter and fast-growing eVTOL. The venue for EUROPEAN ROTORS will be Hall 8 and the Congress Centre North of Koelnmesse, Germany. The motto of EUROPEAN ROTORS 2020 is "It's for everyone". The market leaders Airbus, Bell, Leonardo and Safran are supporting the new format both through their presence as exhibitors and with an advisory function. The fair aims to offer operators, manufacturers, aviation authorities, the supporting industry, mechanics, pilots, customers and suppliers the opportunity to network and also to be informed on state-of-the-art equipment and services, and direct exchange with manufacturers, operators, Approved Training Organisations (ATOs) and maintenance organisations. Visitors will additionally have the chance to discuss present and future regulations as well as to participate in dedicated training. The three-day event will also include the renowned EASA Rotorcraft and VTOL Symposium. Beside the organizers, the service partner is Messe Friedrichshafen, an experienced exhibition and fairs company, which also stages the established aviation show AERO Friedrichshafen. Further information, including opening times and prices, is available at www.europeanrotors.eu.

WISK wants to pursue full autonomous flight from the beginning

The joint venture between Boeing and Larry Page-backed Kitty Hawk wants to bypass pilots in its WISK eVTOL and fly fully autonomously at the beginning. WISK CEO Gary Gysin confirmed in a recent interview with eVTOL.com that WISK are going direct to autonomy. Instead of taking the step-by-step approach like many eVTOL are doing, WISK wants to fly autonomously on its two-seat eVTOL. This bold approach is understandable considering that WISK's current model has only two seats and it only makes commercial sense to devote both seats to paid passengers. However this means that WISK will have to pursue certification for autonomous filght at the beginning. According to WISK's chief marketing officer Becky Tanner, WISK has made more than 1,000 unmanned test flights.

Terrafugia unveiled new eVTOL design

Terrafugia has recently made a sub-scale prototype which first flew in mid-December 2019 in China to validate the design of the new TF-2A all electric vertical take-off and landing (eVTOL) aircraft. According to Terrafugia, TF-2A has a wingspan of 4.5 meters (14.8 ft), maximum take-off weight of 60 kg (132 lb), and a cruising speed of about 100 kilometers per hour (62 mph). The TF-2A eVTOL aircraft will have eight (8) lift-propellers and one (1) rear pusher-prop for forward flight, a cruise speed of up to 180 km/h (112 mph), a maximum range of 100 km (62 miles), capacity for two (2) passengers and luggage, a maximum payload weight of 200 kg (440 lb). The sub-scale model has a MTOW 60kg and can cruise up to 100km per hour.

Image credit: Frank Schwichtenberg

UK granted £9m to develop hybrid electric propulsion system for Islander airplane

A consortium of British business has received a £9m grant from the government to help design, manufacture and integrate a hybrid-electric propulsion system into a nine-seater Britten-Norman (B-N) Islander aircraft, which is typically used on short flights such as island-hopping. The Project Fresson consortium brings together: Rolls-Royce, which will supply the power management system; the Denis Ferranti Group, which will supply the electric motors; Delta Motorsport, providing the battery packs; WMG (University of Warwick), which will perform battery testing; Cranfield Aerospace Solutions (CAeS), an aircraft integrator specialising in green commercial aviation; and the plane-maker, Britten-Norman. CAeS' parent Cranfield University will research key technologies during the 30-month project.

The £9m grant is being provided through the ATI Programme – a partnership of the Aerospace Technology Institute (ATI), the Department for Business, Energy & Industry Strategy, and Innovate UK, which is aimed at maintaining and expanding the UK's position in civil aerospace design and manufacturing.

EASA
European Aviation Safety Agency

EASA released Proposed Electric Propulsion Units for certified aircraft regulation

On January 7, 2020 EASA released "Proposed Electric Propulsion Units for CS-22 Sailplanes and Powered Sailplanes, CS-LSA Light Sport Aeroplanes, CS-VLA Very Light Aeroplanes and CS-23 Normal, Utility, Aerobatic and Commuter Aeroplanes up to Level 1".

JOBY AVIATION

JoeBen Bevirt started his company Joby Aviation back in 2009, but already thought about developing an eVTOL long before. In 2015 the first designs were made which inspired many others to follow. After that it was very quite around the Californian Company and you only heard about it when Intel and Toyota invested in them in 2018. On January 17th , 2020 the next round of investment was published and they are in the focus again: with a record of 590 Million Dollars from investors from the c-round they are definitely the talks in the global eVTOL towns and beyond. Although still many of the developments continue secret, eFlight Journal had the chance to ask JoeBen Bevirt (46) some questions in an exclusive Interview:

eFJ: When did you start the company?
JoeBen Bevirt: In 2009.
eFJ: What is your formation?
JoeBen Bevirt: Master in Mechanical Engineering Design of Stanford University.
eFJ: When did you have the first idea for an eVTOL?
JoeBen Bevirt: First time in 1992.
eFJ: When did the first Prototype Fly?
JoeBen Bevirt: We are not commenting on our historical testing efforts.
EFJ: How many seats will have your first Product on the market?
JoeBen Bevirt: 4 seats and a pilot.

eFJ: How many Prototypes have been Flying?
JoeBen Bevirt: We are not commenting on our historical testing efforts.
eFJ: How many flight hours you have with the different prototypes?
JoeBen Bevirt: We are not disclosing details about our testing at this time.
eFJ: Wisk (before Kitty Hawk & Cora) says that their eVTOL will never fly piloted but autonomous from the beginning – will Jobys first transport flights be piloted?
JoeBen Bevirt: Our aircraft will have a pilot.
EFJ: What do you think: In which country the first eVTOL will be certified? And where will we see the first commercial service?
JoeBen Bevirt: We are not in a position to guess the answer. We are working collaboratively with several regulatory agencies.
eFJ: In which year?
JoeBen Bevirt: We are targeting initial commercial deployment by 2023.
eFJ: You think there will be any private eVTOLs or will the aircraft only be operated by operators ?
JoeBen Bevirt: We expect to launch air taxi operations through either (1) our own rideshare service, or (2) in partnership with Uber and/or other rideshare companies.
eFJ: Who do you think is your strongest competitor?
JoeBen Bevirt: Competition is good; it's a new market, new behaviour on the part of consumers, new thinking in terms of regulation. It requires innovation - competition helps to raise the bar. But: We don't comment on our competitors.
eFJ: How many people work at Joby at the moment?
JoeBen Bevirt: We don't disclose our headcount.
eFJ: When will Joby for the first time fly in public?
JoeBen Bevirt: We are not disclosing details about our future plans.
eFJ: Which cities are in the race?
JoeBen Bevirt: We are not disclosing details about our future plans.
eFJ: Have you ever thought in the beginning that your company would reach this hight?
JoeBen Bevirt: We always believed our dream would become a reality.
eFJ: Joby has suppliers from around the world - I suppose also from Europe and Japan?

JOBY AVIATION

2009-2014
Joby Aviation is founded in 2009 to revolutionize personal transportation with electric VTOL aircraft. Over the following years, Joby develops simultaneous capabilities in rapid prototyping, advanced carbon fiber structures, high-fidelity aerodynamics analysis, and electric motor design. Through analysis and subscale flight tests, Joby designs and evaluates many different electric VTOL aircraft configurations.

2014-2017
Joby settles on the optimal configuration and begins developing technology demonstrators. Early subscale testing followed by hundreds of full-scale test flights throughout the hover, transition, and wingborne flight regimes prove the design is reliable, quiet, efficient, and well-suited to the air taxi mission.

2017-Present
Joby develops and begins flight testing production prototypes on the path towards polished products ready for certification, production, and operation. Joby opens its formal certification program with the FAA.

JoeBen Bevirt: We don't comment on our suppliers.
eFJ: Toyota did also show their own eVTOL design - is this being continued?
JoeBen Bevirt: We can't comment on Toyota's plans.
eFJ: We heard that you are also establishing part of the manufacturing in Europe - is this correct ? If so, in hich countries and which parts? Are you disclosing this info?
JoeBen Bevirt: We are not disclosing these details at this time.
eFJ: Are you also considering certification with EASA?
JoeBen Bevirt: Joby has been working with the FAA for several years and began a formal certification program in 2018. The design certification process assures the safety of the design and typically takes 3 to 5 years.
a. Joby plans to establish a Part 135 commercial aircraft operation with the FAA to assure that once the design is

certified, commercial operations can begin promptly afterwards.

b. Joby continues to evaluate key markets around the world and will pursue certification from the relevant regulatory authorities as required. Joby is in discussion with a number of international regulators regarding the commercial operation of its aircraft.

c.Joby will establish commercial aircraft operations in each country of operation and the best practices from each of these markets will be used to inform the overall safety of Joby's aircraft operations around the world.

eFJ: Why end up with a car company - and a Japanese car company?

JoeBen Bevirt: Toyota Motor Corporation is a visionary in terms of sustainability and mobility.

We have a shared vision of future modes of transportation.

eFJ: What made Joby eVTOL design unique?

JoeBen Bevirt: Joby Aviation's aircraft is designed for four passengers plus a pilot. It can travel more than 150 miles on a single charge, is 100 times quieter than conventional aircraft during takeoff and landing, and is near-silent in flyover.

eFJ: With the speculation on the market: the value of Joby is estimated between 700 Million US$ and over 1 Billion US$ – Where do you see the value?

JoeBen Bevirt: We don't comment on our valuation.

eFJ: Thank you so much. ✔

Joby Aviation - the team

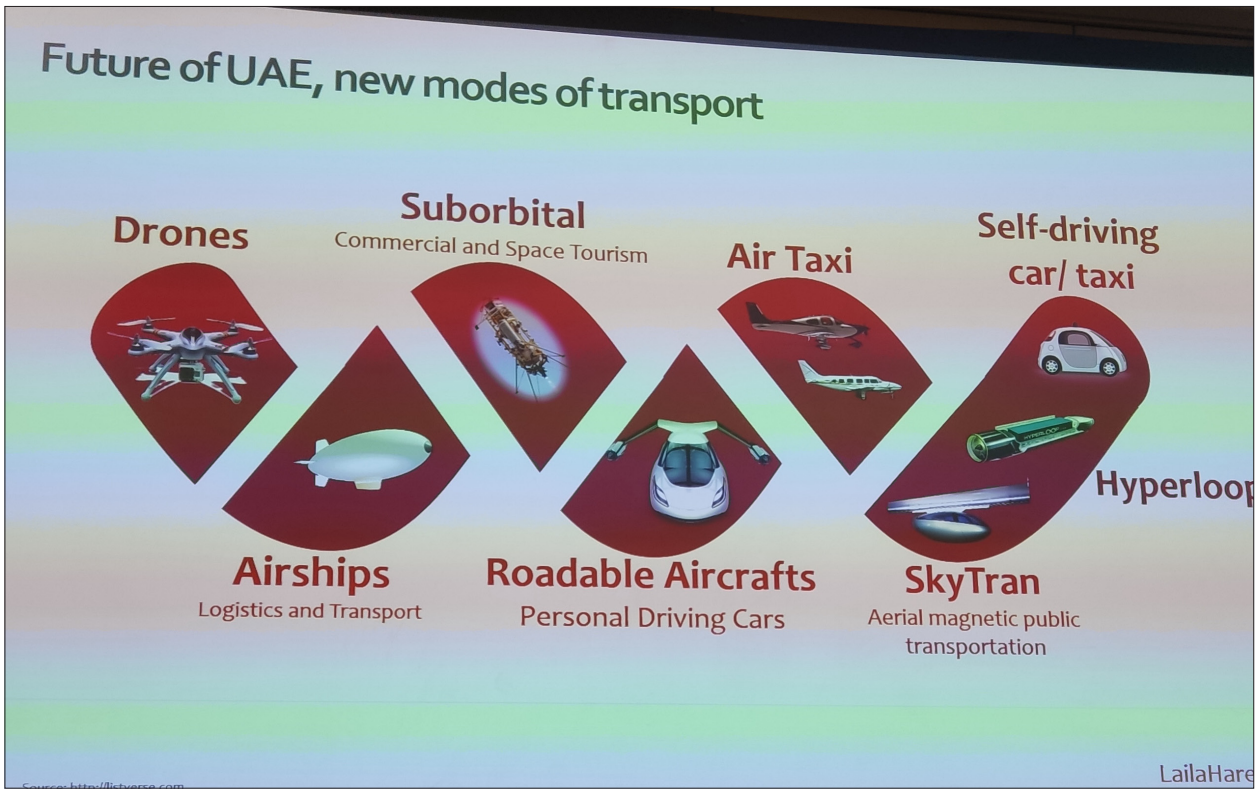
VIENNA CONFERENCE

DIVERSIFIED & INTERCONNECTED

eVTOL and UAM was undoubtedly a highlight of the conference as the introduction video played at the opening.

A REPORT OF "THE FUTURE OF TRANSPORTATION WORLD CONFERENCE"

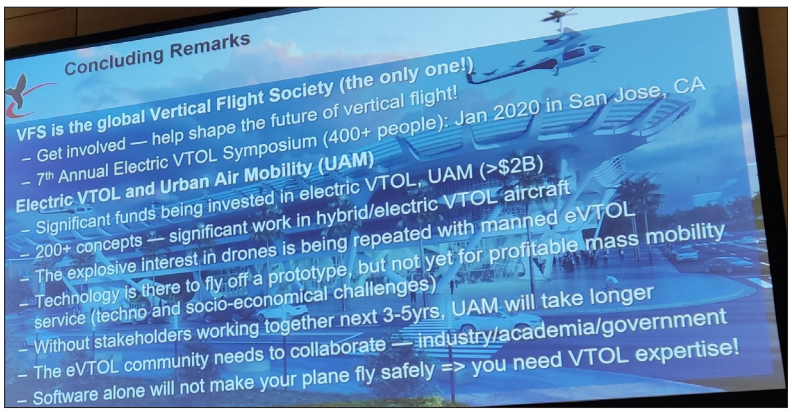
It's crowded. It's distracting, in a good way. "The Future of Transportation World Conference" was held for the second time in Vienna last December. You had to choose from 9 sessions (called streams in the conference brochure) and over 170 speakers, all packed into two days, to attend. I can assure you that's not an easy task.



As Laila Hareb, the advisor to the General Civil Aviation Authority of UAE, presented, UAE is certainly an interesting place to explore for any transportation innovation entrepreneurs. UAE is one of the first countries in the world to approve for eVTOL trial flight and has been working with EASA for eVTOL certification.

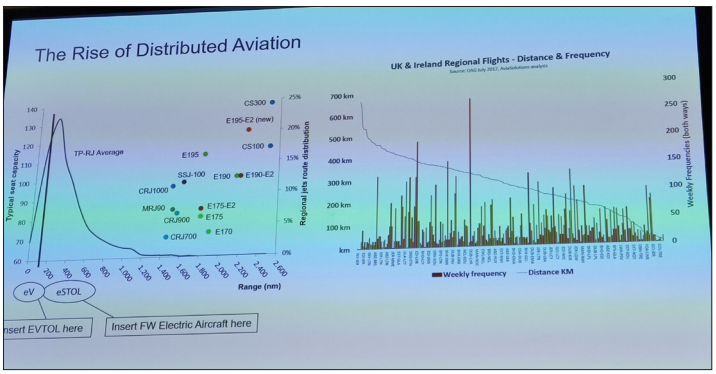
Among the myriad of presentations, there were also a glorious social night on the first day with fancy performances, free beers and a fair sized exhibition, which makes scheduling work even harder (especially during the morning sessions on the second day). Then you know you are at the right place because this is where you can listen to the presentations and bump into people from almost all sectors of transportation and a little beyond, from micro mobility, to urban air mobility (UAM) and eVTOL, to AI, 5G connectivity, electric distribution and anything in between. It's very convenient to jump from a presentation about 5G to another one about road freight management in the next room. You just wish you could have a twin brother or sister, or even better a triplet.

Among the diversification of all the topics, this conference clearly illustrated the strong interest in and prospect of UAM which is becoming part of the larger picture of electric mobility and urban transportation. One of the main reasons is that unlike conventional aircraft designs, eVTOL and UAM application shares technology and infrastructure with electric mobility such as autonomous control, digital connectivity, electric distribution, battery

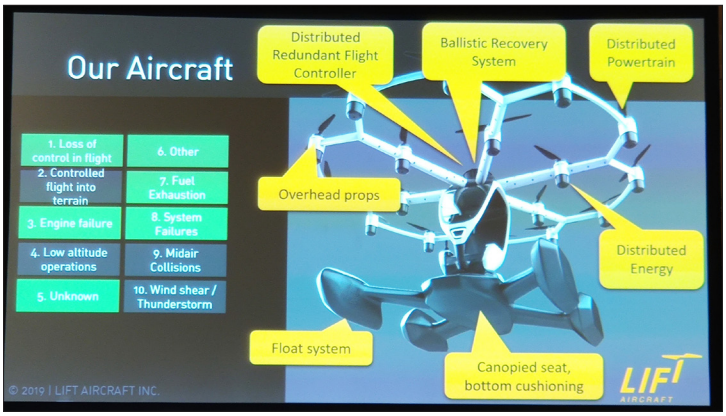


Mike Hirschberg of Vertical Flight Society made a good summary of eVTOL evolution. As of today there have been 231 eVTOL designs listed in VFS's database.

Kaydon Stanzione, the CEO of Jaunt Air Mobility, listed the reasoning for the emerge of eVTOL and UAM application. Jaunt Air Mobility became Uber Elevate partner last June and has been working with BAE and Honeywell on their unique eVTOL design with slow rotor technology.



Darrell Swanson of Swanson Aviation Consultancy was one of the few speakers at the conference mentioning electric fixed-wing airplanes' application in the user case of short-haul intercity transportation, as indicated in his slide of distributed aviation



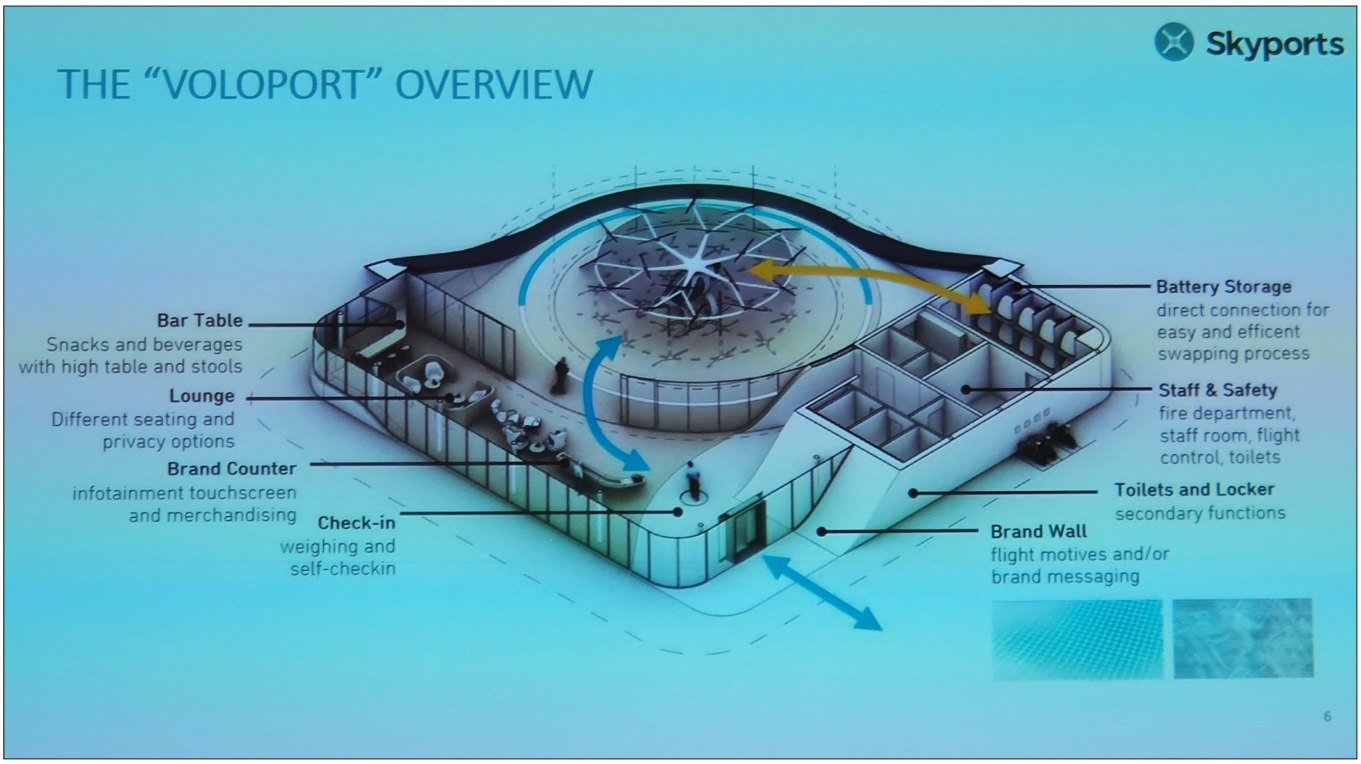
Balazs Kerulo of LIFT Aircraft illustrated the complexity of safety consideration and possible solutions in eVTOL design. LIFT is going to roll out experience ride across the US beginning in 2020 in LIFT eVTOL which is compliant with Part 103 ultralight rule.

and so on. In this sense, UAM may only prevail if it becomes part of the urban electric mobility infrastructure. Therefore, eVTOL and UAM fit in such conference right at home.

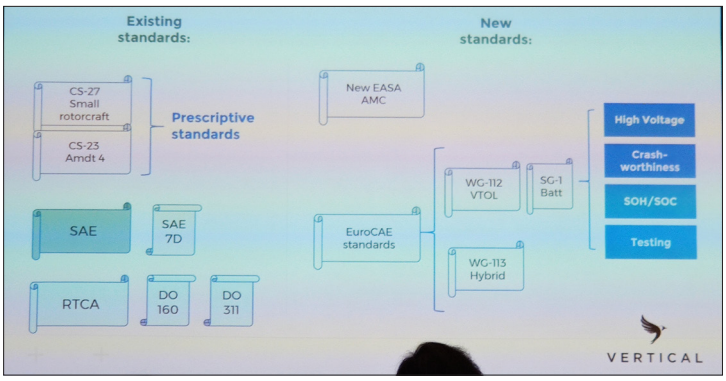
The close collaboration between UAM and urban transportation and other digital technologies also draw the attention of the transportation industry. It's not a coincidence that the beginning scene and a large part of the promotional video of the conference was about aviation and a showcase of eVTOL and UAM. The first session of the conference is "urban and inter-urban eVTOL Air mobility" and it's packed with audiences from many different backgrounds. I met a guy from a Japanese logistic management company and an American kit plane builder who wants to buy a demonstration ride in an eVTOL, to just give you an example.

The two-day UAM sessions were moderated by Mike Hirschberg, the Executive Director of Vertical Flight Society (VFS), and Darrell Swanson, the Director of Swanson Aviation Consultancy respectively. Speakers in UAM sessions included representatives from Roland Berger, Jaunt Air Mobility (Uber Elevate partner), Volocopter, LIFT Aircraft, Porsche Consulting, Rohde & Schwarz, to name a few.

Mike made a very good summary of the eVTOL evolution in his opening speech. VFS has been doing profound work in eVTOL update and analysis. The eVTOL database that VFS has built and offers for public use is the first stop for anyone interested in eVTOL. As of today, there have been 231 eVTOL designs listed in VFS's database, a significant increase from last year. Despite the strong interest in eVTOL and UAM from investors, designers and entrepreneurs, certification and operation regulation, infrastructure and social acceptance remain to be the main barriers for eVTOL's commercial deployment. In the efforts of the industry coalitions such as GAMA and VFS and the e-flight-forum organized by Flying Pages in China, regulators in major markets have been working on a solution for eVTOL certification and even trial operation. EASA and the Chinese regulator CAAC appear to be spearheading policy-making. EASA released the "Special Condition for Small-Category Vertical Take-Off and Landing (VTOL) Aircraft" (SC-VTOL) last July which is a big and the first such achievement of the regulator. CAAC has released several regulations concerning eVTOL and large drones in 2019. CAAC has permit trial operation of eVTOL in designated routes in several cities in China.



Simon Whalley of Skyports gave an insightful presentation of their Vertiport design. Skyports has partnered with Volocopter to build a showcase Vertiport in Singapore last October.



Dr. Limhi Somerville of Vertical Aerospace listed the technical standards involving eVTOL and battery requirement in his presentation. Last year Vertical Aerospace made the demonstration flight of their eVTOL capable of 250 kg payload.

That said, detailed certification rules remain unclear as of today and thus is still a main subject at the presentation and panel discussion at the conference. One of the solutions according to the current rules is to make eVTOL compliant with Part 103 ultralight rule in the US and in China where both regulators do not require any type certificate of Part 103 ultralight. There have been several such efforts including Kitty Hawk eVTOL (just terminated) and LIFT. Balazs Kerulo, the chief engineer of LIFT Aircraft, said in his presentation that LIFT is going to roll out experience ride across the US beginning in 2020 in LIFT eVTOL which is compliant with Part 103 ultralight and thus does not need certification. This kind of experience rides and demonstration flights can certainly help overcome the social acceptance barrier and collect flight data, but the operation model remains to be seen because Part 103 ultralight rule does not allow paid passengers or commercial operation of the aircraft.

As the urban mobility and electric transportation are more and more interconnected at all levels from the ground to the air, it'd be very interesting to see what and who will appear at the conference this year. ✔

3rd e-flight Forum in China

CERTIFICATION IS THE KEY

The Forum was held in Shijiazhuang, China on October 16-17th. Over 30 speakers presented at the forum with topics ranging from certification, eVTOL, electric commuter airplanes, infrastructure, propulsion and batteries. Over 300 audiences from investors, city planners, regulators and automobile manufactures attended the two-day event. Lindbergh Foundation proposed an electric air rally from New York to Paris in 2027 at the forum.

Considering the rapid development of all types of electric aircraft design and market prospective, it is no surprise that certification becomes an urgent need. At the forum Mr. XuChaoqun, the Director General and the No.1 guy at the airworthiness certification department of the Chinese regulator CAAC and Dr. Javier Vicedo,EASA representative in China presented each regulator's thoughts on the certification of electric aircrafts. Mr.Xu is known as a supporter of general aviation innovation in China. Under his leadership, CAAC has been quite aggressive in electric aviation. For example, CAAC already certified the homegrown RX-1E electric LSA four years ago, released a series of new rules last year including the trial operation rule for eVTOL last year, the new LSA rule increasing MTOW from 600kg to 700kg (750kg for seaplanes), and the certification draft for large cargo drones. Mr. Xuadmitted the situation that there currently has little basis for electric aircraft certification especially eVTOL, but he stated that CAAC regarded electric aviation industry standards and practices, as well as the risk-based certification methods as important elements to facilitate the policy making.

Dr. Javier Vicedo introduced the situation and development of certification policy making at EASA which has been trying to spearhead the global efforts of electric aircraft certification. EASA released the draft for new VTOL certification framework policy last November and published the formal rule "Special Condition for Small-Cate-

A solar-powered multi motor UAV designed by OXAI Aircraft in Shanghai at the display at the forum. This prototype has a wing span of 15 m and MTOW of 70 kg. It made the maiden flight earlier this year.

gory VTOL Aircraft" (SC-VTOL-01) this July. Javier mentioned that EASA is trying to Combine small rotorcraft (CS27) and normal-category aero planes (CS-23) in the rulemaking process of eVTOL. Both regulators stated the support for innovation and the importance of "learning by doing"certification approach.

Electric commuter is the highlight

Electric commuting airplanes became an unexpected hot topic at the forum. Eric Lithun of Elflyfrom Norway introduced Norway's ambition of emission free flying and the promising market for short-range electric commuter airplanes. Nordic Network for Electric Aviation (NEA), including SAS, Finnair and Avinor, was formed this September to promote electric aviation in Nordic countries. Eric, along with many players in electric aviation, believes that despite the limit of power density of current battery technology, Pure electric fixed wing airplanes with multiple seats are mature enough to be commercially operational on specific short-range routes and there are quite a few such routes in Nordic countries and around the world. Such full electric commuters with as little as 6-seat could already make economic sense and are much easier to certify under the current rules.

Anders Forslund of HEART Aerospace from Sweden presented ES-19 electric commuter design. As the name suggests, it is a 19-seat pure electric design with 400km range in mind. Susan Ying of Ampaire presented the de-

A roadable eVTOL design by BUAA at the display.

Eric Lithun of Elfly from Norway introduced Norway's ambition of emission free flying and the promising market for short-range electric commuter airplanes. His presentation drew a big interest from the audience.

Derek Chang of Airbus UAM revealed Airbus' UAM ambition in China. Airbus will launch VOOM on-demand helicopter ride-share service in Shenzhen-Hong Kong region in early 2020.

Willi Tacke of Flying Pages has been carrying out the duty as the moderator at the forum since the 1st forum in 2017.

velopment of their electric commuter design. The prototype of Ampaire, which is based on a Cessna 337, made the maiden flight in June this year. Susan said that the reason for using an existing model is for quick STC and operation. Ampaire is working IKHANA for the STC of electric converted hybrid Cessna 337. Ampaire will develop a 9-seat clean-sheet design next and a 40-seat model down the road. Karl Käse, a design consultant of Eviation, presented some design details of Eviation's Alice 11-seat pure electric airplane which was the show star at Paris Airshow this year.

Electric trainer is imminent

Matthias Betsch of Flight Design presented the F2e two-seat prototype which had the first flight in June this year. F2e is based on the popular CT series ultralight design but with many improvement and new features and will apply for EASA Part23 certification. Danny Wu of Pipiestral presented Alpha Electro's current operation situation. Alpha Electro is already the most popular full electric aircraft in the world with customers in Europe, Australia, Canada, USA. According to Danny, the total hourly flying cost of Alpha Electro including battery replacement and airframe depreciation is 33 euro which is much lower than its combusion engineer sibling which is already one of the most efficient two-seat airplane in its class. RX-1E, a two-seat LSA from Liaoning General Aviation Academy (LGAA) was the first certified electric airplanein China and has begun series production since 2016. At the forum LGAA unveiled their 4-seat design RX4E. The prototype made the maiden flight right after the forum on October 30th. RX4E has 1.2 ton MTOW with a flight duration of 1.5 hours. RX4E will undergo CAAC Part23 certification.

eVTOL continues to be popular

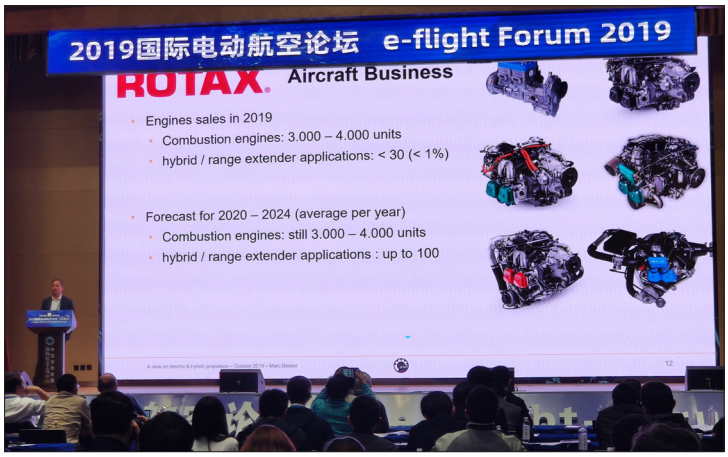
Derek Cheng of Airbus UAM presented the current development and plan of Airbus's urban air mobility (UAM) projects. He believes that China will become a very good user case of UAM application. Airbus has set up its first innovation center outside of Europe in Shenzhen, China last year and one of the first projects the innovation center in Shenzhen is UAM application. Derek revealed that Airbus will begin trial operation of Voom on-demand helicopter rideshare project in Shenzhen-Hong Kong region as soon as the end of 2019 and will begin larger scale operation early next year and will consider to expand to more locations in China down the road. This will be the third Voom project besides Brazil and the US.

Tian Yu of AutoflightXpresented the 2-seat V600 fixed wing eVTOL prototype which was first unveiled at AERO/e-flight-expo in Friedrichshafen this April. Tian said V600 will begin test flight as soon as the year end. Tian revealed two new eVTOL designs at the forum: V880 unmanned cargo version and V1000 manned version. Both models share similar modular base designs. V880 will have 1000kg MTOW. Tian even brought a full size mock-up of V880 to the forum.

Zhang Yan of Ehang presented the latest development of its 184/216 eVTOL models. Ehang became the first eVTOL manufacturer to begin trial operation in China last year under the CAAC rules. Zhang claimed that Ehang has been working closely with CAAC and has made several thousand flights under different weather and geographic conditions. Ehang made the news headline when it announced the IPO plan and the first delivery of its eVTOL to customers in China this year. However, the certification remains a hurdle for any ambition of Ehang.

Propulsion, battery and flight control are the enabler technologies

The so-called "crossover" effect of electric aviation has drawn the attention of many relevant industries. The aviationstandard sets a high bar for any components suppliers, but it also provides a good opportunity to improve the product quality, train the team, build the corporate image and make new friends. Several prominent players in different area presented at the forum, including CATL (the second largest battery manufacturer in the world and the tier-one supplier of Tesla, Porsche, Mercedes, BMW, Audi, VW and so on), Bosch, ATB (a leading industrial electric motor manufacturer in Austria acquired by the Chinese Wolong Group), along with the well-established names in aviation including Rolls Royce, Rotax, Continental. This forum is the first major event participated by Rolls Royce after its acquisition of Siemens eAircraft this year.



Marc Becker of Rotax presented at the forum. The slide indicated Rotax's anticipation of hybrid electric market in the near future.

Rolls Royce brought the electric motor to display at the forum, along with Bosch, Ampaire, Pipistrel, AERO/e-flight-expo.

V880 heavy duty cargo eVTOLUAV by AutoflightX at the display. It has a MTOW of 1000 kg.

Danny Wu of Pipiestral China presented a rare cutaway graphic of 801 eVTOL

Infrastructure is the basis

The prospective of eVTOL use at large scale in cities will dramatically change theurban infrastructure. Not only takeoff and landing pads for eVTOL are important, but also the electric power demand and distribution. Paul Stith of Black & Veatchis the advisor to NASA's UAM research. He said at the forum that if the requirement for power demand and distribution is not addressed in the near future, eVTOL may not be able to take off by then.

Social acceptance is critical

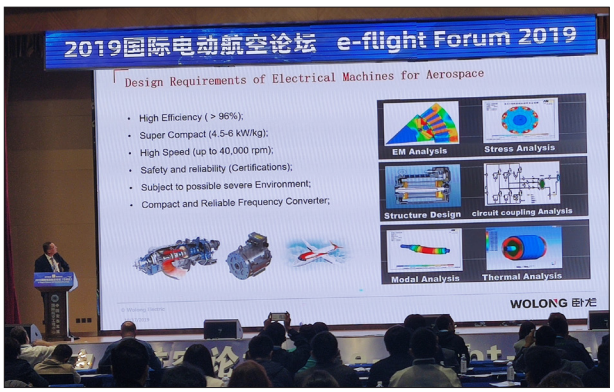
Even though all technologies and regulation are in place, eVTOL cannot be in use if there is strong opposition from the society. Therefore, social acceptance is critical for the ultimate rollout of eVTOL and UAM. Erik Lindbergh of Lindbergh Foundation, the Chairman of the foundation and the grandson of the legendary aviation pioneer Charles Lindbergh, stressed the importance of social acceptance for electric aviation in his video presentation. Lindbergh Foundation launched the global campaign to decarbonizes and reduce noise in aviation at the 100th anniversary of Charles Lindbergh's epic flight across Atlantic in 1919 to inspire the public for electric aviation and to encourage innovation and entrepreneurship. In his video speech Erik proposed an air rally by an electric airplanefrom New York to Paris in 2027.

Dr. Javier Vicedo of EASA presented the regulator's thoughts on the certification of electric aircraft.

Erik Lindbergh made a recorded video presentation at the forum. He proposed an electric air rally from New York to Paris in 2027 and another electric air race as part of the 100th anniversary of Charles Lindergh's pioneering flight across Atlantic.

Besides the presentations, there were more other activities at the forum this year. LGAA signed a sales agreement of 10 RX-1E to a Chinese operator. The advisory committee of electric aircraft certification to CAAC was formed at the forum. The advisory committee is the brainchild of Flying Pages and several key players in electric aviation. Its founding members include CAAC research institute, BUAA (the most prominent Chinese aeronautical university), CATL, Geely (the owner of Terrafugia flying car, Volvo, Lotus, and the largest shareholder of Mercedes), ATB, LGAA. There were also more products at the display this year including Rolls Royce motors, Pipistrel, AutoflightX V880 cargo drone, a large solar-powered drone and even a provocative roadableeVTOL flying car model designed by a BUAA team. With the fast development in technology and policy making, what else may surprise us at the e-flight-forum this year? ✔

Zhang Qinyin of Rolls Royce presented at the forum. This was Rolls Royce's first presence at a major electric aviation event after its acquisition of Siemens eAircraft.



Dr. Freddy Gyllensten of Wolong Group presented at the forum. Wolong, the owner of ATB in Austria, is a new but ambitious and competent player in electric aviation.

As the second largest battery manufacturer in the world, CATL presented for the first time at an electric aviation event. CATL showed a strong ambition for a leading role in electric aviation.

Ehang introduced the flight test and trial operation of their eVTOL.

The advisory committee of electric aircraftcertification to CAAC was formed at the forum. The committee will be the communication channel between electric aviation industry andCAAC.

Group photo of most presenters.

EVTOL SUMMARY FOR 2019

Lilium made the first test of its full-scale, all-electric five-seater eVTOL in May 2019.

2019 was the third year after the first Uber Elevate conference in 2016 which unofficially marked the beginning of theeVTOL hype. After three years of evolution at the speed of the internet and digitalization age, what was the current status of eVTOL at the end of 2019? In our view, eVTOL industry has become more realistic and more clusteredover the past year. These were several important developmentsin eVTOL in 2019 according to our close observation and first-hand experience:

Certificationprospective

The focus of eVTOL industry is certainly on certification because without proper certification there is no commercial use prospect for the new technology. With the advocate of the industry coalitions such as GAMA EPIC and VFS, regulators in major markets are making steady progress in 2019. Though the progress might be much more conservative compare with Silicon Valley speed, for anyone familiar with aviation regulation, it is already quite encouraging. After all safety is the first priority in aviation- and in many cases there is no shortcut but taking time to collect necessary test data for technical evaluation as the basis for the certification.

In 2019, the biggest news in eVTOL certification was the “Special Condition for Small-Category Vertical Take-Off and Landing (VTOL) Aircraft” (SC-VTOL) issued by EASA in July. This highly-anticipated document was the first rule regarding eVTOL in the world. That said, this is a framework to be filled in with more technical details. Meanwhile, the Chinese regulator CAAC issued several rules in 2019 to promote technology and application related to eVTOL. In February 2019 CAAC released an AC “Specific Category UAV Trial Operation Management Requirement” which uses the specific operational risk assessment (SORA) method to conduct safety manage-

EASA European Union Aviation Safety Agency	**SPECIAL CONDITION** **Vertical Take-Off and Landing (VTOL) Aircraft**	Doc. No: SC-VTOL-01 Issue: 1 Date: 2 July 2019

Special Condition for small-category VTOL aircraft

Statement of Issue

The Agency has received a number of requests for the type certification of vertical take-off and landing (VTOL) aircraft, which differ from conventional rotorcraft or fixed-wing aircraft. In the absence of certification specifications for the type certification of this type of product, a complete set of dedicated technical specifications in the form of a special condition for VTOL aircraft has been developed. This special condition addresses the unique characteristics of these products and prescribes airworthiness standards for the issuance of the type certificate, and changes to this type certificate, for a person-carrying VTOL aircraft in the small category, with lift/thrust units used to generate powered lift and control.

ment of high-risk UAV operations in order to gradually establish standards and a regulatory system. This rule literally paves the ground for trial operation of eVTOL in China. Ehang took the advantage to begin flying its eVTOL even with passengers in several Chinese cities.

eVTOL vision becoming more mature and realistic

There has been a surge of eVTOL design concepts ever since Uber published the Elevate Whitepaper in 2016. According to VFS' database, there are currently over 300 all types of eVTOL designs in the world. While it is a fun to surf the VFS' eVTOL database, it makes people wonder how many of those interesting and fancy designs will overcome the challenge of certification in the end and ultimately be put into serial production. Even some large corporations are attempting the learning curve. In October 2019 Audi canceled the Pop.Up eVTOL project with Airbus due to the daunting and complex technology needed to make it a reality. Kitty Hawk stopped taking orders of its Flyer eVTOL. However,as time goes by and more lessons are learned, eVTOL community as a whole has become more mature in the past year. Airbus' CityAirbus took flight for the first time in May 2019. Airbus completed all tests of Vahana eVTOL and moved on to the next stage. The flight data accumulated and the public interest generated throughout the Vahana project are invaluable. Bell unveiled its Nexus tilt-rotor eVTOL mockup in full size in January 2019. Lilium and Volocopter both made some impressive flight tests and demo flights in 2019. Kitty Hawk launched a new eVTOL called "Heaviside" which is a small, quiet design with eight tilting propellers. Kitty Hawk has gone a long way from the ultralight-type Flyer to Cora and then to Heaviside. Uber signed up more manufacturing partners in 2019 as it announced the partnership with Jaunt Air Mobility and Joby.

Volocopter made debut urban flight in Stuttgart/ Germany in September 2019.

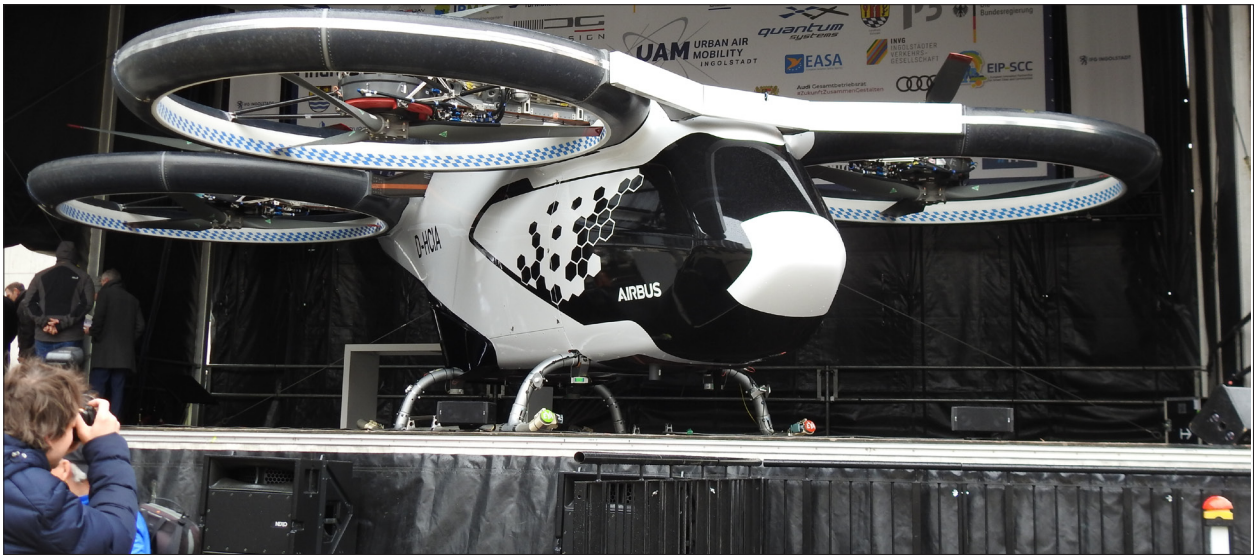
Kitty Hawk unveiled its new eVTOL Wisk in October 2019.

Startups and aerospacepartners joined hands

In 2019 an interesting trend is that eVTOL startups and newcomersmade joint efforts with partners of traditional aerospace companies for certification and mass production purposes. Boeing and Kitty Hawk set up a joint-venture Wisk in December. Boeing is also working together with Porsche to jointly develop an eVTOL. This indicates that eVTOL startups are beginning to realize that as certification and mass production are two prominent barriers for eVTOL's success down the road, it is evitable to learn the experiences and expertise of traditional partners. It may be a growing pain to realize that aircraft design and production are very different from website and mobile app development. After all, very few products in the world are more regulated than aviation products for obvious safety reasons.

UAM integrated into the auto industry's urban transportation solution

In 2019 we saw more automobile companies come into the game besides Audi's Pop.Up project with Airbus and Toyota's investment in Joby. Hyundai and Geely might be the most aggressive automobile manufacturers into UAM scene. Hyundai set up a dedicatedUAMdepartment



Airbus unveiled CityAirbus in Ingolstadt/ Germany, where Audi is headquartered, in March 2019.

Bell unveiled tilt-rotor eVTOL Nexus in January 2019 and again presented a new model of Nexus with four ducted fans in January 2020.

and recruited Dr.Jaiwon Shin, the former NASA Aeronautical Director, to head the new department. Hyundai also included UAM vision in its development roadmap to convert to a mobility solution provider rather than an automobilemanufacturer. As a market leader in electric cars in China, Geely has been invested in UAM earlier through acquired Terrafugia. In 2019, Geely also began a study of eVTOL design in China. In 2019 Porsche announced its eVTOL project together with Boeing.BMW presented Skai an eVTOL mockup, the world's first hydrogen powered eVTOL design, which BMW participated in the design, at the BMW head office in Munich. As moreautomobile manufactures view themselves as integrated mobility service providers, UAM will have a greater chance to gain popularitywhen it evolves beyond the aviation domain.

As the new year and the new decade just began this month, we've already seen many exciting eVTOL news such as the Hyundai's eVTOL design unveil, Bell's new Nexus eVTOL design and the partnership between EmbraerX and Elroy Air. Boeing will host the GoFly eVTOLpersonal flight vehicle design competition finalein February. In no time Uber will host the Elevate Conference for its fourth year. The 11th e-flight-expo will begin in April together with the first electric air rally.We really can't wait for what will happen in eVTOL in 2020. ✔

Porsche and Boeing jointly unveiled an eVTOL design in October 2019.

Technology, Capability, Affordability

FLYDYNON

NEW LOWER PRICE

SKYVIEW SE

A simplified experience, now even more affordable for 2019

NEW LOWER PRICE

SKYVIEW CLASSIC

The original next-generation EFIS system, trusted in thousands of aircraft

NOW STC APPROVED

SKYVIEW HDX

The premier SkyView experience, now also STC approved for type certificated aircraft

DYNON

DYNON.AERO