ODM Technical Roadmap Report Out:

ODM Missions and Technologies

Mark Moore
Ken Goodrich
ODM Planning Leads
NASA, Langley Research Center
Hampton, VA

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Outline

- **ODM Mission Path Forward**
  - Mission Workgroups/University-Centric
    - Urban VTOL Air-Taxi, Thin-Haul Commuter, Scale-up/Scale-down Strategy
  - Focused Regulatory Mission Enablement Opportunities

- **ODM Technologies Path Forward**
  - TAC ODM Roadmaps: Investment Portfolio
  - NIA Strategy White Paper: Partnerships
  - Early Investment Seedlings: ODM Highest Priority and SBIR Topics
  - Integrated Flight Demonstration Opportunities: RFI
  - Professional Society Outreach: Electric Flight Conference
  - Leverage External Technology Research: Connect ODM Industry
ODM Mission Path Forward

Reference VTOL Mission: Urban VTOL Air-Taxi’s

Scale-down Mission: Small UAS Public Service
Scale-up Mission: Thin-haul VTOL commuter
- Partnerships: Strong industry breadth and push
- Technologies: Strong leveraging of technologies
- Regulations: Strong regulation change required
- NASA – Scaling Adoption Alignment: Moderate

Reference CTOL Mission: Thin-Haul CTOL Commuters

Scale-down Mission: Advanced General Aviation CTOL Aircraft
Scale-up Mission: Regional Commercial Airliner
- Partnerships: Moderate industry breadth and push
- Technologies: Moderate leveraging of technologies
- Regulations: Weak regulation change required
- NASA – Scaling Adoption Alignment: Strong
ODM Mission Path Forward

ODM Mission Strategy: Transition ODM work groups to mission/market pre-competitive enablement efforts

- Establish university partners to lead specific thrusts
- Focus on feasibility studies that support industry needs
- Bi-monthly invited progress reports

Urban VTOL Air-Taxi Workgroup
- MIT: Urban environment operational feasibility
- Duke: Operations Center for remote “pilot in command”, fleet operations
- Northwestern: Aircraft automation for remote command
- NASA: Mission economic feasibility

Thin-Haul Commuter Workgroup
- Georgia Tech: Electric operation network and economic feasibility
- Purdue: Electric vehicle integration feasibility
- NASA: Emissions reduction feasibility
ODM Mission Path Forward

Focused Regulatory Mission Enablement Opportunities

- High priority regulatory barriers that require collaborative support across industry-govt-academia
- Follow example of Electric Propulsion F39.05 ASTM standard

- **Urban VTOL Air-Taxi Mission Specific**
  - IFR Reserves for Short Range Electric Aircraft (30 min + Alternate)
  - Electric Multi-engine Single Engine Equivalency
  - Helipad/Vertiport Requirements (Collaboration with HAI)
  - Critical, Highly Augmented Flight/Propulsion and Trajectory Control
  - Automated Perception and Planning for Trajectory, Mission & Airspace Management
  - Fixed Wing Powered-Lift ASTM Sub-committee (Is this possible...?)

- **Thin-Haul Commuter Specific**
  - IFR Reserves for Short Range Electric Aircraft (45 min + Alternate)
ODM Technology Path Forward

ODM Technology Investment Strategy: Present ODM technology roadmaps to NASA Transformational Aeronautic Concepts (TAC) program management for decision making

- Roadmap products show portfolio across near, mid, long term focus
- Technology roadmaps across primary opportunity areas with prioritization based on goal enablement

- Simplified Vehicle Operations
- Electric Propulsion
- Acoustics
- Safety Systems
- Airspace
- Advanced Manufacturing
ODM Technology Path Forward

ODM Technology Partnerships: NIA commissioned white paper being developed by Bruce Holmes

- Understand how prior public-private partnership have succeeded and failed, showing a range of partnering approaches
- ODM Vision opportunity clarification
- Independent assessment of ODM technology needs
- Identification of public good from ODM investment
- Identify potential ODM participants, contributors, stakeholders
- Perform stakeholder interviews
- Identity international efforts, collaborative and competitive
- Provide final report to NASA Aeronautics

- Early review opportunity to provide feedback before final report
ODM Technology Path Forward

**ODM Early Investment Seedlings:** Select highest priority technologies across investment areas for early start, and leverage SBIR subtopics.

- NASA TAC ODM investment is at earliest an FY18 start, but some FY17 seedling starts may be possible. Are there clear high priority investments across the ODM technology areas?

- SBIR Subtopics are creating improved alignment opportunities for small companies to engage in ODM technologies
  - STTR T15.01 Distributed Electric Propulsion Aircraft Research: Electric and hybrid-electric integration, technologies and concepts.
  - SBIR A3.01 Advanced Air Traffic Management Systems Concepts: Includes UAS and ODM integration
  - SBIR A3.06 Hybrid Electric Vertical Takeoff and Landing: VTOL specific electric and hybrid-electric technologies and concepts.
ODM Integrated Flight Demonstration Activities: Develop opportunities for industry collaboration in hybrid-electric and autonomy flight demonstrators.

- “Information is sought for Flight Test Demonstrator Vehicle concepts to substantially buy down the risk of a future Objective Vehicle with one of the following five goals.”
  - A) Reduced carbon emissions through transformative aircraft and airspace operations. The objective vehicle should be 4-9 passenger CTOL aircraft.
  - B) Reduced carbon emissions through transformative aircraft and airspace operations. The objective vehicle should be 1 or more passenger VTOL aircraft.
  - “The Flight Test Demonstrator Vehicle may support a direct commercial spin-off product, while also providing more broadly applicable lessons.”
ODM Technology Path Forward

ODM Professional Society Outreach: Continue to work with professional societies to achieve maximum outreach and engagement across industry and academia.

- NASA ODM workshops are completed, with a transition towards greater support of professional society conferences that continue to offer opportunities for ODM networking.
- AIAA Aviation 2017 Electric Flight Workshop: Jun 5-9, Denver, CO
  - Currently planning a 3 day event including presentation sessions, panels and expo
  - Michael Patterson (NASA Langley) Transformational Flight PC Chair planning lead
  - Opportunity to join planning committee to determine session content and focus.

- AHS 2018 Forum Electric Flight Workshop
ODM Technology Path Forward

ODM Leverage External Technology Research: Connect ODM community to external research that has high relevance.

- Advanced Battery and Chargers: Battery 500 Consortium
- Autonomous Cars: Leverage emerging DOT guidelines
- Guidance from ODM Community to help prioritize engagement strategies.