NASA Aeronautics Research Mission Directorate

ODM Technical Roadmap Report Out

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Transformative Vertical Flight Workshop
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Hartford CT
ODM is Taking Off!

Uber plans self-flying drone taxis to beat city traffic

The Ehang 184, a passenger drone.
Quick Review: High-Speed, On-Demand Mobility

**Mobility**: Movement of people and goods.

**High-speed Mobility**: Mobility at speeds significantly above typical surface transportation speeds (>>70 mph). Enabled by aircraft (air-mobility) for distributed travel needs and high-speed rail for centralized, dense urban corridors.

**Scheduled Mobility**: Public transportation services aggregating the needs of many users with the specifics of a trip (origin, destination, and departure time) determined by service providers (e.g. bus, rail, airline operators).

**On-Demand Mobility (ODM)**: Personal transportation capabilities in which the specifics of a trip (origin, destination, and departure time) are chosen by the user.

**High-Speed ODM**: ODM at >>70mph
- Enabled by small personal, charter, and high-frequency commuter aircraft (Thin-Haul)
- Includes manned and unmanned (passengers & cargo; “piloted” & autonomous)
- Currently a niche market due to cost, safety, and trip reliability considerations.

**ODM** shorthand for High-speed ODM using small aircraft
Example Missions

**Thin Haul Commuter**

**Advanced General Aviation**

**Urban VTOL Air-Taxi**

**Small Unmanned Aircraft**
Why Now? Technology Convergence

**Autonomy**
- Increased safety (70%+ of accidents are pilot error)
- Simplified vehicle operation
- Increases user base 100x
- High-density airspace operations
- Navigation and Guidance assistance -> Full Autonomy

**Distributed Electric Propulsion**
- Scale-free Propulsion
- Highly Redundant and Reliable
- Robust Operations
- High power/weight, Quiet
- High cruise efficiency concepts
ODM Integrates 5 of 6 Strategic Thrusts

Global
Sustainable
Transformative

U.S. leadership for a new era of flight
NASA-FAA Joint ODM Roadmapping

Identify technical and regulatory barriers, and potential solutions, underpinning ODM

- Guide NASA aeronautics research
- Renew collaboration in the spirit of AGATE and SATS programs

Build community of interest

- Operators, airframers, suppliers, start-ups, universities, other gov.

Kickoff at AirVenture 2015, wrap-up September 29, Hartford CT.
Related Activities

**FAA, CFR 14 Part 23 Rewrite**
- Risk continuum
- Performance-based certification
- Consensus Standards

**FAA BAA:** Compliance methods for Advanced Flight Controls in GA, Hybrid Aircraft

**ASTM International**
- F37 (light sport), F39 (Aircraft Systems), F44 (GA Aircraft)

**GAMA EPIC**
- ELECTRIC PROPULSION & INNOVATION COMMITTEE
ODM Workshop Participants

- Over 50 companies
- US & international universities
- DoD
- International aero research organizations
- EASA
- FAA
- 4-NASA centers & HQ
ODM Roadmap Elements

Stakeholders
Industry
FAA
NASA

ODM Barriers / Metrics

Barrier
Decomposition,
Targeted Outcomes

Technology
Survey, Candidates

Research Themes

Tech Challenges,
Roadmap
## Prioritized, ODM Technical Barriers

<table>
<thead>
<tr>
<th>Category</th>
<th>Metric</th>
<th>Description</th>
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<tbody>
<tr>
<td>Ease of Certification</td>
<td>Metric Time/Cost Required</td>
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<tr>
<td>Affordability</td>
<td>Metric Total Operating Cost/Pax Mile</td>
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<tr>
<td>Safety</td>
<td>Metric Fatal Accidents per Vehicle Mile</td>
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<tr>
<td>Ease of Use</td>
<td>Metric Required Operator Training Time &amp; Cost</td>
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<tr>
<td>Door to Door Trip Speed</td>
<td>Metric mph</td>
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<tr>
<td>Average Trip Delay</td>
<td>Metric Time</td>
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<tr>
<td>Community Noise</td>
<td>Metric Perceived Annoyance @ standoff</td>
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<tr>
<td>Ride Quality</td>
<td>Metric Passenger Comfort Index</td>
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<tr>
<td>Efficiency</td>
<td>Metric Passenger Energy/Pax Mile</td>
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<tr>
<td>Lifecycle Emissions</td>
<td>Metric Total Emissions /Pax Mile</td>
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**Product of Kansas City Workshop, Oct. 2015**
Missions Provide Focus

ODM Technical Roadmap Report Out:
ODM Missions and Technologies

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