

AIAA AAM Task Force

Summary Briefing and Recommendations

January 24, 2023

Chair: Virginia Stouffer

Aeronautics Domain Lead: Ming Chang

AAM Task Force

- An ecosystem has arisen around the production of AAM technologies, but transformation on this scale requires multiple areas of effort, and many gaps and issues remain. As an aerospace organization of the future, AIAA needs to have a role in future outcomes of producing more time-efficient transportation modes and use of unpiloted and autonomous aircraft. By request of the American Institute of Aeronautics and Astronautics (AIAA) Executive Director to Aeronautics Domain Lead, an Advanced Air Mobility (AAM) Task Force should be established to:



- Align the efforts across AIAA to promote AAM
 - Ensure that we understand the landscape of the broad efforts underway in the AIAA and across industry, government, and academia
 - Identify gaps that are in AIAA activities that need to be filled in meeting membership needs for promoting AAM
 - Work with Aeronautics Domain Lead (Ming Chang) to establish a roadmap of overall strategic plan and governance to focus AIAA's mission, goals, objectives, and strategies for this emerging capability to meet ongoing membership need.
- In particular, this task force sought a diverse membership and to ensure that members not already in AIAA leadership roles are represented.

Task Force 6 Month Timeframe

Seeking Low-Hanging Fruit

Prior to June 2022:
Set up framework,
Formulate Task Force

June

- Kickoff at AVIATION
- Review fishbone chart; edit

July

- Formulate Problems
- Identify Gaps

August

Solidify at least 4 gaps

October

- Describe gap
- Identify Stakeholders
- Solutions

Dec

Finalize into presentations

Jan.
SciTech

Follow up:
Present to Board
Phase II

Recommendations

1. AAM-specific forum
2. Noise modeling technologies workshop
3. Partnerships with other organizations and joint projects with them
4. Phase 2 Task Forces to identify and refine needs in particular topics
5. New Integration Committee
6. Grass Roots outreach

Index of Gaps and Solutions

GAPS	SOLUTIONS	TIME FRAME	LEAD VOLUNTEERS
Low Noise Technical Development	Design a recurrent track	Immediate – Near	Nathan Alexander
Droneport Design	Local Chapter + Partner	Immediate – Near	Gokhan Inalhan
Technician Labor Scarcity	Local Chapter + Partner	Near Term	
Pilot Labor Scarcity	Certification Task Force subcommittee	Near Term	
Immediate TOL Infrastructure	Certification Task Force subcommittee	Near Term	
Vertiport Design	Certification Task Force subcommittee	Far Term	
Safe Operation	Forum, Task Force, publications	Near to Middle	Vanessa Aubuchon, Irene Gregory
Multi-Vehicle	Forum, Task Force	Near to Far	Vanessa Aubuchon
Multi-Modal	New IC, Partner association	Far Term	Husni Idris
Cross-disciplinary Integration	Forum-based integration	Near to Middle	Dyna Bencherqui, Nancy Mendonca
⁵ Bridging and Maturation Matchmaking	Local Chapter + Partner	Middle Term	

Gap Statements

Low-Noise Vehicle Development and Operation

IMMEDIATE

GAP STATEMENT

- Better models of AAM-type noise in the urban environment are urgently needed
- Although some design changes are being considered for rotor/propeller driven AAM concepts that can reduce the noise compared to conventional aircraft, for instance, lower disk loading, and lower tip speeds, additional sources of noise for these concepts must be addressed to enable the technology. Suitable methods of noise prediction for vehicles in-flight and appropriate metrics for quantifying the acoustic disturbance must also be determined.
 - *Broadband noise* sources must be better understood and modeled
 - *Multi-fidelity design tools* need to be developed to reduce noise through digital engineering in preliminary design stages
 - *Electromechanical noise* must be reduced for certain design concepts.
 - *Propulsion/airframe integration* and the interaction between multiple propulsive elements should be studied to reduce noise
 - *Effects of maneuver and environmental disturbances* on noise must be considered further

TIME FRAME: Must be solved by the mid-term for widespread AAM operation

RECOMMENDATION

- AIAA should design and host a technical track, seminar or symposium focused on AAM noise modeling
- Designate a WG/Task Force to design and lead
 - Recruit from Aeroacoustic Technical Committee and Transformational Flight Integration Committee
 - Create a summit statement and goals
 - Describe a new technical track specifically for low noise for regular Forum inclusion
 - Must involve industry
- Offer with Aviation or in AAM Forum to include significant industry involvement, with some focused separation

Droneport Concept and Design

IMMEDIATE

GAP STATEMENT

- There need to be defined sUAS droneports for multiple users to access
 - Municipal authorities will demand limited launch sites and are unlikely to permit anywhere/anytime launching
 - Operational experimentation needed to refine:
 - Operational practices
 - Cooperative responsibilities
 - Urban traffic management
 - Managing safety with pedestrians

TIME FRAME: Near term

RECOMMENDATION

- Partner with a municipality and local AUVSI / AIAA chapter
 - Task Force leadership: in-depth technical expertise is required
 - Gokhan may head up task force around Cranfield
 - Start with a presentation at a large forum and active brainstorming for contributors and local chapter locations
- Provision demo/test regions with continuous operations to test concepts and solutions
- Advocate and support regulation and dialogue between stakeholders
 - Position statements drive transformation

Technical Labor Scarcity for AAM

GAP STATEMENT

- There is a shortage of pilots, technicians, engineers and other technical staff to fulfill positions in AAM firms, both in development and operation
- Problem includes both tech/engr and software skills
- There is a general labor shortage, but especially in Aerospace and Defense, and more severely for RAM
- Cultural barriers are a part of this problem
- “First job” gap and “job skills” gaps
- Bifurcated problem: addressing technicians here (see next slide)

TIME FRAME: Near term

RECOMMENDATION

- Local problem, needs local-relevant solutions: local chapters + local leaders needed
- Regional section(s) could lead a Task Force on how to move this forward
 - Possibly tie to the persistent demonstration
 - Partnerships with minority-serving engineering associations
 - Diverse leaders needed to cross cultural barriers
 - Drop entry barriers – are academic standards part of the problem?
 - Inclusion needs to include decision-making for engagement to occur
 - Re-skilling opportunities

Pilot Shortage for AAM

GAP STATEMENT

- There is a shortage of commercial transport pilots to fulfill positions in AAM firms, both in development and operation
- Modern pilots will need software skills
- Problem more severe for Regional AM
- Bifurcated problem: addressing pilots
- Cultural barriers are evident in pilot supply
- 1500 hour requirement takes years to accumulate and considerable expense, blocking access for persons who can not afford the lengthy and expensive training (inequitable access)

TIME FRAME: Near-term onward

RECOMMENDATION

- Reduce training time through aircraft automation
 - **Certification task force is the follow-on for this effort**
- Certification recognition of sim training and SVO pilotage
- Reduce cost of achieving pilot certification
 - AIAA reach out to RACCA for collaborative solutions
 - NASA is doing so as well
 - Solutions on the previous slide also apply
 - Partnerships with AAM OEM-Operators are a good supporting structure
 - philanthropic foundation-funded may be providing the initial path, a program for refinement/expansion with partnership (employer-school) scholarships

Readying Immediate TOL Infrastructure

GAP STATEMENT

Existing airports need to add propulsion refueling/charging infrastructure and energy storage

- FAA has indicated Powered Lift aircraft will not use heliports
- Near term: Batteries and high voltage require safety measures for commercial operations
- Mid term: Hydrogen fueling solutions
- Standardization of charging technologies is required
- Accessibility of charge facilities to all operators and OEMs
- R&D associated with chargers for thermal control
- Distribution to sources from the grid, how to store at the TOL site
- Anything designed at existing TOL sites will inform the future vertiports

TIME FRAME: NEAR-TERM (vertiports are a future problem)

RECOMMENDATION

- A Task Force or Subcommittee to formulate solutions such as forums, papers, panels, etc.
- Certification task force is the follow-on for this effort
 - Call For Papers topic about need for national level technologies
 - Derive white papers to inform Advocacy
 - National level discussion about issues with FAA under AIAA's Advocacy role
 - Resulting session is a forum for state leaders to share tips, roadmaps
 - AIAA develop standards for safe and effective AAM technologies for the NAS such as GBDAA
 - New infrastructure sub-group (see next page) coordinate with EATS to inform electric safety standards for charging safety at existing airports

Vertiports Design

GAP STATEMENT

- New design / new build vertiports require designs and forms that we have not yet defined
 - Entirely new landing areas that don't exist now
 - How to direct and keep people (pedestrians) moving in and out of the terminal area and into the aircraft
 - Limited by the space available on the ground and surrounding infrastructure, buildings, roads.
 - Local challenges exist to expanding existing heliports
 - Sharing airspace with other airspace users and rules
 - Environmental impact and reviews are needed
 - Traffic planning: parking at vertiport

TIME FRAME: Middle term to far term

RECOMMENDATION

- Certification Task Force subcmte on airports or airspace management to work on this problem
- May be addressable by new multi-modal IC
 - Start with a working group to write a white paper on Los Angeles
 - FAA has a response group for Los Angeles 2028 vertiports
 - A new downtown vertiport is going to require a lot of lead time or a lot of partnerships: real estate, structure, electric grid, pedestrian infrastructure, building plans & permits, noise modeling

Safe operational efficiency of new vehicles

GAP STATEMENT

- Novel eVTOL configurations being proposed by emerging AAM vehicle manufacturers (applies to both sUAS and UAM) exhibit numerous poorly understood or immature characteristics that make safe and efficient flight difficult to guarantee. These characteristics include
 - immature prediction of aero-propulsive physics and flight dynamics;
 - lack of well studied and assurable advanced control techniques for robust transition modes and contingencies;
 - new technologies lacking reliability history that may exhibit more frequent faults,
 - new piloting rules, etc.
- These ambiguities make safe and efficient operations difficult to assess
- Also make type certification reliant on special airworthiness certificates and waivers, making the certification process lengthier and expensive for emerging AAM companies.

TIME FRAME: Near to middle term

RECOMMENDATION

- Follow-on Task Force / Working Group
 - Development of common problem definitions, models
 - Several committees working together: with all the right people in the same place – would benefit from an AAM forum
 - Data sharing hub (could be facilitated by NASA with AIAA promotion of use)
 - Workshops on specific topics –based around a common model or problem definition (similar to CRM Drag Prediction workshops), (e.g., flight dynamics & control, acoustics prediction, risk calculation methods for safety case/MOC, etc.)
 - Consortium of industry & government that supports/funds research, tests, and integration of AAM-related technologies
 - Do a special issue of JGDC around AAM (Irene Gregory)
 - Do a special issue/conference w/ IEEE on robotics & AAM, American Controls Conference/ Journal of Aircraft on the integrative aspects

Multi-Vehicle and Autonomous Operations for Scalable AAM

GAP STATEMENT

- The AAM ecosystem is expected to advance from current state-of-the-art operations to a ubiquitous capability, similar to cars today. To realize this vision for AAM, technology will be needed to allow a few operators to manage many vehicles. This is accomplished by fully-automated or autonomous aircraft that have no need for a pilot or operator on-board or on the ground, improving vehicle productivity and economics. The likely scenario is that a remote supervisor will oversee the operation of multiple aircraft with strategic fleet management goals. There are numerous challenges associated with technical/operational, safety and security, societal acceptance, and regulatory. Currently, no clear path to operational approval exists for this type of operation in the US NAS.

TIME FRAME

- Near-term for sUAS operations
- Mid-term for auto cargo operations
- Far-term for passenger-carrying UAM/AM operations

RECOMMENDATION

- Follow-on Task Force / Working Group
 - Champion to carry this further, either with an AAM Forum or maturation with a Follow-On Task Force
- Vehicle equipage and defining vehicle performance must close the gaps in the FARs; e.g. performance based operations for trajectory and margins
- Safety Case and associated Means of Compliance development
- Numerous experiments to justify and defend risk calculations and provide guidelines/recommendations for roles & responsibilities, displays, ConOps, etc.
- Consortia, working groups
- UAS playground to rapidly prototype and gather data on potential solutions

Multi-Modal Integration

GAP STATEMENT

- AAM should integrate effectively and seamlessly with other modes of transportation.
- There is a lack of collaboration between aviation and other modes; Aviation is too focused on airport to airport. Less “O-D” type thinking is required
 - Seamlessness must take into account the need for aviation security
 - This includes complementary and competitive interoperability and integration with a passenger/package orientation.
 - There is need for multi-modal data fabric and integrated solutions for efficiency, resilience to disruptions, etc.
- Door to door needs to be a part of the solution.

TIME FRAME: Far term – but AAM should be designed from the onset with this target in mind

RECOMMENDATION

- Establish an Integration Committee around this topic
 - Harvest academic interest
 - TRB and Volpe have communities around this topic, collaborate with them
 - International harmonization is a part; gather lessons learned from intermodalism in other areas (e.g., DLR)
 - It appears there is no AIAA relevant committee to provide a home for this topic
 - Would also benefit from an AAM Forum
- Next steps: WG leading to an IC

Cross-disciplinary Integration of AAM-Related Efforts

GAP STATEMENT

There is a need for willing integrators across the AAM ecosystem. It's not always clear how it all integrates and advances the state of the art, is utilized by the AAM ecosystem, or helps cross the TRL valley of death

BLOCKERS

- 1) people's bandwidth to take on integrating efforts,
- 2) many of these challenges are cross-domain and a majority of SMEs are single or several domain,
- 3) forums and efforts only currently exist in several areas
- 4) need participation from people who do not attend workshops and fora, e.g. regional planners, ATA, ALPA...

TIME FRAME – Near to middle

RECOMMENDATION

- Working Group or Task Force to pursue next step. Need greater numbers of motivated individuals, as in a dedicated forum
 - TFIC, AC Design, EATTC, all work these areas, but more effort is needed
- Parts of the solution
 - Supporting standards – developing Means of Compliance or validating standards. Multiple benefits around developing AIAA groups to support specific standards.
 - E.g., Repair MOC support
 - Filling Research Gaps - Roadmaps are being developed, e.g. NASA's Airspace, Safety and Community and Research Plans, all of which have identified gaps. Being aware of and pointing researchers to these gaps could benefit the ecosystem
 - Supporting Public Private Partnership efforts. Identifying potential efforts and several nascent efforts could benefit from AIAA participation. Example, places where there is a public need and a possible industry solution, and a public-private partnership needs to be worked out

Initial and Bridging Integration & Maturation Steps

GAP STATEMENT

- Localities wishing to jump-start AAM operations need a mechanism for starting. Manufacturers need assistance, often just in-kind, such a site for infrastructure. Repeated flight testing of technology is needed to 1) mature the integration of technologies in AAM, 2) provide flight test experience leading to certification, public acceptance; and provide 3) a funding stream to start-ups to bridge the valley from start up to operation
- Data must be collected to prove the business case, safety case, and inform design guidelines or requirements/standards
- Access & permission to endpoints and airspace, and participants are needed.

TIME FRAME: Near term

RECOMMENDATIONS

- Provide a forum or publications to foster lessons learned, partnering
- Repeated/annual competitions or demonstrations
 - AIAA+AUVSI+EATS collaborate on creating a persistent competition and demonstration
 - Demonstration starter in Monterey Bay, North Dakota, Leesburg VA...
 - Partner with VIPC, EAA, Xelevate, ...
 - Build AIAA staff, volunteers, sponsors
 - LVCE helps to graduate from test case to operational small area use – AIAA Modeling TC can champion
- Interested groups of localities and individuals need to band together around roadmaps for making flight tests happen
 - Lessons learned, roadmap sharing
 - Involve regulators to make testing more flexible and accessible
 - Smooth the path to expansion beyond the test environment

Task Force Members

- Apoorv Maheshwari
- Nancy Mendonca
- Kenney McCombs
- Vanessa Aubuchon
- Tom Irvine
- Gecheng Zha
- Husni Idris
- Gokhan Inalhan
- W. Nathan Alexander
- Dyna Bencherghi
- Simon I. Briceno
- Irene M. Gregory
- Tom Gunnarson

- Parimal Kopardekar
- Keith Hoffler
- Michael D. Patterson
- Lesley Weitz
- Robie Samanta Roy
- Omar Kassim Ariff
- Larry Brase
- Ruben DelRosario
- Hsun Chao
- Isaac Weintraub
- Starr Ginn
- Virginia Stouffer

AIAA Advisors

- Ming Chang
- Ashira Beutler-Greene
- Steve Lee
- Rodger Williams

Next Steps: Please Join Us



AIAA Points of Contact

Ming Chang, Aeronautics Domain Lead

mingc@aiaa.org

Ashira Beutler-Greene, Content Developer

ashirab@aiaa.org



AMERICAN INSTITUTE OF
AERONAUTICS AND ASTRONAUTICS

AAM Working Definition

- Advanced Air Mobility consists of new airborne commercial transportation solutions for both people, cargo, and other missions, taking advantage of new, sustainable propulsion systems; using multiple rotors, electric motors, ducted motors and wing configurations in novel concepts. The operating domains include low altitude, urban, regional, urban to suburban. This encompasses Urban Air Mobility, Unmanned Air Systems, Regional Air Mobility, and Low Altitude Mobility.