NASA Advisory Council Aeronautics Committee Meeting
March 17, 2020
Virtual Meeting Originated at NASA Headquarters
Washington, DC

Welcome

Mr. John Borghese, committee chairman, called the meeting to order, noting this was the first time everyone was meeting from remote locations due to the coronavirus pandemic. He reviewed the committee's obligation to NASA in terms of providing findings and recommendations and reviewed what each type of communication means and what NASA's required response is supposed to be.

Ms. Irma Rodriguez provided the required explanations related to the Federal Advisory Committee Act (FACA) purpose of the meeting and structure of the committee and noted that a public comment period would be accommodated in the virtual meeting mode.

Fiscal Year 2021 ARMD Strategy and Budget Overview

NASA Associate Administrator for the Aeronautics Research Mission Directorate (ARMD), Mr. Robert Pearce, welcomed the virtual attendees to this first-of-its-kind meeting for the NAC Aero committee. He explained NASA's current response and status related to the pandemic and noted the positive support for this new way of doing business he has seen within the agency and all of NASA's partners and stakeholders.

Mr. Pearce summarized the fiscal year 2021 President's budget request to Congress and reviewed the major research themes for the next 50 years of aviation with respect to supersonic, subsonic, and Advanced Air Mobility (AAM); explained the evolution in thinking related to the six research thrusts that are now reflected in the updated Strategic Implementation Plan; and described changes to the aeronautics directorate's organization, which now includes the Aeroscience Evaluation and Test Capabilities (AETC) program. The AETC program was previously slated to be transfer to another mission directorate but in the FY21 budget it was decided that it would stay within ARMD.

Mr. Pearce described how dollars from the budget request will be spent once approved, noting shifts in funding between programs that are a result of some projects ending and increased emphasis on others.

Mr. Borghese asked if ARMD has control over research facilities under AETC and, with the NASA-wide consolidation of AETC resource management within ARMD, did that include aircraft used by other mission directorates, such as the T-38 fleet flown by NASA astronauts. Concern about facility management has been discussed during several previous NAC Aero meetings as NASA deliberated how to manage its research infrastructure. Mr. Pearce responded that ARMD does control the AETC facilities with

the help of a board to manage priorities. Aircraft and aircraft support facilities remain in the purview of the individual Centers and mission directorates they belong to, and to other agency offices (Aircraft Management Division.)

Dr. Mike Francis commented about autonomy and the importance of its inclusion in airspace and vehicle research. He repeated concerns, expressed during previous meetings, that it is important to develop autonomy such that you don't need an airline transport rating to fly simple AAM vehicles. He also suggested that the human-intelligent machine relationship needs to be redefined, as he doesn't see that in ARMD's current charts. He is hopeful that will be discussed the next time autonomy is included in a NAC Aero meeting topic.

Andrew Cebula expressed a desire for more NASA help with data transfer and integration in terms of FAA air traffic management and the new capabilities enabled by Air Traffic Demonstration (ATD) projects. Pearce said that is part of future work NASA is doing and appreciates industry input on their needs.

Mr. Pearce reviewed in more detail plans for some of the major research themes, such as enabling commercial supersonic flight via the X-59 QueSST aircraft. Dr. Francis then asked about contingency planning in the event of a partial or total vehicle loss. While funding for a full replacement aircraft was not pursued, there will be a capability to employ key areas of structural spares.

Sustainability in aviation was discussed by Mr. Pearce and several committee members offered insight and input in areas ranging from supply chain to concerns about climate change inducing increased turbulence for aircraft at cruise. Mr. Pearce continued discussion on this topic by reviewing plans for further developing technology in support of a new subsonic 150-175 passenger transport deploying in about 2030. (Specifics of these technologies are summarized here.)

Mr. Pearce wrapped up his presentation by talking about work being done in support of AAM.

Recommendation:

NASA should take the leadership role in ensuring that the United States continues to retain the world's foremost subject-matter experts in all disciplines essential to the future of the aerospace enterprise through a focused workforce development and pipelining program.

Major reasons for the recommendation
During the past few decades, traditional aerospace disciplines such as aerodynamics, astrodynamics, aerothermal, aeroelasticity, aeroacoustics, and computational aerothermal have been underfunded even though they remain highly relevant. ARMD has provided some funding for NRAs and related University research in these areas but ARMD funding alone has been insufficient. In those traditional disciplines, very few

PhDs who could become subject-matter experts have been nurtured because of lack of research support in these areas. Subject-matter experts currently at universities, industry, and government in these areas are near retirement, and most could retire within a decade with no pipeline in place. In addition, experts in those adjacent disciplines that are becoming ever more influential in aerospace systems and technology such as robotics, artificial intelligence, and other advanced computer science applications are often not equipped to understand the unique needs of our diverse array of aerospace applications.

Consequences of no action on the recommendation
To design the best aerospace vehicles and systems, every discipline must be pushed to the same limits including the risks. Since the design and the product can be no better than its weakest element, we cannot afford to have anything less than the best in any of these disciplines. If we do nothing, we will lose our nation's leadership in aerospace, and, in turn, weaken our national security and the economy.

Small Business Innovation Research

NASA's Jenn Gustetic, Cheryl Quinn, and Max Briggs offered an overview of the Small Business Innovation Research (SBIR) program.

The overall program is managed by the Space Technology Mission Directorate, but all directorates, including ARMD, participate and are represented. The vision for SBIR is on enabling small businesses to deliver technology and innovation that not only benefits NASA's mission, but also provides societal benefit and grows the U.S. economy. Primary customers are small businesses and entrepreneurs who can help provide innovative technology solutions that help meet NASA's research goals. It is further hoped those solutions can provide businesses with the opportunity to fully commercialize the technology and grow their business. During 2019, there were 279 proposals for ARMD-related topics, with 55 selected for funding. Increased participation from disadvantaged small businesses continues to be an emphasis. More complete information about the SBIR program can be found here.

Discussion

Committee members focused their discussion of this topic on measuring success of the SBIR program. The SBIR presenters explained that success is measured in many ways as each company has its own story to tell. And generally speaking the SBIR program – and its sibling Small Business Technology Transfer program, which also was briefly explained – has been a great success. The sense of the committee was that measuring success in more concrete, return-on-investment criteria would be helpful and resulted in a finding listed below.

Mr. Borghese asked how it is determined which mission directorate gets awards. The answer is that solicitations are designed to align with each directorate's strategy and needs, with each directorate providing SBIR with that guidance. The SBIR team also

looks for ways to solicit businesses that might provide help that is relevant across multiple directorates. Ultimately the goal is to solicit and fund the best technical efforts that both align with mission objectives and can be accomplished by small businesses. For ARMD this has meant increased emphasis on areas such as AAM and electrified propulsion.

Committee members asked about SBIR involvement with universities, which spring boarded into a dialogue about industry's ability to attract a workforce that provides expertise in every discipline, a persistent problem in the pipeline from universities to the workplace. This extensive dialogue resulted in a recommendation intended for the NASA Administrator to consider as an agency-wide consideration.

Finding

Note: This Finding is intended for the Space Technology Mission Directorate, which manages the SBIR program.

The Committee applauds the SBIR program which nurtures the growth of emerging companies. These small companies are very important to the supply chain in the development of technology for the next generation of aircraft, supplying innovation into the national aviation enterprise and bringing novel approaches to problem solving. The committee would look forward to seeing a metric for the NASA SBIR investment using standard return-on-investment metrics.

NASA Aeronautics Facilities

Mr. Ron Colantonio, acting director for the Aeroscience Evaluation and Test Capabilities (AETC) portfolio presented an overview of the facilities managed by AETC with a focus on wind tunnels. Mr. Colantonio noted the desire expressed during previous NAC Aero meetings that more information be provided about the research facilities ARMD had available for its use, how ARMD was sharing those facilities within NASA, who was paying for their use, and what was involved to enable outside entities to come in and use them.

Mr. Colantonio explained there are many types of agency-owned research facilities available to NASA and others. These include laboratories of all sorts, computer resources for advanced data processing such as with computational fluid dynamics, fixed and motion-based flight simulators, actual aircraft, and – of course – wind tunnels. When discussing the facilities managed by AETC on behalf of the entire agency, Mr. Colantonio said this referred only to 12 large wind tunnels with test cross sections of four-feet by four-feet or more and used for aeroscience research, or the study of aerodynamic flow or movement of an aircraft or rocket through an atmosphere. These include one tunnel at Ames Research Center in California, four at Glenn Research Center in Cleveland, and seven at Langley Research Center in Virginia. The $117 million line item in the ARMD budget under AETC is only for the operation,

maintenance, and upgrades to those wind tunnels – which he noted once again are available to other NASA mission directorates.

Mr. Colantonio noted there were more than 50 other smaller wind tunnels across the NASA field centers that are doing aeroscience research in one form or another, but none of those fall under the purview of AETC. Those are funded by other ARMD programs, mission directorates, or user fees.

Information about the AETC-managed facilities, including how to engage with NASA to conduct research there, is available online and promoted within the aviation research community, including at major conferences. Mr. Colantonio noted two key venues for this effort: the annual AIAA Sci Tech conference and participation in the AIAA Ground Testing Technical Committee. Another place for promotion and collaboration is with the Department of Defense and the National Partnership for Aeronautical Testing Alliance.

Mr. Colantonio described the process a potential user must follow to conduct research in an AETC wind tunnel. Variables for schedule and cost were presented, as was a break down of who uses the facilities between NASA, military, and commercial partners. He also noted that within NASA, about 80 percent of facility usage is for aeronautics, while the other 20 percent is for space.

Discussion

Mr. Mike Hirschberg asked if NASA has adequate facilities and support infrastructure to work with new vehicles, such as those expected to be designed and developed as part of Advanced Air Mobility (AAM) or other aircraft programs in the future. Mr. Pearce and Mr. Colantonio noted this could best be answered during a future NAC Aero committee meeting as part of a broader update on AAM.

Dr. Eric Allison noted from the charts there was a significant increase in NASA's use of the facilities as measured by hours and asked why that was so. Mr. Colantonio explained it was because of in the new funding models, i.e., covering a full shift worth of operating cost at each of the twelve AETC facilities and who was paying for things like consumables such as power. In the past such things were partially charged to a NASA project, but now are fully part of the AETC budget. While the total operating cost of the wind tunnel hasn't changed, the way the expenses are accounted for has. This has allowed the projects to do more work and thus inflate the number of hours tallied.

The new funding model and availability of funds also is enabling AETC to do more calibration and characterizing of its facility, which is improving overall research quality and allowing the wind tunnels to meet the "gold standard the rest of the world is trying to attain," Colantonio said.

Dr. Allison expressed an interest in if there was an effective way to measure success of a project in terms of a return on investment, especially in light of fixed and variable costs. He suggested it appeared there was a successful story to tell and wanted to be

sure there were ways to tell it such that new users would be enticed to bring their research to NASA. Mr. Colantonio noted their current criteria for success related to reducing risk, increasing knowledge, and improving testing with more innovative methods. A more financial-oriented approach has not yet been studied.

Finding

The Committee recognizes that NASA's facilities are a national treasure and applauds the high utilization of these facilities. Because of the diverse, dynamic aerospace initiatives underway and a new generation of air vehicles yet to be developed, NASA should continue to assure that the next generation of facilities, instrumentation and toolsets are available to address these needs.

Materials and Structures

Dr. Jimmy Kenyon, NASA's director for the Advanced Air Vehicles Program, and Dr. Nateri Madavan, NASA's acting deputy director for the Integrated Aviation Systems Program, provided an update to the committee on NASA Aeronautics' research with regard to materials and structures.

The overall goal of the Advanced Composites Project was to significantly reduce the amount of time it takes to go from concept and design to certification of a composite structure for use on an aircraft. Accomplishing this involved reducing the number of design iterations to reduce testing, as well as employing more rapid inspection and characterization methods, especially with the use of nondestructive testing. Improving the manufacturing process to make it more efficient also helps. Dr. Kenyon presented a number of examples of how each of these technical challenges were addressed.

Final review of the Advanced Composites Project is complete. Documenting results for inclusion in publications and industry handbooks – including the Composite Material Handbook 17 – is ongoing. To aid in transferring technology and knowledge from NASA to industry, an Advanced Composites Consortium was developed and includes more than 50 members.

Dr. Kenyon noted work completed on Vision 2040, which is looking at what the future holds for integrated modeling of materials and systems. The challenge is to develop the right tools, models, and methodologies for the different physics, parts, and kinds of materials that may be worked with – as well as their applications.

Dr. Madavan covered research completed between June 2019 and January 2020 related to an analysis of alternatives (AOA) for a future strategy for research into materials, structures and manufacturing (MSM) The AOA resulted in a recommended strategy that would look at unitizing complex structures, improving structural efficiency of airframe components, improving durability of conventional electrified propulsion systems, and manufacturing at a high rate.

A thorough presentation of MSM and the current industry situation, future needs, research methodology, studies made, and resulting engineering analysis and its documentation was given. This work is helping inform the next steps NASA must take in the area of materials and structures. Dr. Madavan noted there must be a balance across tools, technologies, and processes, while also balancing variables such as manufacturing rate, cost, and performance.

Dr. John Cavolowsky followed up with a discussion of the Vision 2040 document and its role in the computational challenges related to analyzing composite materials and modeling their use in future applications that range from large structures to handling high heat in the core of a jet engine. He provided several examples of where this could be helpful, including electrified aircraft propulsion or additive manufacturing.

All of this work sets the stage for a research project intended to determine how best to increase the rate at which composite materials, especially for large structures, can be safely and certifiably manufactured.

Discussion

Dr. Eric Allison asked if thought was given to scalability of these materials as they are considered for use on AAM-type vehicles versus larger scale vehicles, e.g., single-aisle subsonic transports. Dr. Madavan said that “in a deep sense” the answer was probably no. Consideration was given not so much to the scale of use but to the specific use; but the essence of the question was part of the analysis.

Dr. Karen Thole asked about supply chain issues, especially if the rate of composite manufacturing goes up, will there be supply of necessary materials available from other countries. There was no easy answer to this question other than an acknowledgement that it must be considered, especially in light of a world so quickly affected by the coronavirus pandemic.

The mention of electrified propulsion in Dr. Cavolowsky’s presentation sparked a substantial discussion on the availability and use of several different materials, both natural and man-made, in future electrified aircraft designs. As one example, the topic of exotic materials prompted a question about their use in creating power cells that operated at cryogenic temperatures. While these ideas are not being ignored, they also do not yet warrant the same kind of investment in applying strategic research dollars to their development. At the same time, committee members suggested that a future discussion of NASA Aeronautics’ approach to battery technology would be beneficial.

There were no Findings or Recommendations on this topic.

Public Comments

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

List of Webex Attendees

Committee Members
Dr. Eric Allison
Mr. John Borghese (Chair)
Mr. Andy Cebula
Mr. Darin DiTommaso
Ms. Lisa Ellman
Dr. Mike Francis
Mr. Mike Hirschberg
Dr. Greg Hyslop
Mr. Anil Nanduri
Dr. Tom Shih
Dr. Karen Thole

NASA
Richard Barhydt
Marc Birckbichler
Maxwell Briggs
Ralph Buehrle
Andrew Carnell
John Cavolowsky
K. Cramer
Ron Colantonio
Joyce Dever
Mary DiJoseph
Shawn Engelland
Catharine Fay
Michelle Ferebee
Bradley Flick
Jenn Gustetic
Eric Hendricks
Patricia Howell
Brian Jensen
James Kenyon
Cara Campbell Leckey
Nateri Madavan
Michael Madden
John Martin
Jon Montgomery
Gretchen Murri
Lee Noble
Bob Pearce
Cheryl Quinn
Jonathan Ransom
Irma Rodriguez
Stephen Smith
Tony Springer
Akbar Sultan
D. Thomsen
Ed Waggoner
Sandra Walker
Terryl Wallace
Anthony Washburn
Alicia Wesley
William Winfree
Richard Young

External Attendees

B. Harvey
Joan Higginbotham
Cat Hofacker
Joe Smith

Other Attendees (Affiliation Indicated if Provided)

Lee Olson (FAA)

Meeting Support (FedWriters)

James Banke
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