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The Honorable J. Randolph Babbitt
Administrator
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Dear Administrator Babbitt:

A handwritten signature in dark ink, appearing to read 'R. John Hansman'.

On behalf of the Research, Engineering and Development Advisory Committee (REDAC), I am enclosing the summary findings and recommendations from the spring meetings of the standing REDAC Subcommittees (Aircraft Safety, NAS Operations, Environment and Energy, Airports, and Human Factors).

The full committee also made the following general observations:

Prioritization Within the Research & Development Portfolio – It is anticipated that the difficult federal budget environment will create pressure to reduce the funding of research and development within the agency. In this environment it will be important to take a strategic approach to evaluating research and development activities in order to prioritize those activities which are most critical to the agencies mission or to the staged implementation of NextGen. The REDAC offers its assistance if it can be helpful in this process.

Complexity of NextGen Research and Development Plans – The need to identify the high priority (critical path) research and development activities within NextGen highlights the need for a clear high level Research and Development plan that articulates the critical NextGen needs and links them to the R&D portfolio. The REDAC understands the challenge of defining such a plan for a complex system such as NextGen but has previously noted that the FAA plans and roadmaps do not articulate a high level vision and are so detailed and complex that they are intractable. This makes it difficult to evaluate if the necessary R&D is being accomplished, how R&D results will be used and which elements could be deferred to accommodate budget constraints. The REDAC reiterates its recommendation that a high level R&D plan be developed from the existing more detailed plans and enterprise architecture to articulate the R&D vision and identify the critical path of R&D for NextGen.

Concern on Level of Technical Expertise in Key Areas – As noted in prior recommendations the FAA has a unique need for expertise in key areas such as critical software and digital systems and human factors both for certification and acquisition and it has been difficult to build and maintain the technical capabilities of the agency in these and other critical areas. The REDAC notes some limited progress (e.g. the reported hiring a chief scientific and technical advisor for software after a 5 year search) but *reiterates its now standing concern* that there has been inadequate progress in developing the core competency and technical workforce in this and other key areas. The REDAC recommends that a strategy be developed and executed to improve the ability of the FAA to compete in the market for highly desirable talent.

We hope that these observations are useful to you and the agency. The REDAC stands ready to assist if there is any way we can help in our common objectives of improving the safety, efficiency and capability of the air transportation system.

Sincerely,

A handwritten signature in dark ink, appearing to read 'R. John Hansman'.

R. John Hansman
Chair, FAA Research, Engineering and Development Advisory Committee

Enclosure

**Research, Engineering and Development (REDAC)
Subcommittee Recommendations on the FY 2013 R&D Portfolio**

Subcommittee on Airports

Finding: The Subcommittee is very concerned over potential actions to move the Airport Technology Research Program and the Airport Cooperative Research Program from the AIP appropriation into the R, E and D appropriation. Both programs have grown and matured with the resources and attention provided by the Office of Airports (ARP) and the AIP appropriation. It would be a setback to put these programs back into annual competition for R, E and D funding with the other Lines of Business.

Recommendation: The Subcommittee believes it is critical to maintain this successful management and funding approach and recommends that FAA continue to support these programs in the AIP appropriation. Should, however, that prove unsuccessful, the committee recommends that FAA take administrative action to assure that the Office of Airports is designated to provide primary management control of these two important airport research programs.

Finding: The Subcommittee would like to see more detailed milestone charts for projects instead of the standard “quad” funding charts.

Recommendation: The FAA should develop an example of an improved project tracking approach with milestones that will enable the Subcommittee to better understand the deliverables and project schedules. This should be briefed at the next Subcommittee meeting.

Subcommittee on Environment and Energy

Finding: One of the most promising areas of environmental research continues to be in the area of the development and certification of alternative aviation fuels. Such research will lead to reductions in emissions of CO₂ and air quality pollutants, and will promote energy security by reducing dependence on sources of foreign oil.

Recommendation: The ongoing CAAFI support and alternative fuels research effort must continue to be funded. At the present time, much of the alternative fuels research funding is included in the Agency’s NextGen Research Engineering and Development (RE&D) account, an account that is in jeopardy under current budget scenarios. Faced with this situation, the Subcommittee recommends continuing CAAFI support through the “Core Research and Development” fund category to ensure at least a measure of funding in this area in the event of any future budget cuts.

Finding: Continued Operational Research is necessary to support the implementation of NextGen initiatives.

Recommendation: In order to be able to implement NextGen initiatives, continued funding must be available for continued Operational Research. Such research leads to both increased efficiency and improvements in environmental performance. A recent example of the importance of this research is the so-called “N Control” surface movement research at Boston’s Logan Airport in which aircraft were selectively held at the gates to reduce time idling on taxiways as well as reduction in fuel burn and emissions. This initiative was hailed by everyone from airlines to air traffic controllers and may be ready for more general use in the near future. The Subcommittee recommends that such research activities, which lead to early implementation possibilities, be given a high priority in any necessary budget reductions.

Finding: In the area of technology research, the ongoing CLEEN program to develop new aircraft and engine types with better environmental profiles shows great promise. However, since this program is dependent on funding appropriated after 2008, the entire program would be in jeopardy if Congress cuts funding to 2008 levels.

Recommendation: The Subcommittee recognizes the funding threat to the CLEEN program, but recommends, even in a worst case scenario, that the CLEEN office within the Office of Environment and Energy be maintained to work with NASA on possible continuing projects and to be available should future increased funding return. While the implementation of CLEEN projects is relatively far off, completely abandoning the program will push technology-based environmental initiatives too far into the future.

Finding: United States leadership in the international community continues to be an important environmental priority, especially as the International Civil Aviation Organization (ICAO) debates the setting of a worldwide aircraft CO2 emissions standard.

Recommendation: The Subcommittee strongly recommends that funding necessary to support ICAO activities continue. More specifically, the Agency’s modeling activity (AEDT and APMT) should be supported to enable informed judgments to be made on all possible ICAO scenarios.

Finding: A few ongoing Environment and Energy projects should be given a relatively low priority and scaled back to permit continued activity in higher priority areas.

Recommendation: The Subcommittee recommends that work in the Aviation Climate Change Research Initiative (ACCRI), which concentrates on non-CO2 climate effects, be deferred until a more robust funding stream becomes available. Similarly, research initiatives related to leaded AvGas should be scaled back and noise research should focus on policy issues, with field surveys to determine annoyance levels deferred until more funding becomes available.

Finding: Current versions of the FAA Reauthorization Act provide that projects in the Airport Cooperative Research Project (ACRP) cannot be funded using AIP funds. If enacted, these provisions would require ACRP projects to be funded out of the core R&D pool of funds, thereby competing for funding with other, higher priority, items.

Recommendation: The Subcommittee recognized the problem of having ACRP projects compete with other funding priorities in the core RE&D pool. There was, however, no unanimity on what action could be taken to address the issue. The Subcommittee did agree, however, that it is important for the FAA to be aware of this problem.

Subcommittee on Human Factors

Finding: The Human Factors Subcommittee was briefed on the Flight Deck and ATO Core and NextGen Human Factors programs. We found that their FY 2013 research portfolios and their underlying structure were appropriate to FAA's mission and covered the area of need as understood by the subcommittee, with the exception listed in the subsequent Finding. In particular, the Subcommittee was impressed that other entities within the FAA are actively coordinating with, or seeking human factors input from, specialists in human factors including the FAA Human Factors Research and Engineering Group (HFREG, AJP-61), especially related to NextGen activities. We were also pleased that technically-knowledgeable personnel have been recruited to support these efforts.

Recommendation: We recommend that the human factors community within FAA continue their work in the areas presented, and that the funding continue at (at least) current levels in both programs.

Finding: The Human Factors Subcommittee recently received a briefing on the AVS prioritization of research, and we applaud the efforts of AVS to provide a consistent method to prioritize critical R&D dollars. However, we were severely dismayed that the process results in a 90% reduction of FAA human factor core RE&D funding for contracts in FY13 relative to recent levels, far greater, for example, than the ~1.5% reduction of overall AVS funds from FY12 to FY13, and does not allow for the continuation of on-going research areas. This level of funding will effectively end research in critical areas that cannot leverage NextGen funding and research (e.g., research into human factors in maintenance, including fatigue risk management), and may have long-term effects on the maintenance of facilities such as those at the Civil Aerospace Medical Institute (CAMI).

We are extremely concerned with the results of this prioritization effort and the negative trend of human factor R&D funding. Human factors remain a significant factor in the majority of aircraft accidents and incidents and is a priority in the FAA Flight Plan. In addition, external reviews of FAA Programs consistently support increased funding for human factors. Thus, this reduction is inconsistent with FAA's documented research priorities.

Recommendation (a): This subcommittee strongly recommends the FAA Associate Administrator for Aviation Safety (AVS-1) conduct a thorough review of the recent prioritization results relative to pressing safety concerns and strategic goals. The subcommittee also strongly recommends that the FAA reverse the negative trend in contract funding of core human factors R&D to instead establish a funding level that is appropriately balanced with the core funding needs for human factors R&D, particularly in areas that cannot leverage off NextGen research. To not do this, we believe, will jeopardize the safety of both current operations and future operations involving new technologies and operations with foreseeable human factors concerns.

Recommendation (b): Two changes should be made within the administration of the AVS prioritization process. (1) Increased transparency is recommended for how the research requirements initially established by all the TCRGs are evaluated and selected, so that the final prioritization of the requirements, and the metrics assigned to each research requirement, are clear and not perceived as arbitrary. Specifically, at a minimum the initial and final AVP ratings used to select amongst the research requirements recommended by the TCRGs should be provided, with additional feedback as to the basis for the ratings. This information should be provided for funded and unfunded requirements. (2) There have been wide swings in the prioritization of requirements compared to allocations of contract funding to some of the BLIs. Of note here, the funding level for flight deck human factors varies dramatically across Fiscal Years 2011, 2012 and 2013. The AVS prioritization process needs to ensure the stability in funding between fiscal years required to foster quality research, to prevent the unnecessary application of short-term research methods where longer-term evaluations are required, and to prevent unnecessarily complication of research planning and execution, and to examine the effect of between-year changes in upcoming research funding in terms of the impact on planned human factors research.

Finding: The Human Factors subcommittee was first briefed on the NextGen Weather Technology in the Cockpit in August 2010 at which point it was in the process of replanning in response to earlier recommendations made by other subcommittees. Since the August briefing, significant changes have additionally been made in senior personnel. Although the briefing provided in this cycle (March 2011) provided more detail about specific human factors research activities and interaction with the community, the overall recommendation made in Fall 2010 was not fully addressed: i.e., the vision, intended deliverables and anticipated customers are not consistently and clearly articulated, including the appropriate role of government in this area, and the project should be evaluated as to whether it has the appropriate level of resources and staffing.

Recommendation: The previous recommendation provided Fall 2010 remains open. *As in earlier recommendations, the Human Factors Subcommittee continues to strongly recommend to the Director of Research and Technology Development that the vision, intended deliverables and anticipated customers be clearly articulated. The role of government research in this area needs to be carefully examined, as should whether an isolated program called Weather Technology in the Cockpit is more appropriate than broader inclusion of weather concerns in other NextGen programs including the HFREG flight deck program. An expert review of the project is warranted. Following that, the project should be resourced and staffed appropriately to its goals and intended impact, as judged relative to budget cuts in other NextGen research areas.*

Finding: We were very pleased and impressed with the presentation given by Kathy Abbott regarding the recent multi-year study completed by the Performance Based Operation Advisory Rulemaking Committee/Commercial Aviation Safety Team (PARC/CAST) Flight Deck Automation Working Group. Many of the study findings discussed appear to have great importance and significant implications for several activities, including the design and functioning of flight deck automation and its use, pilot training, air carrier policies and operations, and system certification. Thus, we are concerned that this long promised report and its findings have not yet been distributed or made available to the larger aviation community.

Recommendation: We strongly recommend that the FAA compel the completion of the review process for the final report of this work and its findings, and disseminate the report to the international aviation community as quickly as possible to allow for timely response to its safety implications.

Subcommittee on Aircraft Safety

Finding: The Aircraft Safety Subcommittee recognizes that as the nation's air transportation system moves to NextGen, the demands for digital systems will continue to grow. The comprehensive deep dive presentation in Software and Digital Systems Safety (SDSS) found FAA to be responsive to previous subcommittee recommendations. While it is evident that FAA is pursuing and executing the needed R&D in this rapidly evolving area, the subcommittee remains concerned that FAA in-house capability lags behind the needs. Further, it remains unclear to SAS how the knowledge gained from this work will be applied to improve FAA's ability to support policy, regulation, and certification of new digital system designs.

Recommendation: The subcommittee recommends that at the next meeting (August 23-25) the FAA present its plan to further build and maintain a capability to manage the breadth of SDSS R&D activities, beginning with the investments in R&D and moving the various R&D products into support of certification. This plan should include a review of the technical and project management skills resident in FAA research personnel, the approach to leveraging outside capability to obtain missing skills, and FAA management's plan to maintain those skills. Second, it should include an overview of past and current SDSS research efforts, their requirements, relevant milestones, level of performance, results, and an outline of how the results will be used to support policy and certification. Third, the plan should lay out a roadmap for the management of potential R&D to support future needs in complex, digital systems.

Finding: The Aircraft Safety Subcommittee supports the research being performed in the area of Terminal Area Safety and finds it is well structured and relevant. The stall recovery training research is progressing well with clear recognition of the degree of difficulty in accurately simulating this little explored and data lean flight regime. The subcommittee would like to see action taken to assure very close coordination between this research and that of the Flight Control Mechanical Systems area as synergy opportunities exist. The runway friction research aimed at reducing runway excursions needs to be complemented with continued research into how to prevent other causes of excursions such as unstable approaches. Performance Based Navigation (PBN) research is progressing well in a critical area with more to be done.

Recommendation: The subcommittee recommends that future PBN research include analysis of the performance improvements of NextGen satellite-based navigation solutions (e.g., RNP, SBAS, GBAS) over classic navigation sensors (e.g., ILS). This analysis, which should include RNP to GBAS approach and landing operations, should result in data that can be applied to regulatory criteria that establish operational advantages (e.g., lower landing minima) for these NextGen capabilities.

Finding: The Aircraft Safety Subcommittee is pleased to note that FAA has taken steps to establish a Volcanic Ash research approach to better define the operational requirements for the reporting and forecasting of volcanic eruptions which in turn would support the establishment of international guidance for operations in the vicinity of volcanic ash.

Recommendation: The subcommittee again recommends that the Volcanic Ash Research Program be expanded to include the identification of ash tolerance levels for aircraft, engines, and passengers.

Finding: The Aircraft Safety Subcommittee notes the steady funding decline in the Flightdeck/Maintenance/System Integration Human Factors (HF) research program. The Subcommittee understands that the decline in funding is due to the relatively low ranking of the sponsor requirements during the prioritization process. As explained, many of the requirements lacked sufficient detail to clearly establish the sponsor need, outcome, implementation plan, schedule, and other supporting information. The Subcommittee discussed whether or not the AVS Prioritization Process was somehow defective or otherwise contributed to this result. It was concluded that the Process is effective and did not inadvertently contribute to the low ranking of the requirements. The Subcommittee understands that it is likely that the final portfolio will include additional funding for two other requirements on maintenance fatigue and ADS-B human factors research, which would increase total funding to approximately \$900,000. Furthermore, the Subcommittee understands that AVS is aware of this situation, will thoroughly review the aviation safety human factors research needs, and ensure that the FY 2014 human factor requirements have the necessary detail. AVS has committed to review the status of these actions during the human factors deep dive presentation scheduled for the summer meeting on Aug. 23-25. The Subcommittee finds that these steps are appropriate and has no recommendation regarding the HF program at this time.

Finding: The Aircraft Safety Subcommittee is encouraged by the efforts of the FAA to continually improve the aviation safety portfolio development process. To optimize the allocation of a limited R,E&D budget, AVS has improved the process by which safety research requirements are defined and prioritized. The Subcommittee makes favorable note of the use of committed, multi-year funding for a portion of the portfolio and very strongly endorses the stated AVS commitment to require regular reporting of research progress against a well documented deliverables plan. This approach will greatly assist AVS in deciding, annually, whether to continue to fund, redirect, or cancel the multi-year research efforts.

Finding: The Aircraft Safety Subcommittee is pleased to note that the Weather Technology In the Cockpit (WTIC) research deliverables are to be progressively released to enable timely industry response and the subcommittee looks forward to seeing an updated WTIC program schedule.

Finding: The icing program continues to have several high priority programs with limited in-house expertise that rely heavily on partners and grantees/contractors for program management. Although recruitment has not been successful, the SAS commends FAA's efforts to add a research meteorologist and aerodynamicist to the research team and notes the importance of continued FAA support to strengthen the in-house capability. **Action:** The Aircraft Safety

Subcommittee requests that progress in this area be reported during the Fall 2011 review of the Icing Program.

Finding: The filling of the recently created position of Chief Scientific and Technical Advisor for Vulnerability Discovery and Safety Management Programs is a good first step in ensuring that the ASIAs Program continues to be a safety tool to identify emerging risks before they become potential safety issues.

Finding: The Aircraft Safety Subcommittee remains encouraged by the work being done on Aircraft Catastrophic Failure Prevention. The work being done is highly relevant and continues to enjoy strong industry support. The Subcommittee suggests this research group re-examine fleet safety data to identify the remaining propulsion safety issues deserving of their attention.

Finding: The Fire Research and Safety Program continue to be relevant, well managed and directly responsive to current and emerging requirements.

Finding: Center of Excellence for General Aviation Research (CGAR) continues to be an example of how cost sharing arrangements, complemented by competent management and leadership, can be an effective way to conduct relevant research and advance the knowledge of FAA staff.

Finding: The prioritization process of research proposals has resulted in a substantial decrease in funding for the Aircraft Cabin Environment Research (ACER) Center of Excellence. The Aircraft Safety Subcommittee noted the success that FAA has had in obtaining industry collaboration for the development and upgrading of NextGen research laboratories and test beds. If the FAA believes that the ACER Center of Excellence will be needed to support future, not yet identified, research and operational requirements, the Subcommittee suggests that the possibility of obtaining increased industry support be explored.

Finding: Advanced Materials/Structural Safety (Includes Advanced NDI Methods for Composite Structures) The Aircraft Safety Subcommittee again finds that the FAA with a very small but clearly expert core staff, continues to leverage the work and expertise of other government agencies and the industry on critical safety issues. The focus on developing standards and guidance based on theory and practical experience, and the emphasis on providing usable guidance to FAA staff and others makes this a valuable example of how to do things right. The Subcommittee again recognizes that staying ahead of the composite aircraft fleet is critical to ensuring future continued operational safety and the SAS endorses the proactive approach to composite structure maintenance and inspection.

Finding: The Subcommittee agrees that the two tasks proposed to address Loss of Control (LoC) accidents are of high priority and should be pursued. The Subcommittee is also aware that requirements are still being defined outside of the FAA within joint government/industry activities such as the Low Speed Alerting Advisory Rulemaking Committee. Consequently, the Subcommittee is concerned that the current proposed funding may not be at levels to effectively address requirements forthcoming from the government/industry subject matter experts who are currently studying the issue of LoC. In addition the Subcommittee feels that better collaboration

with the aircraft manufactures will be needed as the FAA studies methods to address stall departure identification, recognition, and recovery technologies.

Recommendation: The FAA AVS sponsors for the Flight Control Mechanical Systems should work to ensure close coordination with other ongoing activities such as the Low Speed Alerting ARC to ensure their findings and recommendations are factored into the next fiscal year funding cycle.

Finding: The FAA continues to work on providing better guidance for maintenance credit determinations for rotorcraft within the current advisory circular. **Action:** The Aircraft Safety Subcommittee requests that a roadmap and schedule of Health and Usage Monitory System (HUMS) deliverables be included for review at the Fall 2011 meeting.

Finding: The Aircraft Safety Subcommittee believes that rapidly transitioning research results into guidance and regulatory material to support ongoing certification of advanced rotorcraft (BA 609 and S92F) should be given higher priority over required follow-on research activities. **Action:** The Subcommittee requests FAA to include a schedule of early Fly by Wire/Fly by Light deliverables along with a timetable for issuance of certification guidance material, for review at the meeting on August 23-25.

Finding: The Structural Integrity Metallic project was found to be a well defined and through research activity leading to improved regulations and standards. This project is a good example of self funding through industry cost sharing and engineering support.

Finding: The Electrical System research project is in line with where the industry is going and supports the need for FAA to have informed regulators.

Finding: The Aircraft Safety Subcommittee was pleased to note that FAA agreed to review Unmanned Aircraft Systems Research (UAS) research requirements and the research plan in an attempt to match the integration timeline to the needs of the UAS community and looks forward to reviewing progress made and revised milestones in the update of the notional UAS-NAS integration roadmap. **Action:** The Subcommittee requests that FAA include the revised roadmap for review at the meeting on August 23-25.

NAS Operations Subcommittee

Finding: After the September meeting, the REDAC observed that there does not appear to be a clear high-level R&D plan for NextGen, and NASOPS specifically recommended the FAA clarify research priorities for the REDAC briefings using a framework based on the FAA's Solution Set taxonomy. The FAA's response letter indicated that "the Office of Research and Technology Development (AJP-6) and the NextGen I&I Office will work together to identify the best approach to articulate the NextGen research and development activities using the plans and roadmaps that have been developed." This NASOPS meeting was a good first step in this direction. The subcommittee received a briefing from Paul Fontaine on the Acquisition Management System (AMS) and the role of R&D in the Concept and Requirements Definition stage. We were pleased, also, to receive a briefing from Michelle Merkle stating that the updated

mid-term NextGen Conops was to be issued this spring, and that concept development and validation guidelines have been developed for AMS that will be used to assess each service as to its maturity and readiness to move toward a final investment decision within AMS. Since the FAA will be using these guidelines to perform its own assessment as part of AMS, presenting the results to the subcommittee should impose a minimal burden.

Recommendation: The Subcommittee recommends that the FAA continue to emphasize and effect internal coordination between AJP-6 and I&I in order to provide an information exchange with NASOPS of all R&D in selected focus areas up to at least the Initial Investment Decision in the AMS. Additionally, NASOPS will review the updated NextGen Conops when it becomes available, and recommends that the FAA present its assessment of the status of NextGen RE&D in the selected focus areas relative to the concept development and validation guidelines that it has developed for the AMS. This will enable the subcommittee to assist the FAA with advancing its RE&D portfolio by making specific recommendations.

Finding: Michele Merkle again provided excellent presentations on NextGen Solution Set Ops Concept Development and Validation. The members once again found the presentations and the work itself to be exemplary of the research and development so essential to the success of the FAA NextGen effort. Michele's Separation Management presentation for High Altitude included the following critical attributes: a clear focus on the potential benefits of the research, a willingness to face the difficult but necessary effect of the research on both pilot and controller roles, and avoidance of overinvestment in a full SRMD for a concept when a preliminary safety analysis was all that was required at an early stage.

Recommendation: The Subcommittee continues to see the Ops Concept research as exemplary in nature and the work itself as critically important, and quite possibly underfunded. We recommend that the FAA continue to ensure funding for these activities.

Finding: The Subcommittee has recommended in the past that the FAA work to define the role of public-private partnerships (PPPs) in accelerating NextGen deployment. The history of successful PPPs in accelerating the maturation and deployment of innovations in the marketplace is rich with examples of relevance to the challenge the nation faces in NextGen. The FAA has made sporadic use of one-on-one government-industry partnerships, for example, the JetBlue, USAIR, and related projects. However, these projects do not represent the opportunity for industry-wide acceleration of NextGen capabilities through PPPs. The SE2020 contracts may offer a first opportunity in this regard.

Recommendation: The Subcommittee strongly encourages the FAA to conduct a rigorous evaluation of the opportunity for NextGen acceleration through PPPs. The Subcommittee volunteers to form a working group in support of the FAA's exploration of these opportunities and to provide the FAA with lessons learned in the design and operation of PPPs.

Finding: Programs in the FAA NextGen implementation portfolio that are reviewed by NASOPS frequently contain transformational goals that may face resistance or opposition from FAA employees, including but not limited to controllers. A specific example from this meeting is the Staffed NextGen Tower – Small and Medium Airport (SNT-SMA) phase. It appears to the

committee that the inhibited dialogue between the controller workforce and the NextGen program leaders significantly limits the valid exploration of such advanced concepts for improvements in operational efficiencies, safety, and cost.

Recommendation: In situations where the research goals have confronted employee organizations' concerns, these concerns should be included in the Subcommittee review process. Recommendations to the Administrator and the Congress on NextGen implementation by REDAC should account for such concerns.

Finding: NextGen capabilities, and the benefits associated with them, will not be realizable if strategies to implement them do not address transition and mixed equipage considerations. Few capabilities requiring flight operator equipage or other investment can provide a solid economic justification for the creation of exclusionary airspace. Transition and adoption periods span multiple years, resulting in a mixed equipage environment that must be dealt with both from the ANSP and the flight operator perspective. Flight operators are not willing to serve as "early adopters" of capabilities requiring avionics or other investments if there is a significant delay in achieving benefits until achieving a high-level of equipage. FAA concept exploration has begun to address this issue through the re-examination of assumptions for equipage in validating operational suitability and through the consideration of "best-equipped, best served" policies for some NextGen capabilities.

Recommendations:

- a. FAA should evaluate current NextGen concept and procedure definition and validation efforts to ensure that extended, multi-year mixed equipage scenarios are both operationally feasible as well as attractive to flight operators that make investments in advanced NextGen capabilities. In particular, concepts need to ensure that benefits to operators with higher levels of equipage are proportionally higher than those accrued to operators with less capability. Concepts and procedures should not unintentionally disadvantage equipped flights or operators due to greater difficulty in managing lesser-equipped traffic.
- b. As part of the concept validation of capabilities requiring avionics not currently available, FAA should work with its customers to better reflect customer perspectives on the business case, quantify the differential benefits of equipage, and assess whether these benefits are sufficient to justify operator investments.

Finding: The briefing by Joe Post on the FAA's System-Wide Airspace Concepts (SWAC) model was very good. The progress by the FAA in implementing the modeling capability needed to evaluate mid-term NextGen capabilities appears quite good. However, it is not clear that FAA decision-makers use SWAC broadly in an *a priori* fashion to inform their investment decisions by performing relatively rapid cost-benefit tradeoff analyses of new technologies or capabilities, as opposed to *a posteriori* studies to justify assumptions, and could be scaled up to make better use of this important quantitative tool.

Recommendation: The FAA should embrace the use of SWAC and its continuing improvements for informing prioritization of investments within NextGen implementation plans.

The FAA should increase its use of SWAC as part of the suite of tools that it uses to generate a quantitative underpinning for the NextGen benefits story.

Finding: The NextGen Weather Operations briefing was the best aviation weather briefing the committee has received. The connection between source weather data associated with the National Weather Service 4 Dimensional Cube, and FAA systems NWP, NNEW, and the provision of source data for CoSPA from the Cube were evidence of the excellent connection between research and the NextGen operations concept. The primary graphic showing connections from base forecasting and observational data, through the cube, to FAA distribution systems, and to FAA and AOC operators was also excellent. Finally, the committee found that the part of the briefing associated with CoSPA (the new NextGen Storm Forecasting Product) was excellent. Member John McCarthy felt that this product was the best produced by FAA research-to-applications effort since the days of the microburst warning system.

Recommendation: The Subcommittee recommends carrying on the excellent progress of this program as currently constituted. The FAA should ensure that the NOAA and NWS observation and forecast community remain fully involved in FAA atmospheric forecast and modeling efforts, and that where appropriate, these be operationally implemented at the National Weather Service, and have the results provided on the NWS 4 D-Cube.

Finding: The briefing on the Weather-Technology-in-the-Cockpit (WTIC) activity was the third in two years to NASOPS. Earlier briefings of WTIC did not articulate a clear set of objectives or a connection to NextGen requirements and the Subcommittee recommended that the FAA correct this shortfall. A critical part of NextGen is the establishment of a Common Operating Picture (COP), which is shared by pilots, controllers, AT managers, and AOC dispatchers. Weather information is clearly part of this COP and the FAA has the objective to ensure that pilots have access to weather information in the cockpit to achieve NextGen safety and efficiency objectives. The most recent presentation demonstrated a greater understanding of issues that need to be addressed with respect to WTIC and a Common Operating Picture (COP) among controllers, TFM personnel, dispatchers, and pilots.

Recommendations:

- a. For WTIC to evolve in a credible manner, the project needs to clarify just what the NextGen objectives are that it is attempting to meet. Specifically, if the objective of WTIC is to establish the essential cockpit weather information required to achieve NextGen Operational Improvements, the Subcommittee recommends that the FAA show that a cost-effective methodology is being undertaken to identify them. On this basis, the developing WTIC effort should be evaluated to see whether it is cost effective to continue with this program relative to other key needs for NextGen research.
- b. As part of the evaluation process, the Subcommittee recommends that the FAA consider any specific cockpit weather information requirements to support NextGen Trajectory Based Operations. Additionally, the Subcommittee recommends that the WTIC consider the impact of weather in the cockpit on pilot training requirements, particularly in the General Aviation environment.

Findings: FAA and NOAA are evaluating MPAR as a possible future replacement for primary surveillance and weather radars. FAA's interest is relative to airport surveillance radars (ASR-8, 9 and 11) and Terminal Doppler Weather Radar (TDWR), while NOAA is evaluating MPAR as a potential replacement for the WSR-88D (NEXRAD).

MPAR offers the possibility of reduced cost-of-ownership for future US national primary radar networks. In addition MPAR may result in enhanced mission performance capabilities for multiple US Government agencies. Capability enhancements include non-cooperative aircraft height measurement, wind turbine clutter mitigation and more rapid volumetric scanning of severe weather.

To fully realize these benefits, FAA, NOAA, DoD and DHS must coordinate the development of MPAR technical requirements and must develop joint concepts of operation and synchronized investment decisions. There appears to be good coordination between FAA and NOAA. DoD and DHS, however, have not been effectively engaged in MPAR research.

Recommendations:

- a. The FAA should establish a coordinated MPAR research program with other agencies including NOAA, DoD and DHS. This activity should develop integrated technical requirements, complementary research investments and a synchronized schedule for investment decisions. The Joint Planning and Development Office (JPDO) would appear to be an appropriate entity to lead this coordination process, but other governances are possible.
- b. The FAA should continue its MPAR research in order to clearly substantiate technical viability and a positive cost-benefit prior to its 2016 Initial Investment Decision milestone. The objectives and expected outcomes of the FAA's MPAR research program should be clearly articulated and the agency should identify key issues that are not being addressed owing to resource limitations. In particular, the FAA should show how its research plan meshes with that of partner agencies (currently NOAA) to address the full spectrum of MPAR implementation issues including technology, concept of operations and system level architecture.

Finding: The NAS Operations Subcommittee was pleased to see the extent to which FAA is funding research into Human Factors, as evidenced by the FAA's thorough overview of Human Factors work sponsored through the RE&D budget line item. This work appears to cover a wide range of activities. The NASOps subcommittee was not able to determine from the briefings the relative importance of the tasks presented, nor how these specific tasks were tied to key NextGen needs.

Recommendation: FAA should integrate human factors research with overall concept validation efforts, rather than planning these as separate activities. In addition, FAA should better articulate

and provide relative criticality information regarding the underlying shortfalls or risks associated with specific human factors research tasks.

Finding: The briefing on the Joint Planning and Development Office (JPDO) status left the Subcommittee concerned about its current role and future contribution to NextGen. Because of the new alignment of the office, it appears that an assessment of scope, strategic approach, and connection to the FAA should be conducted.

Recommendation: NASOPS requests a briefing from the JPDC Director and/or Deputy Director at the next meeting addressing JPDO future objectives, plans and priorities, and how the office connects to the FAA, other government agencies such as NASA and industry stakeholders, especially in the research arena.

Finding: The budget briefing by Mike Gallivan was exemplary for its inclusion of budget lines for all NextGen related work, including the Solution Sets, but no detailed information for FY13 and on was available for this meeting. NASOPS appreciates Mike's commitment to getting the information to us when it is available.