NASA Advisory Council Aeronautics Committee Meeting
August 31-September 1, 2022
NASA's Ames Research Center, Building M3
Mountain View, California

Welcome

Dr. John-Paul Clarke, committee chair, called the meeting to order. Introductions were made and information regarding the purpose and scope of the Committee's discussions, findings, and recommendations were described. This meeting was conducted in a hybrid style, with some attendees present at NASA's Ames Research Center in California and others attending virtually.

Unmanned Aircraft Systems Traffic Management

Mr. Akbar Sultan, director of NASA's Airspace Operations and Safety Program, provided an update on the closeout of the Unmanned Aircraft Systems (UAS) Traffic Management (UTM) project, its impacts, and what is being done next.

Mr. Sultan outlined the vision for UTM and described its key objectives of system development and demonstrations, focused flight tests, and simulation and analysis. He also covered the project's timeline, with details on each Technical Capability Level (TCL) and the continuous transfer of technology to industry through the duration of the project.

He summarized how NASA and the aviation community worked on the UTM architecture, including demonstrations performed in Reno, Nevada, and Corpus Christi, Texas. He noted that said concepts were essentially adopted globally, especially in Europe. He explained the details of UTM's work in multiple areas such as traffic management and data sharing.

Mr. Sultan noted UTM's success with industry partnerships, pointing out the number was in the double digits at each TCL, whereas in the past, partnerships were conducted with one or two partners or an airline. He highlighted the numerous publications that came out of UTM and its community, including NASA technical manuals, external publications, industry publications, and more.

Mr. Sultan explained how following this work and input from the community, the project identified operations and capabilities to move forward based on these results. He emphasized the focus of UTM was uncontrolled airspace below 500 feet where traditional Air Traffic Management (ATM) services are not provided. To achieve UTM's objectives, there must be some ATM coordination, and this requirement grows in urgency as Advanced Air Mobility (AAM) becomes closer to reality. The decision was to continue the NASA/FAA research transition team instead of closing it out with the project.

Mr. Sultan further explained how the work UTM began is continuing within the new Air Traffic Management – eXploration (ATM-X) project, noting that much work remains to be done in certain areas such as beyond visual line of sight. He detailed how UTM's work feeds into ATM-X's subprojects, the AAM National Campaign, and other NASA activities. He explained the collaborative actions embarked on with the FAA for technology transfers.

Mr. Sultan concluded his presentation by stating how there now exists a market for UTM, standards were developed, research is continuing, international interest was observed, and NASA's partnerships were deepened.

Discussion

Mr. Peter Bunce congratulated UTM on its successful work and expressed that from an industry perspective, the next steps are in implementation. He suggested in terms of practical next steps, NASA and the FAA should take into consideration not just the 2040s timeframe, but the 2020s timeframe as well.

Ms. Lisa Ellman also congratulated UTM on its work. Agreeing with Mr. Bunce, she urged NASA to continue being actively engaged and working with others in the federal government, such as the FAA and the White House, to begin this implementation. She encouraged NASA to think about how the policies as they are developed could help lay the foundation for the future. Ms. Ellman elaborated that executive action and other tangible actions that maintain and expand U.S. global leadership must be taken.

Dr. Clarke encouraged NASA as it plans future projects to consider not just the architecture, but also performance requirements and the communications, navigation, and surveillance aspects of ATM. He noted this seemed to be missing from NASA's work thus far and pointed out it would be beneficial so the FAA can regulate third-party providers.

Findings

- The Committee applauds the work and achievements of the Unmanned Aircraft Systems Transportation Management (UTM) project team, especially as it relates to defining a feasible federated architecture and facilitating and influencing national and international rulemaking on Air Traffic Management (ATM) for unmanned aircraft systems (UAS).
- The Committee believes that NASA needs to stay engaged throughout UTM implementation and in developing the associated foundational policies.

Recommendation

- The Committee recommends that AAM project and Extensible Traffic Management (xTM) subproject build on the achievements of the UTM project by determining the communications, navigation, and surveillance ATM performance requirements and

the tradeoffs thereof, and by providing the rigorous technical analysis of policy options that are necessary for successful certification and deployment of the proposed federated architecture.

- Major Reasons for the Recommendation:
  NASA's work on UTM was invaluable and has been implemented in many places around the planet, but has not been fully embraced in the U.S. UTM is critical to enable complex scaled UAS operations and U.S. global competitiveness in advanced aviation.
- Consequences of No Action on the Recommendation:
  Implementation of UTM requires foundational policies. NASA has a critical role to play in the administration-wide policy deliberations by providing data and analysis to support these deliberations. For example, the Remote ID rule represents a missed opportunity as it failed to enable a network-based solution for compliance, which would have provided a foundation for UTM.

Advanced Capabilities for Emergency Response Operations

Mr. Marcus Johnson, planning team lead for NASA's proposed Advanced Capabilities for Emergency Response Operations (ACERO) project, provided an overview of the project's pre-formulation stage, its context, and potential outcomes. ACERO is seeking to enter project formulation in fiscal year 2023.

Mr. Johnson explained ACERO's background, including the successful workshop held in 2021 with wildfire management agencies, organizations, and experts. He explained in detail how the primary finding was that wildfire management groups face general issues in surveillance, communication, coordination, and aerial operations above fires, particularly for suppression purposes and especially at night.

He explained how, as a result of these conversations, NASA would focus heavily on a unified concept of operations that can help wildfire management organizations address these broad issues. He reported that the wildfire management community doesn't currently have the bandwidth to address certain challenges themselves – for example, the broader picture of what these organizations want firefighting to look like in the future.

Mr. Johnson provided an overview of future plans for the ACERO project, including timelines, a concept of operations, regulatory and technological barriers, and ways NASA's technological expertise can specifically be tailored and harmonized to the wildfire fighting ecosystem.

Mr. Johnson emphasized how NASA's research can address the challenge of wildfire management in multiple ways. He also pointed out collaboration with NASA's Science Mission Directorate (SMD) in working these solutions, as well as multiple government agencies at the federal, state, and local levels.

Discussion

Dr. Clarke stated ACERO is a great example of NASA extending the core capabilities it developed for ATM and others to new domains. He pointed out the Department of Defense and other areas of government are substantially looking at the coordination of first responders and asset management. He encouraged NASA to define requirements for first responder activities beyond wildfires so it can "build the hooks" early for the capabilities that will be required.

Ms. Ellman expressed the industry's appreciation of NASA's leadership in this topic. She explained how, in addition to the technology, another important area for NASA to consider is the regulatory challenges preventing drones from assisting first responders in high-value situations, including wildfires. She suggested working closely with the FAA and other agencies in getting approval to use these technologies outside a narrow set of circumstances.

Dr. Hassan Shahidi pointed out another consideration may be coordinating with the medical community to address firefighter injuries and responsiveness to those emergencies as part of ACERO's ecosystem.

Mr. Bunce echoed Ms. Ellman's and Dr. Shahidi's suggestions. He also explained how, with NASA demonstrating capabilities in urban areas and controlled airspaces with Automatic Dependent Surveillance-Broadcast, working with the FAA and conducting operations in metropolitan areas could be a possibility.

Building on Mr. Bunce's input, Dr. Clarke noted that in Austin, Texas real fires are created in an urban scene for training purposes at a fire training facility near the airport. He suggested that such training centers could be a setting to expand NASA's wildfire response capabilities.

Findings

- The Committee finds that the proposed ACERO project is a promising application of core NASA capabilities to the new domain of wildfire management, and that there are broader applications in terms of first responder operations and safety.
- The Committee also finds that the ACERO technologies and capabilities could help with resolving the regulatory challenges that might be preventing drones from assisting first responders.
- The Committee believes NASA has an opportunity to extend the technologies and capabilities developed for wildfire management to urban and suburban fire management via collaboration with fire departments in metropolitan regions that have extensive "live" fire training facilities.
- The Committee believes the outcomes and goals for ACERO should be expanded to include enhancing firefighter safety.

Recommendations

The Committee recommends that the proposed ACERO project seek closer collaboration with the Department of Defense, Federal Emergency Management Agency, and additional state-level first responder research and development organizations to define the capabilities necessary for optimal allocation of resources.

- Major Reasons for the Recommendation:
  Other agencies in the federal government such as the Department of Defense are looking substantially at the coordination of first responders and their management of assets.
- Consequences of No Action on the Recommendation:
  By working with other agencies to define requirements for first responder activities beyond wildfires, NASA can build the hooks early for the capabilities that will be required.

The Committee also recommends that NASA collaborate with the FAA to develop the technologies, capabilities, and policies necessary to enable unmanned aircraft systems visual and beyond visual line of sight operations, and thereby make it easy for drone operations to play a meaningful role in disaster response.

- Major Reasons for the Recommendation:
  The challenges posed by developing and implementing these wildfire management capabilities are both technological and regulatory. Working closely with the FAA can ease this process.
- Consequences of No Action on the Recommendation:
  Getting approval for these technologies to be used in practical situations outside a narrow set of circumstances is critical to NASA's capabilities having an impact.

Advanced Air Mobility

Mr. Davis Hackenberg, NASA's mission integration manager for AAM, gave a presentation updating the Committee on the activities of NASA's AAM mission.

Mr. Hackenberg highlighted NASA's participation in the August 2022 White House AAM Summit. After the summit, NASA held follow-up discussions with industry partners and received useful feedback from several parties, including in the international community. He noted it was an impactful summit that helped develop useful conversations and information.

He gave a general overview of the scale AAM's impact can have in local communities and the larger regional level – emphasizing the transformational changes AAM can provide. He also discussed the definition of AAM, noting some confusion across industry and pointing out the discussion itself may be holding industry back. He stated AAM is an umbrella term for multiple use cases, though several other definitions are still important, and work remains to be done in defining topics including area/region, vehicle classes, use cases, and others. He noted use cases as potentially being the more significant aspect, with each use case having its own concept of operations and

requirements for integration and operation. He explained NASA is now looking into tradeoffs and how some of the use cases for AAM play against each other.

Mr. Hackenberg explained the importance of NASA's relationship with the FAA for policy and guidance, as well as standards bodies being a critical focus of what NASA does as AAM technology is built and shared in an open-source manner. He also explained the importance of industry in making some of the early operations successful and breaking down barriers that don't allow AAM to scale. He stated industry working together to develop standards and getting them in the FAA's pipeline is important to the success of the industry.

He described the partnerships with industry leaders and how they have been advantageous. He noted how the open conversation on AAM has been highly successful – stating NASA's relationship with the FAA is stronger than ever, and there is interest from the International Forum for Aviation Research (IFAR) and the International Civil Aviation Organization.

Mr. Hackenberg added that examining the results of concepts of operation in requirements, standards, and regulations could be better done to link together a long-term roadmap synchronized across NASA, the FAA, and other standards bodies more intentionally.

Discussion

Mr. Bunce discussed different areas of the federal government involved in AAM policy including the Department of Defense and congressional committees. He pointed out they all have different definitions of AAM terms. He suggested NASA could give input to or collaborate with the FAA to provide better definitions to prevent confusion on what counts as AAM-related technology and work.

Ms. Ellman noted appreciation for NASA's participation in the White House AAM Summit. She suggested NASA could work more directly with the White House and the FAA on tangible policy for a governmentwide strategy to ensure U.S. competitiveness in AAM that furthers U.S. global leadership in advanced aviation.

Dr. Clarke recommended AAM and xTM could build on the achievements of UTM by determining the airspace management, communications, navigation, and surveillance performance requirements – and the tradeoffs thereof – that are necessary for a successful certificated deployment of the proposed federated architecture.

He explained that the driving force behind his suggestion is to encourage providing the FAA with exact requirements for how these systems have to perform and how the tradeoffs made achieve safety targets, even though the FAA determines the policy. To do so, NASA would have to accomplish successful test capabilities to determine these requirements.

Dr. Clarke also recommended AAM and xTM be used to develop, evaluate, and validate technologies and capabilities for ATM for commercial passenger aircraft.

Ms. Ellman recommended NASA should remain engaged in UTM and continue to work with the FAA and industry to assist with implementation, and build support on a policy level administration wide to lay UTM's foundation.

Finding

The Committee applauds NASA for its support of and participation in the recent White House AAM Summit and for supporting the development of a government-wide strategy to strengthen U.S. competitiveness in advanced aviation. Industry strongly supports the goal of the recent White House AAM Summit to maintain and enhance U.S. global leadership in advanced aviation. The advancement of UAS/AAM benefits all Americans – including those in underserved and difficult to reach communities.

Recommendations

The Committee finds that there is a need for a single nationally and globally accepted definition of AAM and an opportunity to leverage the technologies and capabilities being developed in the AAM program for commercial passenger aircraft operations.

- Major Reasons for the Recommendation:
  Many agencies, institutions, and organizations participate in the AAM mission which all have variations in definition.
- Consequences of No Action on the Recommendation:
  The further implementation of AAM into commercial operations will require a set of consistent definitions.

The Committee recommends that the AAM and xTM projects be leveraged to develop, evaluate, and validate ATM technologies and capabilities for commercial passenger aircraft operations.

- Major Reasons for the Recommendation:
  The policy of the U.S. should be to lead the world in the development and deployment of uncrewed, autonomy-enabled, and Electric Vertical Take Off and Landing aircraft.
- Consequences of No Action on the Recommendation:
  This requires a government-wide strategy to strengthen U.S. competitiveness in advanced aviation.

University Innovation

Mr. Koushik Datta, project manager of NASA's University Innovation (UI) project, gave an overview of the project including details on the workings of the University Leadership Initiative (ULI), University Student Research Challenge (USRC), and Gateways to Blue

Skies competition. He explained the differences between the three activities and how the solicitation process works for each of them, and gave a numerical overview of how many awards have been given, how many institutions are involved, and how many faculty and students have participated thus far.

Mr. Datta noted the diversity of the institutions and individuals involved across the country, as well as the project's focus on bringing in minority institutions such as historically black colleges, and that there are women principal investigators among the awards given. He emphasized also how some of these student participants are at the K-12 level because of ULI awardees' individual outreach programs.

He described in detail several specific ULI and USRC awards given and which areas of NASA Aeronautics' Strategic Implementation Plan the awardees are researching. He discussed ULI's and USRC's Tech Talks and how they have expanded. Faculties from different universities began attending virtually and an information exchange has developed.

Mr. Datta discussed the inspiration generated by UI's activities and how it has engaged with students and faculty in a new, exciting, and long-lasting way. He described the positive outcomes for those who have participated such as working on real-world aviation challenges, being part of diverse teams, presentations at conferences, internships, and offers from companies. He noted the possibilities of what could be done with more funding and collaboration with other parts of NASA.

Discussion

Mr. Bunce asked how UI announces and publicizes its Tech Talks and who can participate. He expressed interest in seeing the participation and scope of the talks increased. Dr. Clarke agreed.

Dr. Shahidi suggested that metrics or statistics recording the percentage of participants who stay in the aerospace industry following their involvement in UI would be useful. He explained that universities could then gain an expectation or benchmark of how many are retained to best incentivize more to stay.

Dr. Clarke found the onus is on universities to put together system-level teams to tackle system-level ideas. He expressed concern that the ability for "wild and wacky" ideas to survive the process is jeopardized. He explained that the process itself, finding and building a team, can lead to the burying of these out-of-the-box ideas, and suggested what NASA does with the NASA Innovative Advanced Concepts (NIAC) program could be considered – specifically, NIAC's ability to preserve those one or two person groups pursuing an out-of-the-box concept.

Addressing both retaining talent and preserving out-of-the-box ideas, Dr. Clarke suggested considering a post-doctorate program in which NASA can retain the best talent for more than a couple of years. He highlighted the use in periodically reviewing

the project's portfolio and determining how it can best be designed to include other channels and ensure access is not limited. He noted existing NASA activities with these channels, namely NIAC, could be utilized.

Dr. Nicole Key agreed with Dr. Clarke, echoing how forming a team and working through the ULI channels may lead to a "watering down," and that different avenues for different types of research proposed could be beneficial. She added that industry is easier to engage with through NASA Research Announcements versus ULI, and that a collaborative balance between industry and universities is a struggle.

Dr. Naveed Hussain commended the positive outcomes of ULI from the industry perspective, with particular focus on the students who have achieved exposure, internships, formed companies, and jointly published papers. He also commended the UI program for being a needle mover on diversity in multiple areas, from the principal investigators to the students in the STEM pipeline being built for them.

Findings

- The Committee applauds the efforts of the UI project and is pleased with its continuing impact. The Committee notes that it has been a needle mover with regards to increasing the diversity of participants included in NASA's STEM pipeline and encourages NASA to continue the project.
- The Committee finds there is a need for a systematic review of channels and pathways to reach different types of research, especially innovative out-of-the-box ideas UI researchers may have. The onus of dealing with system-level challenges lies with universities, and there runs a risk of "wild and wacky" ideas being buried in the process. Considering mechanisms that broaden UI's research avenues could be worthwhile.

Recommendation

The Committee recommends NASA more broadly publicize and engage the aerospace community in the activities of its UI project. For example, having outside entities and organizations be able to participate in the Tech Talks held as part of the USRC could be mutually beneficial to all involved.

- Major Reasons for the Recommendation:
  Broadening UI further into the aerospace industry by including more institutions and organizations can increase awareness and interest in their ability to participate and benefit from the activities.
- Consequences of No Action on the Recommendation:
  NASA could be missing an opportunity to make the Tech Talks the equivalent of a tent top activity for the aerospace community.

Zero Emissions

Dr. John Cavolowsky, director of NASA's Transformative Aeronautics Concepts Program, gave a presentation on NASA's zero emissions strategy and sustainable aviation portfolio.

Dr. Cavolowsky provided an overview of the mid-century vision for sustainable aviation by 2050 laid out in NASA's portfolio and the U.S. Aviation Climate Action Plan driven by the FAA. He detailed how the key driver is making sure aviation is sustainable without the use of offsets or suppressing demand for aviation. He mentioned that the aspirational view of achieving net-zero carbon and greenhouse gas emissions industrywide also involves a critical international component.

He explained that alternative energy and propulsion architectures are essential to achieving this vision, as well as the importance of overall aircraft architecture and airspace operations. He pointed out that lifecycle system models to understand all the impacts is also required due to sizeable non-carbon dioxide impacts on climate.

He made distinct the use of the terms "zero emissions" and "zero impact." He stated "zero emissions" refers to assessments of atmospheric conditions post-flight, post-trajectory, and more to see how well technology has done in order to improve. He differentiated "zero impact" as considering other dynamics such as societal impact and health going beyond the aviation industry, as well as how the industry is able to grow and be sustainable.

Dr. Cavolowsky emphasized NASA's role of addressing the technological and operational sides of achieving sustainable aviation, as opposed to the more lifecycle-oriented challenges such as fuel sourcing and development. He noted how system studies are helping NASA understand the entire space and where the return on investment lies. He described collaboration with other agencies such as the Department of Energy and others in detail.

Dr. Cavolowsky explained the wide net NASA needs to cast to tackle the challenge of decarbonizing aviation, noting the importance of reaching many areas of government, industry, and academia.

He outlined the near-term research occurring across NASA's Aeronautics portfolio. He described collaboration with other agencies, such as the Department of Energy and FAA, NASA's SMD, and universities such as Georgia Tech.

Discussion

Mr. Bunce questioned the terminology used to discuss NASA's sustainable flight activities, particularly the use of the term "zero emissions," which may inaccurately cast NASA's work as having no emissions whatsoever. He detailed how some sustainable aviation technology still has emissions, even if the emission isn't carbon-based. He

stated that “net zero” is the term NASA should use.

Dr. Clarke posited that the impact is what matters most, pointing out how even if net zero emissions of carbon through sequestration is achieved at scale, there are still emissions because something is burning at altitude. He agreed there needs to be greater clarity and consistency in NASA’s terminology and wording in this area.

Mr. Bunce brought up the commitment toward net zero in 2050 – specifically, how the process of implementing NASA’s sustainable technology beyond the point it has reached maturation. He noted much of this technology is aimed at the 2035 timeline, and that is only 15 years from the overall goal of net zero by 2050.

Dr. Clarke encouraged NASA to collaborate with other directorates, agencies, and partners, such as NASA’s SMD and IFAR, to understand prediction capabilities for technology and operations with an end goal of a real-time system for managing the net impact.

Dr. Clarke suggested a good role for NASA would be looking at sustainable aviation from an impact perspective, looking at the uncertainties, and looking at the systemic consequences not only on the vehicle side but also on the operational side – airport operations, for example.

He suggested NASA consider a portfolio optimization approach that deals with decision-making and uncertainty about potential technologies and their impact in the same way NASA would view its portfolio. He further explained how, although the systems approach of developing definitive solutions is also useful, portfolio optimization enables the approach of investing money into technologies that provide potential benefits in a way that maximizes the probability or likelihood of achievements being made in the future.

Findings

- The Committee finds there should be greater clarity with regards to terminology, noting that “zero emissions” may not be the most accurate term for NASA’s work in sustainability given that different sources of energy still create emissions of some kind. Scrutinizing the implications of terms such as, but not limited to, “zero emissions,” “net zero,” or “zero impact” would be beneficial to NASA in defining the purpose of its research in this area.
- The Committee finds collaboration with NASA’s other mission directorates and IFAR partners could be beneficial – specifically around how to develop the science and understanding prediction capabilities to marry with the technology and operations – with the end goal of a real-time system for managing the net impact.

Recommendation

Though the Committee applauds the systems approach taken by NASA, it suggests considering a portfolio optimization approach that considers both the uncertainty in terms of the potential capabilities that would be developed as well as the impact.

- Major Reasons for the Recommendation:
  The portfolio optimization approach enables investing money into technologies that provide potential benefits in a way that maximizes the probability or likelihood of achievement being made in the future.
- Consequences of No Action on the Recommendation:
  The opportunity for NASA to make a more immediate impact with technology it can develop as part of its current portfolio could be diminished.

Public Comments

A public comments period was offered as required. No public comments were received.

Conclusion

The meeting of the Committee was concluded with discussions on the timeline and plans for future meetings.

MEETING ADJOURNED

List of Attendees

Committee Members:

1. Dr. John-Paul Clarke, Chair
2. Mr. Peter Bunce
3. Ms. Lisa Ellman
4. Dr. Naveed Hussain
5. Dr. Nicole Key
6. Mr. Natesh Manikoth
7. Ms. Susan Pfingstler
8. Dr. Helen Reed
9. Dr. Hassan Shahidi

Virtual:

10. Mr. Michael Dumais

NASA:

11. Ashly Barnes
12. John Cavolowsky
13. Suzie Cisneros
14. Christine Clark
15. Steven Clarke
16. Koushik Datta
17. Davis Hackenberg
18. Parimal Kopardekar
19. Jon Montgomery
20. Lee Noble
21. Robert Pearce
22. Cheryl Quinn
23. Leighton Quon
24. Naseem Saiyed
25. Eugene Tu
26. Edgar Waggoner

Virtual:

27. Vanessa Aubuchon
28. Tiffany Blake
29. Karen Cate
30. Mary Dijoseph
31. Shawn Engelland
32. Barbara Esker
33. Jay Fletcher
34. Kenneth Freeman
35. Laurie Grindle
36. Kelley Hashemi
37. Stephen Jensen
38. Marcus Johnson
39. Michele Johnson
40. Sharon Jones
41. Paul Krasa
42. Samantha Magill
43. Jeffrey McCandless
44. Michael Patterson
45. Irma Rodriguez
46. Michael Rogers
47. Steven Sidorek
48. Hillary Smith
49. Barry Sullivan
50. Akbar Sultan
51. David Thipphavong
52. Steven Velotas
53. Jason Welstead

External:

Crown Consulting:

54. Lexie Brown

FedWriters (NAC Meeting Support):

55. John Gould

Wyle Labs (NAC Meeting Support):

56. Alina Eskridge
57. Gregory Harbert
58. Michael Tsairides

No Affiliation Identified:

Virtual:

59. Dennis Feerick
60. John Herbert
61. Doug Johnson
62. Christine Joseph
63. James Lochner
64. Martin Ruzek
65. Todd Solomo
66. Rocio Frej Vitalle