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Urban Air Transport – State of the Industry

**National Academies of Sciences, Engineering, and
Medicine**

**Aeronautics Research and Technology Roundtable
Washington, DC
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Dr. Bruce J. Holmes, VP Digital Aviation

Topics

Strategic Context for Innovation in Aeronautics

Emerging UAS – UAM – ODM Industries

Progress Dependencies

UAM – ODM Vision

<http://www.nianet.org/ODM/roadmap.htm>

Vision for On-Demand Mobility (for example):

“... air transportation from here to there, anytime, anywhere ...”

- ▶ Widespread public use of ODM = transformative increases in U.S. productivity.
- ▶ UAM - ODM vehicle and airspace technologies are exportable innovations.
- ▶ The vision must be codified in public policy and strategy to support action by legislators, regulators, innovators, investors, and the public.



Strategic Context for Aeronautics Innovation



- Environment
- Airline Consolidation
- Cost of Congestion
- Cost of Infrastructure
- Convergent Solutions

▶ The **confluence of emerging technologies** affecting aviation, along with **innovations in business models**, will enable mobility solutions that can **transform** environmental quality, economic opportunity, accessibility, and travel time, cost, and convenience.

For many millennials, second cities are becoming their first choice
By [Patrick Sisson](https://www.curbed.com/2018/5/1/17306978/career-millennial-home-buying-second-city) May 1, 2018,
<https://www.curbed.com/2018/5/1/17306978/career-millennial-home-buying-second-city>



Louisville, Kentucky Shutterstock

UMTRI 15-101 MARCH 2015
HAS MOTORIZATION IN THE U.S. PEAKED?
PART 7: UPDATE THROUGH 2013

MICHAEL SIVAK



COUNTING THE FUTURE COST OF GRIDLOCK

The Economic Impact of Congestion in Europe and the US: 2013-2030



Strategic Context

Contextual Observations

- **Productivity:** “We are out of big ideas. (WSJ)” – ODM is a worthy U.S. productivity hypothesis.
- **Competitiveness:** U.S. economic competitiveness is at high risk due to international ODM activities. The U.S. needs to lead in “big ideas” like IoT-Aviation; ODM; UAM.
- **Economics:** Transportation technologies that respond on-demand to society’s needs for mobility offer broad, transformational opportunities to improve the wellbeing of U.S. citizens through enhanced domestic and international commerce.
- **Congestion:** The growth of surface congestion in large cities vastly outpaces the ability of highways to meet demand. Lost productivity and congestion-induced carbon emissions create both a challenge and an opportunity for airborne concepts.
- **Airline Consolidation:** In the U.S. and EU, scheduled air carriers are consolidating services toward larger aircraft, serving larger markets, flying longer legs. A vacuum in smaller community service exists, diminishing economic opportunity and quality of life for increasing numbers of communities.

Connected Aircraft and Connected Airports

Imagine – aviation apps with real-time airborne operations.

Maintenance Operational Control (MOQA)

Airborne V2X

Flight Safety (FOQA)

Pilot Mobile Devices

**Software
Upgrades**

**Retail /
eCommerce**



**Real-time System
Status**

**Powerplant Digital
Twins**

Cybersecurity

**Flight, Fleet, and Airspace
Ops**

What will you do with it?

Unprecedented Innovation Landscape

- ▶ Globally, more than 30 aircraft development projects underway.
- ▶ Urban Air Mobility (e.g., Uber Elevate) - UAM
- ▶ Regional (Thin Haul) On-Demand Mobility
- ▶ Regulatory transformation underway
- ▶ Public value proposition includes vastly increased connectivity among virtually all markets
- ▶ Investments in \$Billions



“The electric flying taxi service that Embraer SA is working on with Uber is “likely” to launch in 2024 or so, the CEO of Embraer Paulo Cesar de Souza has been quoted as saying...



Norway aims for all short-haul flights to be 100% electric by 2040.
The Guardian.

Global Leadership

From the beginning of aviation, the United States has led the Globe in setting regulatory and certification standards, to the significant benefit of U.S. economic competitiveness and balance of trade.

Current international initiatives in emerging UAV-UAM-UAS and ODM technologies, including new vehicle capabilities and architectures, challenge that leadership.



Intense

Global

Acceleration

Progress Dependencies

- ▶ Connected aircraft and connected airports.
- ▶ Robust, resilient PNT including GPS alternatives.
- ▶ Vehicle autonomy.
- ▶ Airspace management automation.
- ▶ Standards for systems and architectures.
- ▶ Means of compliance for certifications.
- ▶ E-Aircraft systems design exploration.
- ▶ Aero-acoustics technology.
- ▶ Battery and fuel cell options for aviation.
- ▶ Airspace architectures and procedures.

The political, regulatory, policy, and financial domains affecting emerging air mobility concepts are aligning *rapidly* in ways relevant to bold action and investments.

Thank You!



Unprecedented Aeronautics Innovation

Landscape

- ▶ Alakai (H2 Hybrid eVTOL)
- ▶ Airbus Ventures (Vahana Sky Taxi Project)
- ▶ eHang (eHang-184 Autonomous Aerial Vehicle)
- ▶ Airbus Group (E-Fan Project)
- ▶ Airbus Group (Urban Air Mobility Division)
- ▶ Aeromobil (CTOL Flying Car v3.0)
- ▶ Bell Helicopter, Innovation Division (Urban VTOL Vehicle and ConOps Studies)
- ▶ Boeing (Aurora Flight Sciences)
- ▶ DeLorean Company (VTOL Aircraft, U.S. Patent 9085355)
- ▶ Embry-Riddle electric propulsion consortium (GE, Textron, Hartzell, et. al.)
- ▶ Embraer X
- ▶ E-volo Company (Urban eVTOL)
- ▶ Joby Aviation (Urban eVTOL)
- ▶ KittyHawk Company (Urban eVTOL)
- ▶ Lilium Company (VTOL Jet Aircraft)
- ▶ Pipistrel (Hydrogen-powered Aircraft; Electric VTOL; Regional Commuter)
- ▶ SureFly Workhorse (Industrial eVTOL)
- ▶ Siemens Corporation (World Record Electric Motors for Aviation)
- ▶ SkyRyse Company (Urban eVTOL)
- ▶ Terrafugia Company (Geely Industries ; TF-X VTOL Flying Car)
- ▶ Uber Elevate (VTOL Urban Transportation Requirements White Paper)
- ▶ Workhorse SureFly (Hybrid VTOL)
- ▶ Zee.Aero (Larry Page Investment – Urban VTOL)
- ▶ Approximately ten other ODM vehicle development projects underway globally, some not yet public
- ▶ Numerous Supplier Organizations (Operator Platforms; Motors; Fuel Cells; Controllers; Avionics; Composite Material Systems; 3D Printing, etc.)

Globally, > 30 companies investing ODM systems and concepts



Challenges remain: Regulatory; Infrastructure; Consumer and Community Acceptance; Airspace; PNT.