




U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

November 1, 2017

Dr. R. John Hansman, Ph.D.
Chair, Research, Engineering and
Development Advisory Committee
Massachusetts Institute of Technology


Dear Dr. Hansman:

Thank you and the Federal Aviation Administration's Research, Engineering and Development Advisory Committee for your June 14, 2017, letter providing recommendations on the Fiscal Year 2019 Research and Development (R&D) Portfolio. The important guidance generated during the REDAC Winter – Spring 2017 meeting is sincerely appreciated.

Various important topics discussed during this meeting included the future investigation of Cyber-Security issues, continued enhanced development of the National Aviation Research Plan, and engaged knowledge sharing and technical collaborations to promote successful outcomes of Unmanned Air Systems (UAS) Integration in the NAS. We will also continue, as suggested, to investigate and implement sound practices to conduct early benefits analyses necessary to prioritize R&D efforts throughout the FAA.

I have reviewed your recommendations and enclosed are the Agency responses to the various Subcommittee recommendations.

We will continue to incorporate the Committee's recommendations as we maintain an R&D portfolio that addresses safety, efficiency, and capacity of the air transportation system in an environmentally sound manner.

Sincerely,



Michael P. Huerta
Administrator

Enclosure

FAA Response to REDAC Recommendations for the Fiscal Year (FY) 2019 Research and Development (R&D) Portfolio

Subcommittee on Aircraft Safety

Finding: Propulsion Research Resource Targets - As modern aircraft have evolved to employ new and novel materials to improve efficiency and reduce life cycle costs the FAA has appropriately applied increased funding levels to conduct research in the area of advanced materials. The majority of this funding is being directed at aircraft composite structures. Engine manufacturers also continue to push for improvements in fuel economy and provide some of the enabling technologies to the advancements and benefits observed at the aircraft level. The funding levels associated with propulsion research continue to decline and are proposed at \$1.1M for FY19. This is nearly a 50% reduction from 2015 levels and compares unfavorably to the nearly \$7.2M planned for aircraft composites research.

The Subcommittee made a prior recommendation that the FAA consider funding of advanced inspection techniques, hot corrosion in nickel alloys, cold dwell fatigue in titanium and advanced computational methods for microstructure changes. These could be target areas for propulsion research in future years.

Recommendation 1: The FAA should evaluate the target funding levels for propulsion research with a goal of achieving a proper balance between aircraft advanced material and propulsion research budgets.

FAA Response: The FAA appreciates the Committee's assessment of propulsion research. In fact, some of the areas previously recommended have been supported; such as advanced inspection and cold dwell fatigue. However, propulsion sponsorship is based on potential certification and guidance needed for such areas. Since the limited research budget cannot support all areas of interest, only those requiring certification products are considered for sponsorship.

Finding: Unmanned Aircraft Systems (UAS) Implementation Plan - The Aircraft Safety (SAS) REDAC reviewed the 2019 proposed research portfolio and specifically research related to UAS. Several of the smaller items in the presented plan were questioned (e.g. hi-visual contrast, air carrier operational considerations) for their necessity and safety value in relationship to our understanding of other possibly conflicting research being conducted in the same general areas. As we have noted in the past it is still hard to get a complete picture of the total research scope related to UAS. It is especially difficult to understand the context of this proposed research without appreciating the full picture of FAA-funded UAS-related research given that overwhelming majority of the UAS research resources are grants to the UAS COE (i.e., ASSURE). Visibility to safety research requirements in other areas of the UAS implementation plan need to be reviewed as well.

Recommendation 2: Complete, update and make routinely available to SAS REDAC the UAS implementation plan so that we may get a clearer picture of the complete UAS research plan. The REDAC SAS would also like to routinely receive information about the UAS research being conducted by ASSURE. To better understand how the significant research

investment has benefited the FAA, we would like a briefing on the highlights of UAS research portfolio including ASSURE over the last two years and how this research has impacted FAA decisions with regard to UAS related regulations and other decisions.

FAA Response: The FAA appreciates the Committee's recommendation on the (Unmanned Aircraft Systems (UAS) Implementation Plan. The FAA continues to update the UAS Implementation Plan to document and coordinate internal FAA activities to enable the integration of UAS in the National Airspace System (NAS). This document is not intended for external release and will not be provided to the SAS REDAC. However, the FAA will continue to keep the SAS REDAC informed on its UAS research program and how research informs FAA UAS integration activities. This includes:

- The UAS Integration R&D Plan as outlined in Section 2211 of the FAA Extension, Safety, and Security Act of 2016 which describes the application of research internal and external to the FAA.
- The FAA's UAS R&D Portfolio, including research conducted in partnership with ASSURE, and with other research performers.

The FAA provided briefings on the ASSURE COE and the UAS R&D Plan to the Subcommittee at the fall 2017 meeting.

Finding: Fatigue Research Program - The REDAC Subcommittee on Aircraft Safety (SAS) received a deep dive briefing on the FAA's overall fatigue research program. The Subcommittee was impressed with the progress that parts of the program are making, particularly the research on fatigue genomics and biomarkers. However, the Subcommittee remains concerned that the FAA program is not taking a holistic approach to fatigue, which remains a widely acknowledged and pervasive risk to aviation safety. There is a concern that this may be a consequence of the reductions to the A11G BLI, which averaged 80% over the past three years.

Currently, there are no funded programs to detect and mitigate fatigue problems across the breadth of civil aviation -- other areas of aviation operations that have widely acknowledged fatigue concerns seem to have been overlooked. While aviation maintainers and air traffic controllers have been recently studied, other broad areas of aviation, including aeromedical ambulances, other commercial aviation, and general aviation operations are not being sponsored by any of the FAA policy holders and potential fatigue problems are not being addressed.

Finally, there is no convincing plan to analyze data from the Fatigue Risk Management Plan (FRMP) or Fatigue Risk Management System (FRMS), to determine the utility and cost- effectiveness of these important FAA fatigue initiatives.

Recommendation 3: The Subcommittee recommends an expanded fatigue research program that integrates the different policyholders, funding programs, and research organizations within the FAA. This program should provide surveillance for early indicators of fatigue hazards across aviation operations in the US. The integrated research program should facilitate identification and advocacy for needed research and ensure sharing of results across aviation domains within the FAA.

FAA Response: The FAA concurs with the Committee's finding, with the noted clarifications below, and intends to undertake the following actions to address the recommendations:

- The briefing provided to the Subcommittee on Aircraft Safety (SAS) focused on programs within the purview of the Aviation Safety portfolio that covered the flight deck operations, maintenance, and even aeromedical factors.
- Other fatigue efforts and activities relating to air traffic operations and technical operations, are not included under this aviation safety portfolio and were not briefed.

To address the SAS findings, we will conduct an internal technical exchange meeting with representatives from the other agency policy organizations and the results of this meeting will be presented at the spring 2018 SAS meeting.

Recommendation 4: The Subcommittee also recommends that a structured research program to assess the effectiveness of Fatigue Risk Management Plan (FRMP)/Fatigue Risk Management System (FRMS) in Part 121 passenger carrying operations be planned, given high priority for funding, and commenced immediately.

FAA Response: The FAA concurs with the Committee's recommendation to address the effectiveness of the FRMP/FRMS, and is planning to proceed once the FRMP/FRMS database has been established and populated with the appropriate data. The FAA provided a briefing on the FRMP/FRMS database at the fall 2017 meeting.

Subcommittee on Human Factors

Finding: Human Factors Portfolio Prioritization and Competencies - The Human Factors (HF) Subcommittee had a previous finding concerned about how HF research funding for NextGen and Unmanned Aerial Vehicles (UAVs) have significantly increased at the expense of core HF research areas like fatigue and training. The Subcommittee received a briefing on the prioritization process but it did not answer the question. Further Subcommittee discussion addressed how the HF research community manages its competencies whether organic, contract, or Centers of Excellence. The HF Community could not tell the HF Subcommittee how it assesses its technical competencies.

Recommendation 1: The Subcommittee recommends that the FAA HF research community establishes a process to define and assess its technical competencies in a Lead, Leverage, Watch, or similar construct to be able to determine the status of their ability to respond to changing FAA priority needs.

FAA Response: The FAA concurs with the Committee's recommendation regarding a process to define and assess its Human Factors technical competencies and has taken the following action. A process has been established to define and assess the Human Factors competencies. This assessment will be conducted periodically to determine the status of organic, contract, and academic expertise.

Recommendation 2: The Subcommittee recommends the FAA Human Factors (HF) community report out to the HF REDAC Subcommittee at its next meeting.

FAA Response: The FAA concurs with the Committee's recommendation on Human Factors portfolio prioritization and competencies. A briefing was made to the HF REDAC Subcommittee at the August 2017 meeting.

Finding: NextGen HF Research Support - The Subcommittee has made previous recommendations on the need for HF research in NextGen. The Subcommittee received a briefing and was very pleased with the HF communities' response and proposed research plan for FY19. However, due to current budget deliberations, this research was reflected as unfunded. The Subcommittee supports this proposed research.

Recommendation 3: The Subcommittee recommends the FAA assess the priority and funding of this HF NextGen research and report out the results at the next HF Subcommittee meeting.

FAA Response: The FAA concurs with the Committee's recommendation. A briefing was presented to the HF REDAC Subcommittee on the NextGen research prioritization and funding process at the August 2017 meeting.

Finding: Mixed-Capability NextGen Environment - For two years a recurring topic of discussion at the REDAC Human Factors Subcommittee meetings raised questions around Human System Integration (HSI) across multiple capabilities and operational changes converging at the human operator and users over the coming years. For NextGen to realize its planned operational benefits and capabilities, the human operators and users of the NAS, both on the flight deck and on the ground, must be willing and able to effectively utilize the combined suites of capabilities and operational changes they will be given by the system.

It is not clear to the Subcommittee whether, or to what extent, integrated assessments across the users and stakeholders of those combined suites of capabilities have adequately been done in order to reduce risk and ensure the delivery of benefits. Discussion around these questions inspired the Subcommittee to request that the FAA summarize what efforts have been made on this issue, so that the Subcommittee can provide appropriate and useful advice.

Recommendation 4: The Human Factors Subcommittee requests the FAA define the plan, including any research, for assessing the risks and alternative designs and procedural solutions related to the multiple capabilities across the NAS and increased complexity on the human role in Next Gen. This complexity includes the interaction of the various humans and systems as well as integrated human performance considerations on pilots, dispatchers, and controllers and traffic managers and report back to the HF committee on this research plan at the next meeting. This will enable the Subcommittee to assess the extent to which human-system collaboration concerns have been accounted for in the complex multi-capability of NextGen and to determine where more specific HF research may be warranted.

FAA Response: The FAA concurs with the Committee's recommendation and has undertaken the following actions to address the recommendation. The FAA has

initiated research to assess the impact of multiple capabilities across the NAS and the increased complexity of the human role in NextGen. A briefing on this research program was provided at the HF REDAC Subcommittee's August 2017 meeting.

Subcommittee on Environment and Energy

Finding: Noise Research - Noise research is making substantial progress in studies related to the understanding of impact of aviation noise on annoyance, sleep, health, and children's learning and in the planning of studies related to noise from supersonic aircraft, Unmanned Aerial Systems (UAS), and commercial space. Some of the impacts of noise have become barriers to the implementation of NextGen.

Recommendation 1: Since the results of some of these studies will generate significant public interest, the Subcommittee recommends the FAA prepare a public outreach plan to proactively manage this public interest.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions concerning ongoing studies related to understanding aviation noise annoyance and impacts of aviation noise on sleep, health, and children's learning. We are developing a public outreach plan to communicate noise issues more effectively using new and innovative ways to engage the public.

Finding: Aviation Environmental Design Tool (AEDT) - In response to the action from the last Subcommittee meeting, FAA provided clarity on improvements and further development needs for the Aviation Environmental Design Tool (AEDT). This will enable enhanced usability, improved airspace and airport design, continued support for analyses that support domestic and international decision-making. The FAA also identified key risks to AEDT development (e.g. availability of Base of Aircraft Data (BADA) 4 on airplane performance and noise) and has developed appropriate contingency plans.

Recommendation 2: The Subcommittee recommends the FAA continue the simultaneous (and balanced) development of usability improvements and enhanced features in the near term.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address its recommendation. We appreciate the Subcommittee's support for the continued development of the Aviation Environment Design Tool. AEDT is the required tool for domestic environmental analyses and has been at the core of our efforts to support the ICAO CAEP standard setting process. The new developments will allow AEDT to more accurately capture fuel burn in the terminal area, which is important for the benefits assessment of NextGen, and to improve AEDT's ability to calculate noise at levels below day-night average sound level (DNL) 65. Based on the Subcommittee's support, we will move forward with these efforts.

Finding: Continuous Lower Energy, Emissions, and Noise (CLEEN) Program - In partnership with industry, the Continuous Lower Energy, Emissions, and Noise (CLEEN) Program is maturing new technologies that will continue to show significant engine and aircraft performance benefits (fuel burn and operations improvement, noise and emissions

reduction). The Commercial Aviation Alternative Fuels Initiative (CAAFI) also continues to make significant progress in advancing alternative jet fuels as a private public partnership between the FAA and industry.

CLEEN and CAAFI are both very successful industry/FAA cost-share programs as is the Aviation Sustainability Center (ASCENT), the FAA Center of Excellence for Alternative Jet Fuels and Environment. Three quarters of Environment and Energy research funds are generating 100% plus cost matching from non-federal partners (CLEEN, CAAFI, and ASCENT). This leverages scarce FAA R&D funds to accomplish significant advances and improvements.

Recommendation 3: The Subcommittee encourages Public Private Partnerships like CLEEN, CAAFI and ASCENT programs to leverage resources and recommends that FAA should continue to prioritize robust funding for these programs.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address its recommendation. We appreciate the Subcommittee's recognition that the vast majority of the Environment and Energy R&D program has been leveraging resources from the private sector via public-private partnerships. CLEEN and ASCENT account for roughly three quarters of the RE&D Environment and Energy funding. As such, three quarters of the RE&D budget is generating 100% cost share. CAAFI does not have a cost-share requirement so the non-government funds going toward it have not been tracked over time. However, the effort has considerable industry support – especially from the airlines – and has been successful in directing efforts across the Federal Government. CLEEN, CAAFI, and ASCENT have all been successful because of their strong engagement with industry. We were excited to see that the work of the FAA and industry in CAAFI to advance alternative jet fuels was highlighted as a model for public-private partnerships in the UN Secretary General's 2016 report on Sustainable Transport.

Finding: Operational Research Program - The operational research program is an important and impactful program in the Environment and Energy portfolio. These projects are being worked (or planned to be worked) in collaboration with the FAA Air Traffic Organization (ATO), FAA NextGen Office (ANG), FAA Office of Airports (ARP), NASA, and MassPort.

Recommendation 4: The Subcommittee is pleased to see this research included in the portfolio after having been impacted due to the reduction and eventual elimination of F&E funds for this category. We encourage FAA to pursue this research while recognizing the potential for environmental benefits thru operational changes in all phases of flight.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address its recommendation. We are pleased with the collaboration that has developed around the FAA-MassPort-MIT effort to examine how noise could be changed and potentially reduced via changes in aircraft operational procedure concepts.

The collaboration with MassPort is part of our overall effort to accelerate the maturation of low noise aircraft technologies and noise mitigation techniques for arrivals and departures that could

reduce community noise exposure. While the CLEEN program will help to reduce noise from new aircraft, we know that we also need to find ways to reduce the noise from the current fleet of aircraft while maintaining safety. The FAA-MassPort-MIT effort is using tools that were developed by MIT (as a part of the ASCENT Center of Excellence) with funding from FAA to evaluate procedures and procedure modifications with noise reduction potential. We have also begun efforts with UPS to identify and evaluate operational procedure concepts that could reduce noise, including those being developed in the FAA-MassPort-MIT effort. Based on the Subcommittee's support, we will continue to conduct research to identify procedures and procedural changes that could mitigate noise from the current fleet.

Finding: Staff Vacancy Expansion - The workload of FAA AEE staff has been increasingly driven by CO2 standard setting, global market based measure (CORSIA) development, non-volatile particulate matter standard settings, supersonic aircraft, and a broad range of noise work. Staff vacancies within the organization are a big concern. These vacancies need to be filled. A lack of skilled personnel could delay completion of critical projects, and in the long term, prevent achievement of the core FAA mission, including improving efficiency of aviation system.

Recommendation 5: The Subcommittee recommends that the FAA place a high priority on filling staff vacancies to manage the AEE portfolio and support the expanding workload.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address its recommendation. We understand the Subcommittee's concern about staff availability within the Office of Environment and Energy. The work load in AEE has indeed increased due to increasing concerns regarding aviation noise and the continuing international efforts. AEE have had good success over the years in filling positions with highly qualified environmental professionals. This is due in part to the students and staff that have been trained as a part of PARTNER and ASCENT, the FAA Centers of Excellence for environment and alternative jet fuels. We are currently in the process of developing hiring plans in accordance with administration guidance.

Finding: Collaborative Research Topic Priorities - The REDAC Environment and Energy Subcommittee had believed that water issues were proactively being addressed by the Airports and Safety REDAC Subcommittees, but learned that water research was not a priority on the 10- year research plan for the Airport Technology Research (ATR) Program.

Recommendation 6: REDAC Subcommittees Designate Federal Officials (DFOs) should communicate amongst each other and develop a list of research topics that they believe are priorities but feel is within the domain of a different subcommittee.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address its recommendation. Representatives from Environment and Energy, Airports and Safety portfolios have met to discuss water research items that are being addressed via the Airports and Safety Portfolios. These discussions have led to a better collective understanding of the water research that is being conducted by the FAA. In addition to airports and safety, much research on water issues is also being undertaken by the Airports Cooperative Research Program (ACRP). At present, it appears that water issues are being handled appropriately.

Subcommittee on NAS Operations

Finding: Operations Concept Validation - The Subcommittee received briefings on Operations Concept Validation Modeling (BLI 1A11) and Operations Concept Development & Infrastructure (BLI: 1A01C). The Subcommittee found the briefings to reflect the high quality of the briefers and the excellent research and development work carried out in both areas. The Subcommittee notes that operations concept validation activity represents one of the most valuable programmatic risk mitigation investment tools available to the FAA for advancing the state of the art in airspace operations. Early identification and resolution of operational and integration issues yields tremendous cost avoidance during implementation.

The strategic context motivating FAA and NAS users' investment in ops concept validation includes both near and far term considerations. These considerations include the accelerating pace of change affecting all aspects of the Agency's NextGen portfolio. Examples include the pace of advancement in connected aircraft capabilities, increased confidence in investment decisions on the part of NAS users to complement FAA investments, community sensitivity to terminal airspace noise resulting from improved arrival and departure management schemes, as well as advancements in aircraft and airspace automation systems and concepts, among others.

The Committee observes that the priority given to Ops Concept Validation projects has been in decline over recent years. In particular, the work that was performed under BLI 1A11 was moved from a cross-cutting, enterprise-level F&E activity to within the NextGen portfolios. There, this activity competes directly for funding with the day-to-day pressures of NextGen implementation. Portfolio managers are very much focused on program implementation and thus it is very difficult for them to properly prioritize this work, particularly since the work should be done well in advance of implementation. The Subcommittee notes that the result has been a significant decline in the level of effort devoted to operational concept validation across the FAA.

Recommendation 1: The Subcommittee recommends that the FAA increase the priority given to Ops Concept Validation investments, particularly those that are closer to implementation, as the most effective and affordable means of strategic risk mitigation in a time of rapid technological and business concept advancements affecting the NAS. The savings in time and implementation cost more than offset the relatively low cost of increased concept validation.

FAA Response: The FAA concurs that operations concept validation activities constitute one of the most effective programmatic risk mitigation investment tools available to the Agency for advancing cutting-edge airspace operations. The FAA agrees with the Subcommittee's recommendation that priority be given to those operations concept validation investments which are closer to implementation, as the most effective and affordable means of strategic risk mitigation in a time of rapid technological and business concept advancements affecting the NAS. Therefore, the FAA will be consolidating concept validation work from individual portfolios into a cross-cutting, enterprise-level F&E funding line. This approach will be reflected in the Agency's FY 2018

budget formulation process. The FAA has in place internal mechanisms by which it identifies and prioritizes those key areas that will receive prioritization over others. This is a key strategic decision-making process that also takes into consideration the fluid nature of the budget formulation process and out-year planning activities captured in the FAA's capital investment planning documents and enterprise architecture.

General Observation:

The Runway Incursion Reduction Program (RIRP) has been developed to address the NTSB recommendation A-00-66 (July 6, 2000), which states:

“[The FAA should] require, at all airports with scheduled passenger service, a ground movement safety system that will prevent runway incursions; the system should provide a direct warning capability to flight crews. In addition, demonstrate through computer simulations or other means that the system will, in fact, prevent incursions.”

In 2015, the Subcommittee found that this NTSB recommendation failed to address the cost/benefit assessment that is required as part of an investment decision and recommended that the FAA should estimate the potential benefits of the Runway Safety Assessment (RSA) and Small Airport Surveillance Sensor (SASS) projects under RIRP.

In response to this recommendation, the FAA conducted a causal factor analysis and technology evaluation study under the Runway Incursion Prevention Shortfall Analysis (RIPSA).

Finding: The Runway Incursion Prevention Shortfall Analysis (RIPSA) - The RIPSA project was intended to (1) identify the causal factors associated with runway incursions at small and medium airports and (2) identify feasible runway incursion prevention technologies to address those factors. The Subcommittee has previously noted that feasibility includes technical performance and cost/benefit. While the RIPSA analysis has examined the estimated cost and general technical performance of candidate technologies, the project did not estimate the benefits pool available to runway incursion prevention technologies as recommended by the REDAC in the fall of 2015. The Subcommittee finds that the FAA cannot perform cost-effective research and development of runway incursion prevention technologies in the absence of any knowledge of the potential benefits pool that such technologies target.

Recommendation 2: The FAA should not invest any more funds in Runway Incursion Prevention technologies until they have estimated the benefits pool as previously recommended by the REDAC. Further technology development in these projects should be contingent upon an initial positive cost/ benefit estimate. REDAC looks forward to reviewing this benefits estimate in its fall 2017 meeting.

FAA Response: The FAA appreciates the Committee's view on stopping the funding of runway incursion prevention technologies until benefits have been estimated. However, we are not able to pursue this recommendation at this time for the following reasons: The objectives of the Runway Incursion Reduction Program's (RIRP) is to research, prototype, test and conduct operational evaluations of potential runway incursion reduction technologies to

assess their technical capability and operational feasibility. If the systems meet the technical requirements and prove to be feasible, only then, in accordance with the FAA's AMS process, does the RIRP proceed with activities pertaining to cost and benefits estimation. The lessons learned during the test and evaluation of the technologies determine what section of the benefits pool the system can claim, and are used to build a potential business case for an acquisition decision by the FAA.

The Runway Safety Metric, currently under development, will serve as the cornerstone to quantify the benefits of all future runway safety systems, included those being investigated by the RIRP. As this metric is still being developed, the estimation of the benefits pool is a future activity in the roadmap for the Runway Safety Group; one that will be applied to all applicable runway safety systems and technologies.

The RIRP and the Runway Safety Group continued discussing this approach with the REDAC NAS Ops Subcommittee at the fall 2017 meeting to keep them apprised on the development of the FAA Runway Safety Metric and RIRP's progress towards a potential business case/benefits estimate.

Subcommittee on Airports

Finding: Cross-cutting Strategic Research - The Subcommittee supports the FAA's efforts to update its research strategy, goals, objectives via the NARP, particularly with respect examining how the FAA's various research programs can more effectively address research that cuts across multiple research areas (e.g., air traffic system operations, airports, safety, and environment). Such a cross-cutting approach to research has proven to be successful in the area of airport noise research involving both the Airport Technology Research Program and Environmental Research Program.

Recommendation 1: The Subcommittee recommends that the FAA seek additional opportunities to utilize cross-cutting approaches to research and development that draw on the skills and expertise from multiple research programs. In addition to aircraft noise, research areas that are ripe for this approach are (1) Cyber-Security, (2) Unmanned Aircraft Systems (UAS), (3) Time-Based Flow Management (especially the surface elements of TBFM), (4) management of operations during irregular operations such as airport construction and adverse weather conditions, and (5) aviation safety management.

FAA Response: The FAA concurs with the Committee's finding and is undertaking the following actions to address its recommendation(s): The FAA's Airport Technology Research Branch (ATR) will continue to seek opportunities to leverage other research programs, and when needed, will partner up with others (government agencies, trade associations, private industry, etc.) to enhance the ATR research portfolio. For instance, unmanned aircraft systems (UAS) research needs are constantly evolving, and the ATR branch is currently fully engaged with others at FAA, airports, and industry to define airports-related UAS research and is planning to execute its research as part of a larger government-wide UAS research portfolio.

Finding: Airports Research Prioritizations - The Subcommittee placed a high priority on research into new categories of aeronautical vehicles--UAS and commercial space vehicles specifically--and their potential impacts on airport safety, operations, and infrastructure. Other high priority research areas are (1) pilot perception of light emitting diode (LED)-based airfield lighting systems (RPA S5), (2) aircraft rescue and firefighting agents (RPA S3), (3) runway incursion prevention technologies (RPA S1), and (4) noise standard development/refinement based on the findings of ongoing noise annoyance data collection (RPAs N2-N5).

Recommendation 2: The Subcommittee recommends that the FAA Office of Airports place a high priority on research associated with the research areas that include (1) pilot perception of light emitting diode (LED)-based airfield lighting systems (RPA S5), (2) aircraft rescue and firefighting agents (RPA S3), (3) runway incursion prevention technologies (RPA S1), and (4) noise standard development/refinement based on the findings of ongoing noise annoyance data collection (RPAs N2-N5), as well as, UAS and Commercial Space.

FAA Response: The FAA concurs with the Committee's finding and is undertaking the following actions to address its recommendation(s): The FAA's Airport Technology Research Branch (ATR) with concurrence from the FAA's Office of Airports is placing high priority on research areas identified in Recommendation #2.

Finding: Research Programs Completion Projections - Although it understands that the timelines for research projects are inherently uncertain, the Subcommittee would like to have a better understanding of when research projects are expected to conclude and get periodic updates regarding their schedule for completion as the projects progress.

Recommendation 3: The Subcommittee recommends that the FAA provide information regarding the estimated schedules for completing new research projects and provide schedule updates regarding ongoing research projects in its briefings to the Subcommittee.

FAA Response: The FAA concurs with the Committee's finding and is undertaking the following actions to address its recommendation(s): The FAA's Airport Technology Research Branch Research Program Area (RPA) managers will provide estimated schedules with planned starts and projected durations of major projects in their Research Program Areas.

Finding: Research Completion Priorities - The Subcommittee finds that priority should be given to research projects that are close to completion (i.e., issuance of final research findings and/or conclusions), particularly those that have promising practical applications.

Recommendation 4: The Subcommittee recommends that the FAA prioritize research projects that are close to completion such as the regarding trapezoidal grooving project (RPD S.1.4).

FAA Response: **The FAA concurs with the Committee's finding and is undertaking the following actions to address its recommendation(s):** The FAA's Airport Technology Research Branch (ATR) with concurrence from the FAA's Office of Airports is constantly reviewing the list of research projects that are ready to be undertaken and for which results can be obtained in a timely manner, and plans to fund these as soon as budgets allow to proceed. For example, the final FY 2017 ATR budget was recently received and ATR proceeded with funding of the trapezoidal grooving project in the summer of 2017.