 Founded as “The American Helicopter Society, Inc.” 76 years ago in Connecticut on Feb. 25, 1943
  – “For the purpose of collecting, compiling and disseminating information concerning the helicopter”
  – Sikorsky Aircraft received its order for the first American helicopters on January 5, 1943 (28 XR-4 helicopters)

 The first and longest-serving helicopter non-profit
  – Founding members Igor Sikorsky, Art Young, Frank Piasecki, etc.
  – Included engineers, pilots, operators and presidents from industry, academia and government in Allied countries

 First Annual Forum in Philadelphia in April 1945

 Now 6,000 individual and 105 corporate members

 Born with the American helicopter industry, but advancing vertical flight worldwide
AHS is the Vertical Flight Society

- Official name change last April
  - More accurate description of who we are
- We’ve been using the words for 50 years
  - “AHS International—The Vertical Flight Society” since 1997
- www.vtol.org since 1995
“The reasonable [hu]man adapts himself to the world: the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable [hu]man.”

— George Bernard Shaw, *Man and Superman*

“We’re living in a changing world.... We can’t get comfortable with our [high] barriers to entry, that we can move slowly, that we can create at a slower pace than other industries. **We’ve not yet had a Tesla come and rev our engines and show us who we need to be.**”

— Lynn Tilton, CEO, MD Helicopters

Heli-Expo 2016
Disruptive Technologies

- Drones: 1.2 millions drones in the US. DJI has 85% of the market due to FAA restrictions during 2000s
- EVs: Tesla S started in 2012, now all car companies have electric cars
- Space: SpaceX and Blue Origin commercial human space launches
- Airliners: P&W GTF and GE LEAP provide ~20% fuel reduction
- App economy: Smart phones, ride-sharing, Airbnb, etc

- Advances in helicopter tech
  - New products with modern tech
  - H160 suite of technologies
  - Electric tail rotors, fly by wire, etc.
- Tiltrotors & Compounds
  - Step-change in range and speed
- Electric VTOL
  - Potential for step-change in utilization through reduced costs, noise and speed
  - Vertical flight for consumers
  - “VTOL for All”
Disruptive technologies and approaches …
The Future of Vertical Flight

www.vtol.org/vertiflite

Clean Sky 2 RACES FORWARD

Civil and Military Compound Helicopters

JMR Prepares for Takeoff

Civil and Military Tiltrotors

UrbanAero's Fancraft Transformation

Unconventional Configurations

Electric VTOL Takes Off

Winged eVTOL Flight Testing

... enable a transformation in vertical flight
New players and new products promise new capabilities...
The Future of Vertical Flight

What’s Next??

New Military Helo Tech

Urban Air Mobility

... for military and civil applications
V-22 only new U.S. military rotorcraft design fielded in past 30 years

All other deployed designs are 30-50 years old

- UH-1 Huey first flight 1956; Chinook 1961; Black Hawk 1975; Apache 1976
- Many 1960s airframes are still flying!
- CH-53K only new design in acquisition process
US Military: VTOL Capability Gaps

- **Performance shortfalls**
  - Speed, range, payload, endurance, altitude

- **Unexploited autonomy/collaboration**
  - Significantly increased mission effectiveness remains untapped

- **Unacceptable survivability & situational awareness shortfalls**
  - Safety and threat losses, no common picture

- **Costly sustainment**
  - Supportability, maintainability, reliability and availability

18 years of conflict and DoD studies reveal significant VTOL mission capability gaps
Future Vertical Lift (FVL)

- **5 Capability Sets from Light to Ultra Heavy**
  - Plus advanced unmanned programs Army Future UAS and Navy/Marine MUX

- **Currently 3 Capability Sets in planning**
  - **CS1** (Light): Army’s Future Attack Reconnaissance Aircraft (FARA) to replace Kiowa Warriors
  - **CS2** (Medium): Navy to replace Seahawks and Fire Scouts
  - **CS3** (Medium heavy): Army’s Future Long-Range Assault Aircraft (FLRAA) to replace Black Hawks

- **Joint Multi-Role (JMR) Technology Demonstrations – 30,000 lb-class (13.6 t)**
  - Bell V-280 Valor and Sikorsky-Boeing SB>1 Defiant
  - *US industry has invested $1B in JMR at 4:1 government spending*
Solicitation released Oct. 3; proposals submitted Dec. 18
6 contract awards June 2019
2 prototypes – flights in late 2022
$750M in government funding + $375M contractor funding = $1.1B
Smaller in size than Capability Set 3 assault aircraft
  – approx. 14,000 lb (6.5 t) and 12.2 m (40 ft) rotor diameter
Operational by 2028

Likely 6 companies competing:
  – Airbus Helicopter
  – AVX Aircraft/L3
  – Bell
  – Boeing
  – Karem Aircraft
  – Sikorsky Aircraft

Improved Turbine Engine (ITE)
  – GE T901 @ 3,000 shp selected over ATEC (Honeywell/PW) T900
  – Most advanced turboshaft ever
  – 25% sfc reduction, 20% longer life
  – 10,000 engines for Black Hawk, Apache
Sikorsky Boeing SB>1 Defiant JMR Demonstrator
Bell V-280 Valor JMR Demonstrator
Compounds & Tiltrotors

Sikorsky-Boeing SB>1 Defiant™ (2019)
- 30,000 lb (13.6 t) class

Sikorsky S-97 Raider™ (2015)
- 11,000 lb (5 t)

Sikorsky X2 Technology™ Demonstrator (2008)
- 5,500 lb (2.5 t)

Bell Helicopter V-280 Valor (2017)
- 30,000 lb (13.6 t) class

Leonardo (with Bell) AW609 (2003)
- 16,800 lb (7.6 t)

Bell Boeing V-22 Osprey (1989)
- 52,600 lb (23.8 t)
AW609 Civil Tiltrotor
Next Gen Civil Tiltrotor (NGCTR)
Clean Sky 2: Airbus RACER
CityAirbus spotted in Donauwörth
Sikorsky officially announces in UAM
Workhorse SureFly exhibit (10x20)
Terrafugia exhibit (40x40)
Bell Nexus on display
Airbus UAM models
1st Annual Panel (2018)
The Electric VTOL Revolution

Wednesday, Feb. 28, 2018 @ 11:00-11:45 am

- Mike Hirschberg, Executive Director, AHS International (moderator)
- Michael Thacker, EVP Technology & Innovation, Bell Helicopter
- Mark Moore, Director of Aviation Engineering, Uber Technologies
- Greg Bowles, VP for Global Innovation & Policy, General Aviation Manufacturers Association (GAMA)
- Dr. Mike Romanowski, FAA Aircraft Certification Service’s (AIR) Director of the Policy & Innovation Division (AIR-600)
2nd Annual Panel (2019)  
The Electric VTOL Revolution  
Wednesday, March 6 @ 9:00-11:00 am Room B310  

*Moderated by Elan Head, Vertical Magazine*

- **Mike Hirschberg**, Executive Director, Vertical Flight Society  
- **Scott Drennan**, VP Innovation, Bell  
- **Zach Lovering**, VP of Urban Air Mobility Systems, Airbus UAM  
- **Thierry Grison**, VP Business Development Hybrid New Market, Safran  
- **Danny Sitnam**, President/CEO, Helijet International  
- **Rex Alexander**, President, 5 Alpha  
- **Michael Dyment**, Managing Partner, NEXA Capital Partners
Electric Helicopters?

- Eliminate complex rotors!
  - Cyclic, collective, swashplate
  - Transmissions, gearboxes, shafting, hydraulics, etc.

- Distributed Electric Propulsion
  - Replace single complex system with multiple simple thrusters

- Get on a wing for efficiency
  - Higher speed, longer range

- Environment
  - Noise, noise, noise!
  - “Tailpipe” emissions

- Not this!
- Cars were not buggies with mechanical horses
The Electric VTOL Revolution

- Electric & hybrid electric propulsion enable new possibilities for:
  - Regional Air Mobility (RAM)
  - Urban Air Mobility (UAM)/Air Taxis
  - Urban Cargo Delivery
  - Personal Air Vehicles
  - Ultralights
  - Personal Flying Devices
  - Urban Package Delivery
150+ Electric VTOL Designs?!?

“To invent an aircraft is nothing. To build one is something. To fly is everything.”
Otto Lilienthal

“It’s easy to design an aircraft if you don’t know how.”
Mike Hirschberg

“If you want to end up with a small fortune in aerospace, you need to start out with a large one!”
Anonymous
Advancements in electric motors
+ Advancements in batteries
+ Advancements in computer modeling and simulation
+ Advancements in composites
+ Change in FAR Part 23
+ Tech innovations
+ Tech investments > $1B

= All enable new configurations and new innovations
Advancements in electric motors
+ Advancements in batteries
+ Advancements in computer modeling and simulation
+ Advancements in composites
+ Change in FAR Part 23
+ Tech innovations
+ **Tech investments > $1B**

= All enable new configurations and new innovations

Joby Motors 10 kW (2010)
Advancements in electric motors
+ Advancements in batteries
+ Advancements in computer modeling and simulation
+ Advancements in composites
+ Change in FAR Part 23
+ Tech innovations
  + Tech investments > $1B
= All enable new configurations and new innovations
“The Hype Cycle”

“The Hype Cycle”

The eVTOL Revolution Needs YOU!

Uber Elevate

- Unveiled at eVTOL Workshop in Sep 2016
- Summits April 2017, May 2018, June 2019

Developing an “Ecosystem”
- Partnerships with cities, real estate companies, aircraft manufacturers, EV charger manufacturers and cities
- Connecting innovators, investors, regulators, technical experts, media

Small aircraft, but high barriers
- Technical, regulatory, environmental, economic, infrastructural and cultural

VFS www.eVTOL.news website
- 150+ aircraft concepts detailed
- Many missions beyond Uber’s Elevate
Uber Elevate: 5 Aircraft Partners

Aurora Flight Sciences

Pipistrel

Bell

Karem Aircraft

Embraer
Uber Elevate: 5 Key Challenges

1. Flight demos in 2020; operational in 2023
2. Technology: all-electric (not hybrid) for 5 seats (pilot + 4 pax)
3. Infrastructure (physical and ATM/UTM)
4. Pilot shortage vs. autonomy
5. Regulations
“The pilot managed a vertical takeoff, 15 minutes of flight in a 15-mile loop, and a safe landing. Powered by electric motors and sophisticated control software, the taxi performs like a cross between a drone and a small plane, able to zip straight up on takeoff and then fly at twice the speed of a helicopter while making about as much noise as a swarm of superbees.”

Joby Aviation S4

- Joby S4
  - 4-Seat all-electric
  - 6-propeller tiltrotor
  - Ultra-quiet
  - 200 mph

- Robinson R44
  - 4-Seat piston
  - Single-main rotor
  - 135 mph
- Flight experience offerings
- Ultralights under FAR Part 103 do not require certification
- Less than 254 lb (115 kg) plus 30 lb *per float* plus parachutes, etc.
- Restricted in speed, overflights, etc.

Kitty Hawk Flyer (<254 lb)  
Hoversurf Scorpion (<254 lb)  
Opener BlackFly (310 lb)  
LIFT Aircraft Hexa (432 lb)
Gyroplanes have taken off in Europe
- AutoGyro GmbH sells 300+/year – 2,500 sold to date
- Magni Gyro sold more than 1,100 gyroplanes

AutoGyro flew hybrid-electric eCavalon in 2015, but not pursued

No good US regulations – restricted to Experimental home-build kits
- Now some movement with “Primary Category” basis

Jaunt Air Mobility bought Carter Slowed Rotor/Compound (SR/C) IP
- Hopes to be 6th Uber Elevate partner

Skyworks Global bought Groen Brothers Aviation IP
- Tip-jet Vertijet and electric eGyro developments
The GoFly Prize is a two-year, $2,000,000 USD competition to develop

safe, quiet, ultra-compact, near-VTOL personal flying devices

capable of flying twenty miles (32 km)

while carrying a single person

Max dimension: 8.5 ft (2.6 m)
Max noise: 85 dBA @ 50 ft (15 m)
Max speed: >30 kt (56 km/h)

2886 registered “innovators”
716 teams
164 Phase 1 proposals
GoFly Prize Phase 1 Winners
10 winners announced 14 June @ $20k each

www.goflyprize.com
eVTOL Online Resources

- Electric VTOL News
  - www.eVTOL.news
  - www.facebook.com/electricVTOL
  - www.twitter.com/electricVTOL
  - www.youtube.com/VTOLsociety
  - www.vimeo.com/VTOLsociety

- Also
  - Email newsletter
  - eVTOL News videos
  - eVTOL video proceedings
VTOL Innovators – Then and Now

1st AHS Banquet
1944

1st eVTOL Workshop
2014
Plan now to attend Forum 75!

... Returning to Philadelphia, where the Forum began in 1945.
- Annual Forum attracts 1,250 engineers, scientists and leaders from industry, academia and governments
- VTOL aircraft CEOs/VPs/engineers, military leaders, researchers, etc
- ~300 technical papers
- ~50 panelists
- ~65 exhibitors
- Grand Awards Banquet
- eVTOL short course & industry tours

Forum 75 is May 13-16, 2019 @ Philadelphia
Summary

- We are the global Vertical Flight Society
  - 75th Annual Forum is May 13-16 in Philadelphia

- Significant civil and military advanced rotorcraft developments underway
  - State-of-the-art conventional helicopter developments and AW609 tiltrotor
  - FVL/JMR: advanced compound and tiltrotor — see www.vtol.org/FVL
  - Clean Sky 2: advanced compound and tiltrotor

- Significant funds being invested in electric VTOL (>1B)
  - 150+ companies investing in electric and hybrid/electric VTOL aircraft
  - The explosive expansion in drones may be repeated with manned eVTOL
  - For more info, see www.eVTOL.news

We exist to advance vertical flight!