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Clean-Fuel e-VTOL Air Mobility Vehicles for Unmanned and Manned Operations

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The background of the slide is a night-time aerial photograph of a city skyline. A prominent skyscraper, the Lotte World Tower in Seoul, is the central focus, illuminated with blue and white lights. Other buildings in the surrounding city are also lit up, creating a vibrant urban scene.

ALAKAI

TECHNOLOGIES

**The Future
of Air Mobility Vehicles
and Services
and The Implications
for Training Systems**

Dr. Bruce J. Holmes,
Larry D. McCarroll,
Henry Vu,
Bruno T. Villela,
and Brian D. Morrison

How Will We Train?

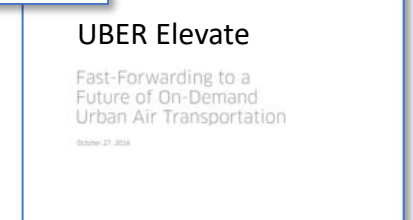
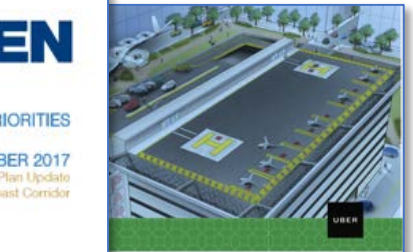
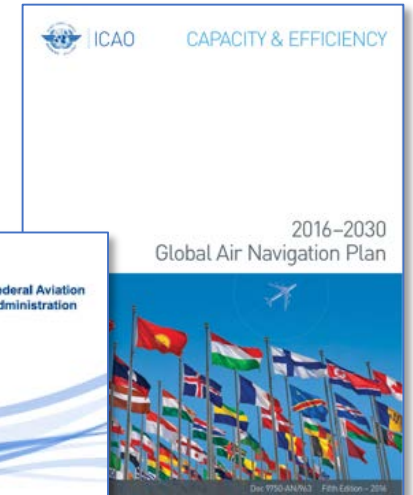
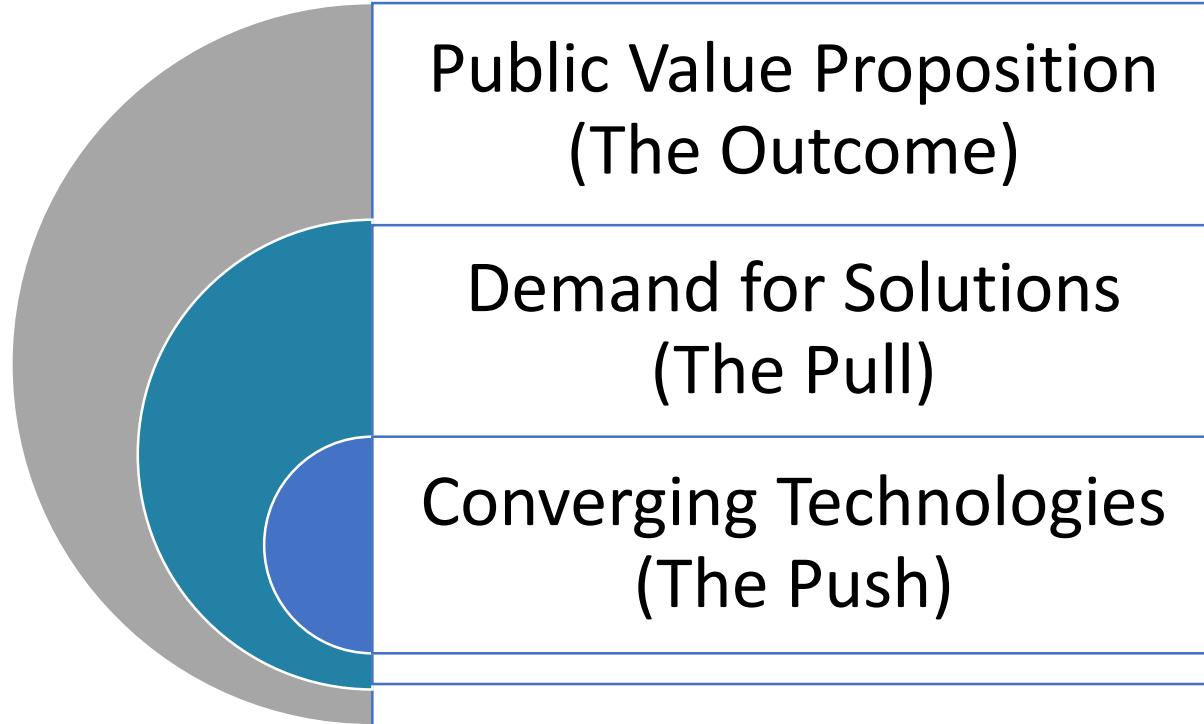


A Brief Retrospective (NASA, FAA, Industry 1993 – 2006)



Then: We could not go far enough – Now: We can.

Strategic Context for Aeronautics Innovation



On-Demand Mobility (ODM) Vision

Urban and Thin-Haul Regional Distribution of People and Goods

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

Vision for On-Demand Mobility:

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

- An Hypothesis: Widespread public use of ODM supports transformative increases in U.S. productivity.



Enabled by:

- Electric Propulsion
- Connectivity
- Automation and Autonomy

“The convergence of technologies, and new business models enabled by the digital revolution, is making it possible to explore this new way for people and cargo to move within our cities.”

... Jaiwon Shin, NASA's Associate Administrator for Aeronautics Research.

Unprecedented Innovation Landscape

- Globally, more than 40 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



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

Connectivity for Aviation Innovation *and implications for crew training*

V2V

Vehicle-to-Vehicle for
Sense and Avoid,
Trajectory
Separation,
“WAZE” for Pilots



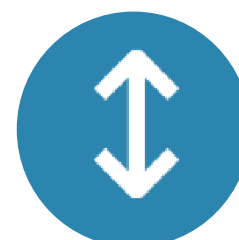
V2ANSP-FOC

Vehicle to
Air Navigation Service
Provider (ATC) and Flight
Operation Center (Dispatch),
Machine-to-Machine



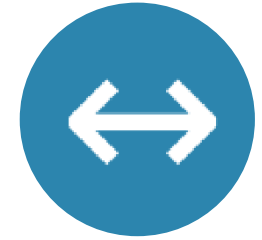
C2

Command and Control
to enable Beyond Visual
Line of Sight (BVLOS) for
UAS, Remote Pilot
Operations



V2Cloud Services

Streaming Data on
Return Link for Total
Aircraft System
Prognostics and MRO
Optimization

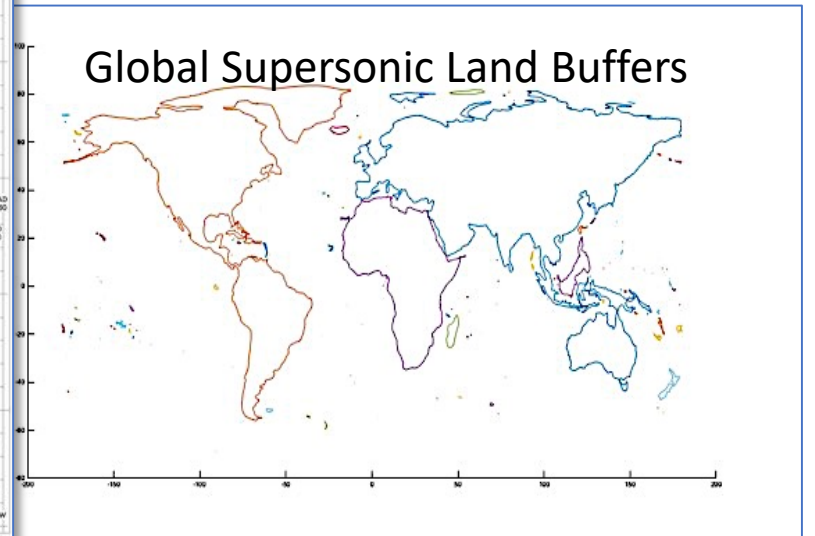
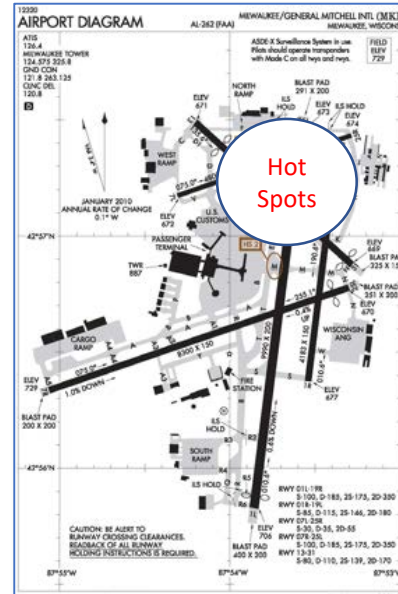


These connectivity solutions create a new capabilities and new challenges for operations, crew training, and proficiency maintenance.

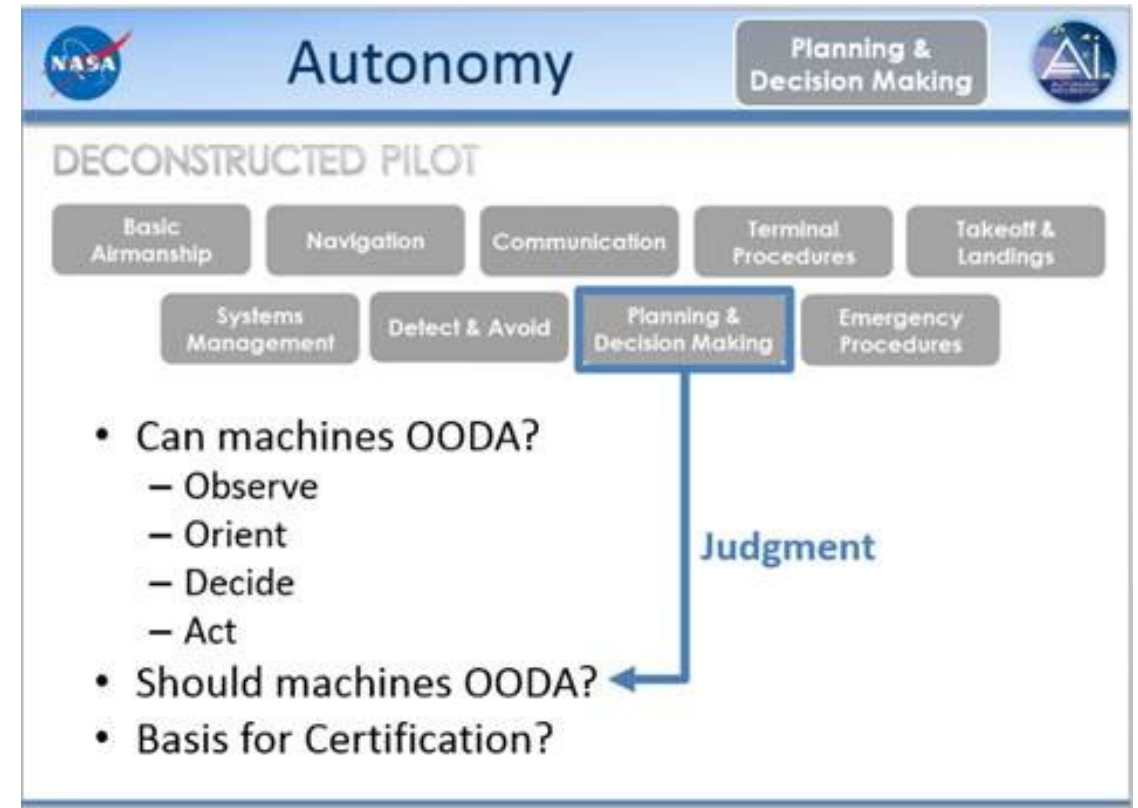
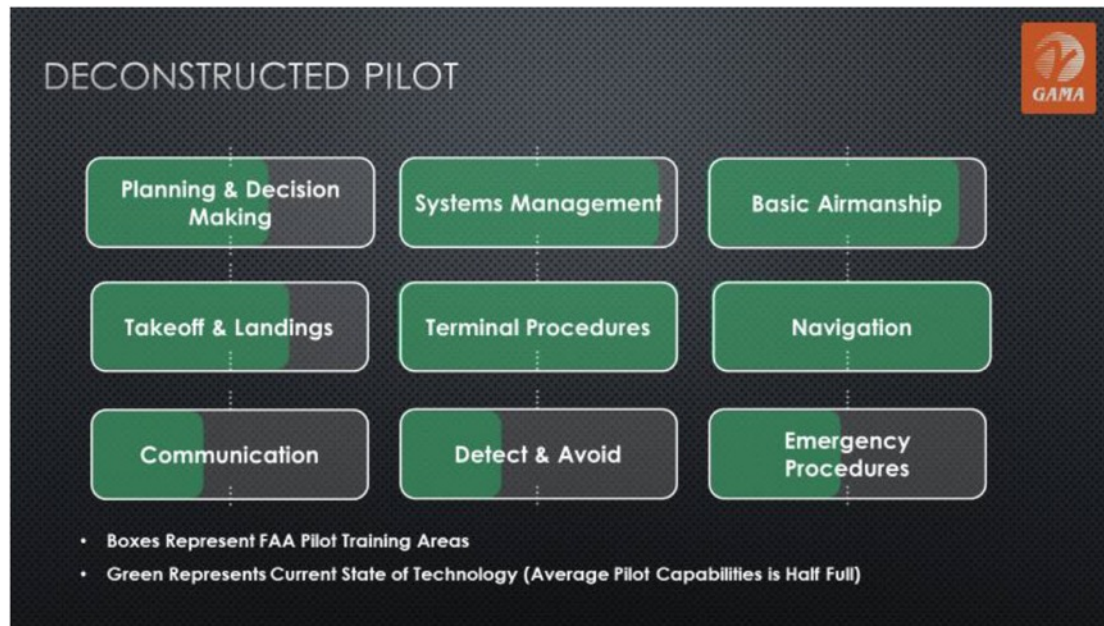
Connected Aviation – Feature Innovation Landscape

- Digital Twin
- Supersonic Trajectory Management
- Wake Hazard Avoidance
- Cost Index without an FMS
- Software and operating system updates
- Smart Airports
- Runway Incursion Mitigation
- Graphical METARs, TAFs, IFR Clearances and Releases
- “Waze” for Pilots

These candidate innovations demand training strategies.

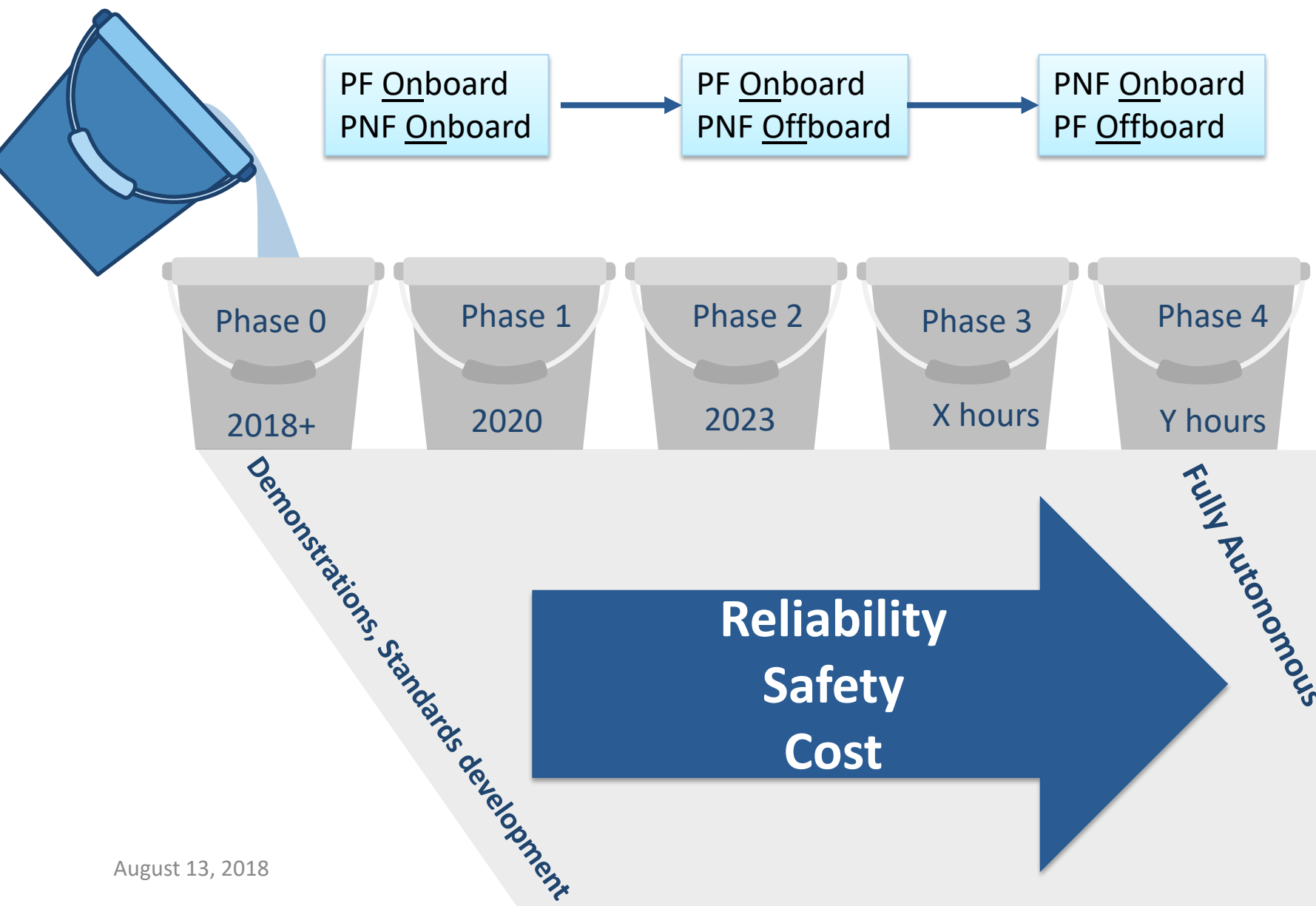


What Pilots Do and (do not) Do Well



What pilot functions might be more reliably performed through autonomy or through off-board applications (remote or optionally piloted)?

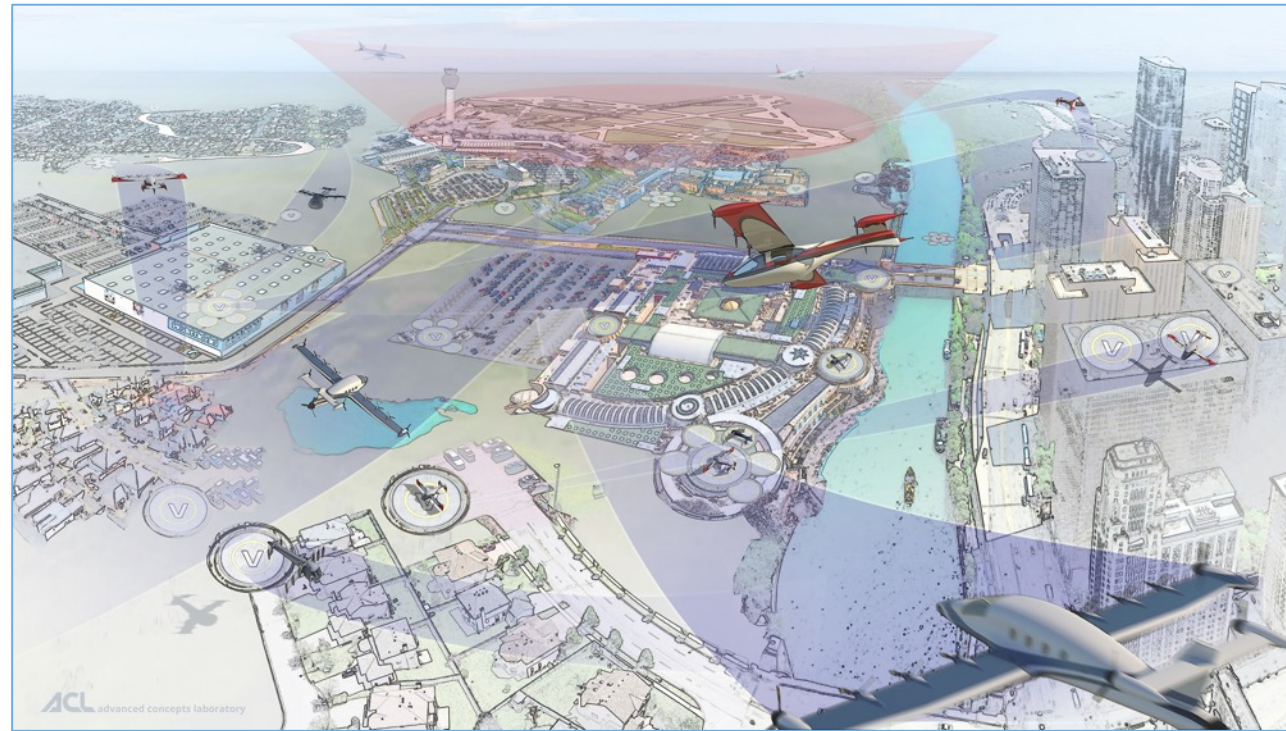
Simplified Vehicle Operations Roadmap & Candidate Outcomes



	Sport Pilot	SVO
Ground Training	40	12.5
Flight Training	38	4
	Commercial	SVO
Ground Training	175	45
Flight Training	250	60

Summary Remarks

- System Innovation Strategies Required (Integrated Design, Operations, Training).
- How Will We Train?
- How Will 'How We Train' Drive Innovation in Aircraft, Airports, Airspace Systems?



Credits: NASA / Advanced Concepts Laboratory

Thank you.

