

Minutes

Research, Engineering, and Development Advisory Committee (REDAC)

Subcommittee on Human Factors (HF)

Summer/Fall 2022

August 16-17, 2022

Meeting location | *Remote (due to COVID-19)*

Purpose: Review the Federal Aviation Administration (FAA) RE&D accomplishments and expectations for FY22, and research plans through FY24, and advise FAA on future research

Tuesday, August 16, 2022

Opening Remarks | Presenter Shelley Yak, FAA Director of William J. Hughes Technical Center, REDAC Co-Chair

Dr. Barbara Holder opened the meeting and turned it over to Shelley Yak, Tech Center Director. Shelley thanked the committee for their attendance and hard work with the additional tasks. She provided the current COVID status of the Tech Center and a high level history of the budget. She discussed the focus on Messaging, Planning and Strategy and the importance of communicating what is being done and why. She touched on the National Aviation Research Plan (NARP) and how the 5 goal areas assist with the planning and strategy of the research.

She provided insights to move towards a Strategy Map which would focus on what are we doing in the near term, mid-term and long term. Her desire is to get to a place where the activities that the industry works on in the near, mid and long term, can influence what the FAA works on and vice versa. Shelley thanked the committee for their extra work and insight for the Unmanned Aircraft System (UAS) Advance Air Mobility (AAM) research plan. Dr. Bill Kaliardos asked if there are some principles on who should lead such topics, the FAA or Industry. Shelley stated it depends on the technologies that are being implemented by the Industry and if we have the regulatory obligation on how to implement them. There are roles for the FAA and roles for Industry.

Welcome / Introductions and Update from Full Committee Meeting | Presenter Dr. Barbara Holder, Embry-Riddle University, HF Subcommittee Chair

Barbara welcomed the subcommittee for attending virtually. She walked thru the objective and purpose of the meeting and the Five Subcommittees under REDAC. The term Findings and Recommendations (F&Rs) were described and she asked the subcommittee to write F&Rs as clear and simple as possible so people outside the Industry can understand them. This meeting will include the special task of reviewing the UAS/AAM Integration Research Plan. Barbara sent the plan out for review prior to the meeting. The feedback will be discussed on day 2.

She provided a quick summary of the Full REDAC Meeting from Winter/Spring 2022. Discussed was the movement within the agency such as: retirees, new hires and management changes. The REDAC membership process is still being worked. The key take away from the Full REDAC meeting is the increased interest in sustainability, commercial space, and UAS/Beyond Visual Line of Sight (BVLOS). Barbara thought the subcommittee would be interested in the briefings that stood out from NAS Ops, Energy and Environment, and Aircraft Safety. The minutes from these presentations are on the REDAC site if interested.

Barbara reviewed the F&Rs and Actions from the last meeting.

Dr. Bill Kaliardos, Designated Federal Official (DFO) reviewed the agenda and the meeting was called to order.

Overview of Budget Line Item (BLI) plan for A11G, Flight Deck HF Research || Presenters *Rany Azzi, FAA Flight Standards R,E &D Program Manager; Kathy Abbott, FAA Office of Aviation Safety, Chief Scientific and Technical Advisor, Flight Deck Human Factors*

Rany Azzi provided a briefing on FAA Flight Deck/Maintenance/System Integration Human Factors Research Program. Rany noted there were 61 research proposals (drafted) and 32 will bid for funding.

Kathy Abbott spoke on the overall scope of the Flight Deck/Maintenance/Systems Integration Program and how its requirements are covered by the needs of the Office of Aviation Safety (AVS). She went over the 10 Operational

Capabilities (OC) in the A11G BLI Plan for FY23-FY28 and pointed out that some of these OCs are driven by requirements in the Aircraft Certification Safety and Accountability Act that was signed in 2020. She provided examples of the topics where the research is used in the formulation of Advisory Circulars (AC).

Bill asked about the consolidation of the NextGen and Core portfolios. Chris DeSenti (MITRE) asked if there will be any delineation between near term and far term research. Phil Smith (The Ohio State Univ.) asked if it's treated as one large uniform budget or whether there are focus areas within in it and how is the decision made.

FAA Budget Briefing | Presenter Elizabeth Delarosby, FAA RE&D Budget Analyst, Manager

Beth provided an overview of the FAA budget slides. Maggie Ma (Boeing, Maintenance HF) asked for the definition of Continuing Resolution (CR). Chris asked for clarification and Beth provided additional details. Bill checked to ensure the slides would be available to the subcommittee. Beth reminded everyone that the current FAA reauthorization expires in September 2023.

Bill opened the floor to questions on the brief. Chinita pointed out that a subcommittee member posted this question in the chat: Is 2023 FY or calendar? Beth clarified that it is Fiscal Year. Maggie asked about the workforce development project and how the funding would be used in 2023, would it be used for current pilot/maintenance personnel or future personnel development? Beth explained that it is to get new entrants into the programs.

Flight Deck Human Factors Research, NextGen | Presenter Dr. Victor Quach, FAA NextGen Air/Ground Integration Portfolio Manager

Bill introduced Dr. Victor Quach to brief the subcommittee on the NextGen Air/Ground Integration Human Factors research, which is also known as "NextGen Flight Deck Human Factors Research". Victor provided an overview of the program before briefing the FY22 highlights from the research accomplishments and ongoing and anticipated research in FY23 and beyond.

Barbara had a question on the extensible traffic management (xTM) project, is it AAM or air transport? Victor answered that it was air transport. Barbara needed clarification, is he stating that the current air transports are highly automated or is this in anticipation of future aircraft? Kathy mentioned some of both, it's broad.

Bill asked if the subcommittee would like to discuss Victor's Air Ground presentation now or after the Core Flight Deck presentation. Barbara asked if there were questions on the portfolio and if there were any potential F&Rs.

Phil asked for more description on the category of dynamic aerospace trajectory management negotiation. Chris DeSenti asked about timelines on Information Automation systems and Connected Aircraft for Flight Crew Displays and Interfaces Research; is the flight management work connected?

Katrina Avers (FAA-Flight Deck Research Manager, Civil Aerospace Medical Institute (CAMI)), had a question in the chat: Victor, you mentioned some of these projects being funded in FY25. I thought this was the last year for this Budget Line Item (BLI). Thanks for any clarification. Victor clarified how the funding would work after FY26.

Wes Olson (MIT Lincoln Lab) had a question in the chat: Is there a separate budget line for flight deck displays and interfaces for advanced concepts such as simplified pilot operations or optionally piloted freighters? Kathy answered that there is a different operational capability but it isn't a different BLI.

Barbara had a question on resilient behaviors under the Human Error and Complex Systems Research. Kathy said that it is resilient in the broadest sense, and not resilient engineering.

Katrina commented in chat: So the ones represented under FY25, have been prioritized under the Core BLI for FY25. In other words, in the future these will be combined and represented by Chuck. Thank you for simplifying. Appreciate the complexity associated with change. Victor's answered: Yes, future work will be under Chuck's BLI.

Break

Flight Deck Human Factors Research, Core | Presenter *Dr. Chuck Perala, FAA Core Flight Deck HF Portfolio Manager*

Bill introduced Dr. Chuck Perala to brief the subcommittee on the Core Flight Deck Human Factors research, which is also known as “Core Flight Deck”. Chuck began with an overview of the program before briefing the FY22 highlights from the research accomplishments and ongoing and anticipated research in FY23 and beyond.

Kathy made a note on the Electronic & Distance Learning-Current Training Programs and Emergent Technologies. The Emergent Technologies is focused on using Virtual Reality (VR) for pilot training. Barbara asked her for more information on that. Kathy talked about the work University of Central Florida is doing using the technology in different aspects of pilot training. She volunteered to give a briefing on this at a future meeting. Barbara agreed that she would like that. Barbara brought up the number of training providers and companies that already do this training and asked what is being done in this training that isn’t already currently being done? Kathy explained further that this is intended to provide data to help decide what to approve and what not to approve and understanding what the technology can do and what are its limitations.

Chris had a question on Emerging Trends and Air Ambulance Operations and 5G interference with altimeters. Phil asked about Rotorcraft Pilot Visual Scanning behavior.

Barbara asked about pilot state monitoring and how it is tied to reduced crew. Is this intended to be more broad (wearables, etc.) or is it tied to reduced crew ConOps? Suggested they talk offline to discuss this further. Kathy said the initial baseline is intended to see what the technology is capable of.

Barbara complimented the new format of the slides because they are much easier to follow and they link the timeline to the objective.

Flight Deck Recommendations | HF Subcommittee-*Preliminary flight deck HF research recommendations by HF Subcommittee*

Barbara opened the discussion up to potential F&R’s.

Phil spoke on continuing the theme of cross communication among the different projects (manned and unmanned). He felt there are more opportunities for Air Traffic Control research interacting and coordinating with Flight Deck research. Not necessarily an Action but something to talk about. Barbara asked how ATC research accounts for consequences of new airspace procedures on pilots. Bill brought up the prior research examples and agreed with Phil. Dave McKenny (MITRE) also agreed with Phil and Barbara, he thought we have a good understanding of all the projects and the research being done and how they fit into the big picture. He thought this should be commended in some way, perhaps as an F&R.

Barbara is pleased to see projects that were recommended in the past are starting to show up. Dave agreed that the subcommittee is making a difference because they (FAA) are listening and understanding the importance of it. He also brought up the Emerging Technology brief, on the OC 1 Slide-Improving Pilot Training, Procedures and Operations-Training and Operational Effectiveness. Barbara asked for a briefing on that as an Action.

Bill reminded the subcommittee about the F&R discussion later on Augmented Reality (AR)/VR so this action might not be necessary. Barbara made note of the potential for an action.

Barbara brought up the Info Centric NAS and connected aircraft. She asked for a better understanding of what that is. She proposed a briefing related to this, and mentioned the overview provided by Tara Gibson (FAA NextGen HF Manager) at the last subcommittee the last meeting, but would like more information.

Potential ACTION: Update on the details of the Info Centric NAS; what it is and what it means for the research portfolios.

Bill thought there would still be questions after the additional Info Centric NAS presentation but they can provide another briefing on it.

Cheryl Quinn from NASA said they are doing something along the lines of Info Centric NAS and finding out how the information flows, how to secure it and how it's used. There is a lot of research to be done and she would be happy to talk about it more, if the subcommittee is interested. She also had a question on the scope of the supersonic aircraft, is that from the FD perspective? Chuck answered it's about managing fatigue effects on pilot performance in the supersonic operations and they would have more details next year. Dan commented on cognitive deskilling, and automation.

Dave had a question, from the FAA viewpoint what is the relationship between Human Factors and Human Performance within the BLIs? Kathy said Human Factors is anything that affects Human Performance. Human Factors is a broader term. Dave wondered if the people doing the research are using the same definitions or if they are defining it differently based on their studies of research. Kathy hoped they are not and they encouraged the use of Human Factors as the broader term.

The subcommittee discussed Sarah Ligda from CAMI's question on Skill Degradation vs Graceful Degradation and how they intersect.

Maggie Ma added this link and comment to the chat:

I remember seeing this presentation on graceful degradation in Air Traffic Management (ATM):

https://www.futuresky-safety.eu/wp-content/uploads/2018/11/17-%E2%80%93-Edwards_Graceful-degradation-in-ATM.pdf

Maggie had an observation on the Maintenance (OC3) topic. What has the FAA research considered regarding the guidance from the ICAO, the Competence based training assessment? She also had a question on how the "methods to Identify Root Causes of Human Factors Risks in Maintenance Programs" work and how human performance is being measured for maintainers. Kathy mentioned that there is some disagreement with the competencies (from the competency based training) defined through ICAO and she doesn't see FAA adopting those.

Maggie asked if Human Factors is a consideration in Cabin Crew and Cabin Safety. Kathy replied that the Cabin Safety Specialist do work with Human Factors. Cathy Swider (FAA Aircraft Certification HF Specialist) said that she can inquire about more information on Cabin Safety research if Maggie would like. Maggie will follow up with Barbara if this is something the committee can share.

F & R #1-AVS HF Research Roadmap-Hannah Baumgartner

Bill recapped the F&R for this topic, which was from the previous meeting (March 2022). The subcommittee recommended the AVS Human Factors Research Roadmap development continue and for it to be sent to AVS for signature. The Action Item for tomorrow will discuss the Air Traffic Organization (ATO) side. Bill asked that discussion on that wait until then.

Hannah Baumgartner briefed the subcommittee on the AVS Human Factors Research Roadmap update. Bill asked if there were any issues with management approvals, Hannah replied that the hurdles have not been too big to pass. Barbara asked Hannah about the timeframe for the sign off on this; she anticipates starting the formal process this month.

Kathy said it is difficult to tell and she is reluctant to give an estimate. Hannah expressed her appreciation for the support from REDAC for this effort.

Barbara asked Chinita if this F&R should be left open until it's completed. Chinita said no unless you wanted some type of follow up, in which case you would write a new F&R.

Barbara recommended to the subcommittee to close this F&R.

F & R #2-Immersive Technologies for Training Update-FAA

Bill read the F&R to the subcommittee, which was from the previous meeting (March 2022). Bill said this discussion is to give an overview of what research is being done across the Agency related to AR/VR Immersive Technologies.

Bill brought up the University of Central Florida (UCF) research on the subject. Kathy said this phase, started in 2019, is VR not AR. They are looking at the currently available technology and the companies that use it, which has seen a huge increase in the last year or so. The intent is to give us (FAA) information that we can use to develop guidance on what pilot task can be trained in this way and which tasks should not be. The report for the first phase is due to come out in September 2023. They expect to start running subjects this fall and will work with airline and air carrier pilots after that. Bill asked if Auburn University is also doing something related. Kathy said it is a different look at how the training should change to accommodate the emerging pilot workforce.

Bill provided a quick overview on the other things going on outside of the Human Factors Division in the Agency; such as weather related decision making and the work CAMI is doing with Aircraft Maintenance on the use of AR/VR for maintenance tasks.

Angela Campbell gave an overview of the research projects related to VR, AR, XR (extended reality) at the Tech Center. Barbara mentioned that Embry-Riddle had acquired a device to replace the visuals of their CRJ simulator and would like to stay in touch to continue to discuss this topic.

Bill asked Dr. Ian Johnson (FAA NextGen, Weather-in-the-cockpit) to talk to the subcommittee about the Weather side to AR/VR. Dr. Johnson introduced Dr. Lori Brown from Western Michigan University to present her brief on the research on AR. They have also started work with VR using collaborative platforms to create a VR experience focusing on Weather.

Brett Torrence from CAMI presented an overview of research on AR/VR, for both air traffic equipment maintenance and aircraft maintenance side, with Extended Reality and their collaborative efforts with other government agencies. Dan mentioned a market survey and industry day coming up soon and asked if it is open to the public. Brett will check and provide that information.

Bill asked if this was enough information to close the recommendation. Barbara has a better understanding of the scope of the work being done. The technology is advancing rapidly and it is an important area that can drive a change in training. She suggest more urgency and coordination across the teams. She felt the recommendation has been satisfied and opened up the floor for comments. Chris Desenti had a comment on Training issues with getting pilots enough training time on the simulator. Bill would like to close this recommendation for now and perhaps reissue more if needed. Barbara agreed with closing this F&R but would also like to have a discussion on creating a new one.

F&R is closed.

F & R #3-UAS Beyond Visual Line-of-sight (BVLOS) Update-FAA

Bill reviewed the F&R for UAS/BVLOS, which was from the previous meeting (March 2022). The FAA UAS Integration Office doesn't have updates and are still responding to the rulemaking recommendations and perhaps at the next meeting the subcommittee can ask for an update.

The next topic, Operational Approval of Control Stations for BVLOS. There is no specific research plan to address this topic yet, which is the second part of the recommendation from the last meeting. Bill asked for a discussion, if the guidance needs to be different than what we already have for manned aircraft and what we need to prepare for in the UAS world. Phil needed clarification that this is concentrating on small UAS. Bill asked what research is needed for operation approval of control stations that is different than what they already have for Flight deck approvals for manned aircraft. Oscar Bocanegra (FAA, Flight Standards) agreed that more research needs to be done from the Aircraft Evaluation Division particularly with the larger UAS aircraft. They have some idea of the type of research they want to get involved with and what results they would like to see. Eric Carroll (FAA, Flight Standards) said one example is that applicants are starting to move away from 1-to-1 concepts on their ConOps, and they want to move to multiple (1-to-many) with optionally piloted aircraft as well. What would that cockpit look like? From their standpoint they need more research.

Bill opened the floor for discussion and questions for Eric and Oscar, and they offered to answer any questions from the subcommittee via email. The subcommittee discussed the topic further.

Bill asked for inputs. Barbara asked Oscar and Eric about Amazon moving forward pretty quickly with this and if there are other companies moving in a similar timeline. Eric replied yes, they are starting to put forward proposals now. Oscar encouraged contacting them with any further questions or comments. Barbara asked for any other questions or comments.

Barbara recommended for this F&R to be closed.

Homework Assignments for Day 1:

Potential F&Rs:

Barbara asked the subcommittee if there were any potential F&Rs they would add. She did not have any but required more time to think about it and would listen to the discussions tomorrow before proposing anything. Bill said there are no F&Rs that need to be crafted at this point. Barbara requested for all to review the FAA UAS/AAM Integration Research Plan for tomorrow's meeting.

Barbara closed the meeting for the day.

End of Day 1

Wednesday, August 17, 2022

General Review of Day 1 | All

Barbara began the meeting by revealing the dates for an upcoming meeting, August 29-30, 2023. She reminded everyone that F&Rs can be something positive, something they need to continue doing, as well as gaps. She asked if there were any questions or follow ups from yesterday. Chris DeSenti asked a question about the Budget briefing slide regarding altimeters interference, has anyone looked at any potential hazardous misleading information on flight deck from a Human Factors aspect. Bill mentioned meetings AVS had but wasn't sure of the outcome and will inquire during the meeting offline. Barbara suggested to proceed with the briefings.

ATC Enterprise Human Factors Research, NextGen | Presenter *Karl Kaufmann, ATC Enterprise HF Portfolio Manager*

Karl Kaufmann briefed the subcommittee on the NextGen Enterprise ATC Human Factors research. He began with an overview of the BLI before briefing the FY22 research accomplishments and ongoing and anticipated research in FY23 and beyond.

Phil added this to the chat: Can we get a copy of the TMU DM report?

Phil spoke on coordinating with Tanya Yuditsky who was doing some similar research. Karl mentioned that he continues to manage Tanya's research to examine the effects of Trajectory Based Operations on Traffic Management Unit, as well as a related effort by MITRE. Both were addressed in his portfolio presentation.

Barbara asked if they have identified the things that should be automated versus what can be automated. Is there research purposed to address that? Karl replied that there will be. Chris DeSenti asked if the question is being asked broadly to the human experience or something specific such as the Info-Centric NAS. Karl said the Info-Centric NAS is provoking it. He also asked about the human readiness work, is the attention to provide a framework for understanding how to apply human readiness to automation. Karl said that the human readiness work is more about what HF work has been done to make sure the final product fits the needs of a particular user group; not what should be should or should not be automated or how to prevent deskilling. Chris asked if they are in the process of addressing what does and doesn't need to be automated, Karl will bring it into the next Project Level Agreement he works on after this one. Barbara made a note to circle back on this. Dan made a comment about HF not actually being the drivers for the design for NextGen.

Chris had another question about the human readiness levels. Eddie Austrian spoke on HRLs in response to Chris's questions. Phil Bassett had a comment about their work with regional decision making.

ATC Human Factors Research, Core | Presenter *Dan Herschler, ATC Core HF Portfolio Manager*

Dan Herschler briefed the subcommittee on the Core ATC Human Factors research. He began with an overview of the BLI before briefing the FY22 research accomplishments and ongoing and anticipated research in FY23 and beyond.

Barbara had a question about the VR training, however Dan clarified that this is not VR training, this is virtual training such as zoom and other web based applications. Phil commented on how broadly the term "systems" is being used. He also wanted to point out how great it is to see their input help in providing guidance and support in the creation of these projects. Bill reminded everyone that some of the topics here will also be presented at the HF Review next week. Barbara commented on the broad set of areas being looked at and how well Dan has summarized how things are going in his slides.

Barbara opened the floor up to the subcommittee to discuss what has been presented and to make Recommendations.

Bill asked if they had any F&Rs so far. Barbara has notes for potential F&Rs; a positive one about the direction of the portfolios and how the inputs the subcommittee provided are having an impact.

Barbara desired briefings on some of the topics discussed yesterday such as:

- Competency based training for Maintainers and how to measure human performance
- Supersonic aircraft/pilot controller interactions
- Workload for remote and piloted vehicles in the one to many and how that would be addressed
- Automation and ATC traffic management design is Human Automation interaction is researched or understood before implementation. Are we automating the right things?

No committee members proposed an F&R so Barbara encouraged the subcommittee to share their thoughts.

Chris had a question on how to contrast what we have already learned with humans and automation in ATC and where we want to go. Phil followed up with asking what the opportunities are in the near future versus the proposals that want to change the whole nature of ATC. How far ahead do we make the recommendations and what do we focus on.

Chris felt there should be something, perhaps an artifact, to say what that phased approach would be.

Dan spoke on Human Automation Teaming led by Vicki Ahlstrom (FAA Tech Center, NextGen HF researcher) that defines what the future research roadmap looks like.

Wes Olson (MIT Lincoln Lab) added this to the chat: UK NATS project on Artificial Intelligence/Machine Learning for ATC - <https://www.turing.ac.uk/research/research-projects/project-bluebird-ai-system-air-traffic-control>

Chris asked if it was focused on the Info Centric NAS. Dan said that it is not the specific focus but it is a driver. Chris suggested an update on this issue. Dan mentioned Vicki is getting close to providing a brief. Kenneth Allendoerfer mentioned that she will speak next week at the HF Review.

Phil mentioned the update to the Human Factors Design Standard with the focus on automation. The guidance statements are pretty specific, so should they have been broader. What are the thought processes there? Barbara mentioned the multiple levels to this topic and it should be addressed strategically. Dan requested to get this discussion into the conceptual level so they will think of the potential consequences from a human performance perspective. Bill thought guidance can be created to be used in the first phases of FAA acquisitions, in which human factors guidance is lacking. Phil summarized that Dan was making two points; what are the HF considerations when you're looking at new ways of doing business and how do you make sure the research you're doing has an impact. There was a question on phone about the ConOps level and what change had to take place to get HF to the table. Currently, HF specialists have to justify why HF needs to be present in the early phases of capability development.

Kelley Krokos had a comment on the importance of involving HF early in the FAA acquisitions process. There are also the regulations and policies if things aren't done right. She was surprised that our HF policy isn't stronger. Bill said it's the enforcement of the policy not the policy. Kelly shared a situation where after they brought in an HF person early in the process they had to then change things. She wondered why it got that far.

Barbara asked if there is an agreement to write an F&R. Bill asked if there is a research recommendation or is it getting into the way the FAA makes decisions; and to keep that in mind and stay within scope. Chris doesn't know if they came to that conclusion. Phil wondered what our role is, what is the mechanism for the results of the research to make it into the decision-making area. He felt there is probably research work going on but it's probably less that what should be happening.

Barbara recommended that the scope of the strategic work go beyond what it is now so they can provide guidance for the design and the implementation process.

Angel Millan (Boeing, Human Factors) added to the chat: It seems that there is a need to institutionalize standards such as Human Readiness Levels or Human System Integration.

Dave McKenney mentioned a similar F&R years ago on the Flight Deck side and felt the issue still needs to be looked at for both ATC and Flight Deck. Barbara asked if he was in possession of the past F&R that he spoke of. Chinita said if they can narrow down the date then she can look for it. Dave said he will also look.

F &R's

Barbara recommended to do an F&R about Automation and a positive F&R about the encouraging progress the portfolios are making. Phil agreed to write this positive one. Chris mentioned he would attempt to put together a few sentences to get the discussion going on how we are handling the human automation questions within the InfoCentric NAS. Barbara felt they need to write something that encourages more strategic engagement with Human Factors. Dan acknowledged the role that the REDAC is limited to research but are aware of other challenges at the FAA related to the way HF is integrated into development of new concepts. Bill asked what would come out of the research that we don't already know. Barbara pointed out what Angel added to the chat.

Ben Willems added to the chat: @Kelly - although we have the 9550.8 Order, human factors is not part of the Joint Resource Council checklist. Therefore, although there is HF guidance, there is no follow up on the order's mandate.

Bill asked everyone to look over the UAS/AAM Integration Research Plan for discussion after the lunch break.

Break

Maggie Ma from Boeing offered to hold a future meeting in their location in Seal Beach, CA.

Feedback on the FAA UAS/AAM Integration Research Plan | *HF Subcommittee*

Bill asked if UAS would like to add comments to the group before hearing the feedback from the rest of the group.

Sabrina Saunders-Hodge spoke to the group about the recent version of the UAS/AAM Integration Research Plan. She asked that the group to have their comments back to John Hansman (MIT, REDAC Chair) by the full REDAC on Oct 5th and for consolidation of comments through John to the FAA by November 1st. The document is not to be distributed beyond the committee members. She asked for feedback on the plan and any research being planned that can go into informing the safe integration of UAS and AAM.

Chris was curious of the intended use of the document outside of the FAA.

Bill opened the floor up for discussion and any questions for Sabrina and the UAS/AAM team.

Phil commented on Human Automation interactions and how do we help ensure that the operator has done all their preflight calculations and inputs correctly. Ferne Friedman-Berg agreed that it is a legitimate concern if the algorithms are doing the proper de-confliction. Chris DeSenti complimented the FAA UAS Integration Office on how well done the document was done. Kerin Olson said they would be interested to hear about what others are doing and what they are aware of that addresses the research needs so they can track them and use it to help feed the integration pathway.

Cheryl Quinn from NASA liked the way this was presented, she thought there is tie in to NASA research and would like to talk offline to address those. Sabrina asked Kerin to speak on that. Kerin agreed that they are very closely partnered with

NASA and seek their feedback and input directly for the plan (initiatives, activities and timeline). Cheryl asked, what is the data that needs to inform the rulemaking policy? Bill pointed out the formal coordination with NASA/RTT to list the considerations for Human Factors in AAM, and thought it would help with considering AAM's research needs, and would like something similar for UAS. Cheryl mentioned Human-in-the loop to Human-on-the-loop operation and the research that needs to be done for that transition from one to the other. Wes Olson asked about the development of the ground control station standards. Bill said there isn't a plan to use those categories (Human-in the loop, Human-on- the-loop, Human over-the-loop) as drivers to other operational aspects. Phil had a comment about how to address the development of new aircraft systems and what are the classes of scenarios that need to be considered as part of the development that produces something that is acceptable to the FAA. What is the mechanism between industry, consensus standards and FAA guidance that ensures the companies outside the FAA have the right questions and scenarios considered? Standardized scenarios for helping the industry outside the FAA was discussed. Dave brought up safety issues and how they affect the safety of PSUs that are already operating.

Sabrina requested that the subcommittee send their official comments and questions for REDAC consolidation among the subcommittees, to present to John Hansman at the Full REDAC meeting by Oct 5th.

Barbara requested the subcommittee to send it to her instead and she would consolidate the questions and submit our response.

Action Item #1- Air Traffic Organization Human Factors Research Roadmap | FAA

Bill provided an overview of the Action Item (from March 2022 REDAC HF meeting), and mentioned how the current NAS Enterprise Architecture (EA) includes a Human-Systems Integration Roadmap might address the subcommittee's question about an HF research roadmap for FAA Air Traffic Organization that is similar to the FAA Office of Aviation Safety HF Research roadmap (draft). Eddie Austrian explained the NAS EA and the document suppository (NAS Systems Engineering Portal) which maintains the documents that allows for the FAA to plan, document, coordinate NAS wide changes. They are reviewed and updated by leadership on a regular basis. They will show the progression of changes up to a 15 year period. Bill said there are 2 parts to this discussion: what the roadmap is and the other part is the need to cover HF in research across the ATO. Eddie pointed out the document is not intended to capture program specific activities because it is a big picture document. Ben Willems talked about taking advantage of the research that the HF division (ANG-C1) does. He spoke on not being a part of the Joint Research Council Checklist so when issues are looked at early on there is no mandate to address Human Factors, which has been an issue. Bill thought we have a good representation of the scope of what goes on in the NAS EA level. Dan mentioned that the maturity of the requirements process within the ATO is not as advanced as it is in AVS. His other comment was on the nature of work as an air navigation service provider organization and that they don't have the longer term planning vision. He would prefer that ANG-C1 has the authority to develop the longer term research and planning.

Barbara proposed to move onto the next Action Item.

Action Item #2- Briefing on Electronic Flight Bag Human Factors Research | FAA

Bill provided an overview on the Action Item (from March 2022 REDAC HF) meeting involving Electronic Flight Bag (EFB) HF Research that the FAA Office of Aviation Safety, Human Factors, has sponsored over the years. Barbara asked for clarification so they understand that has been a lot of work already through the years and EFB has been increasingly used. Are there research needs going forward? We need context to understand if we could advise there.

Tracy Lennetz from Volpe gave an overview of their research going back 22 years on this subject.

Barbara asked if the tools are used to access the usability of the device, the applications or all of that in operational context. Tracy thought it meant for both. Bill recalled that research did include addressing FAA Flight Standards operational approvals of EFBs.

Phil had a comment about the capabilities of the EFB. Have there been new capabilities that call for a reconsideration for things in the checklist. Kathy mentioned yes there are significant differences in the capabilities of the systems and they

are looking to address such concerns as Information Management. Another is the pilot's ability to differentiate the level of reliability with the source of information. Bill asked Meredith Carroll (HF researcher, Florida Institute of Technology) to speak on their research on this topic. Meredith spoke on their focus on what happens when the EFB says something different than the certified system and the information conflict between the two. They surveyed over 100 pilots then conducted a simulation study.

Chris Reed had a question to Kathy about the Information Management and if there is already research captured to inform POI's for approvability. Kathy said that they don't have great guidance for that and she is not sure if they have enough research data to develop the guidance. Chris DeSenti supposed he heard her saying what we have done is necessary but not sufficient to inform operational approvals. Kathy agreed that on Information Management issues, yes, but on the issue of research on EFB to develop guidance for inspectors, she is unsure.

Barbara suggested coming up with an F&R. Kathy would find it helpful if the committee could lay out what they view as the upcoming near and long term Human Factors issues with such systems. Bill said be as specific possible, that would help.

Bill proposed moving on to the next Action Item.

Action Item #3- Review of Research on Reduced Crew Operations Including Single Pilot Operations | FAA

Bill reviewed the Action Item from March 2022 REDAC HF meeting. He asked Lisa Thomas (FAA, Office of Aviation Safety, Human Factors Specialist) to review the brief on HF Research on Reduced Crew Operations. Lisa went over the 4 categories of research planned. Dave asked if the slides were sharable to which Lisa replied yes, this is publically available information. Barbara is not sure an F&R is needed on this. Kathy asked if it is possible to get briefed on what Industry research is out there. Barbara was not sure they were doing research, it is more development and she is not sure they are ready to share the information.

Kevin Comstock add this to the chat: NASA has done a lot of research already. Lisa Thomas replied to Kevin Comstock's comment in the chat that this is true and they would be looking at a wider range of capabilities, what the state of the art is and what is the equivalent level of safety for aircraft certification.

Action Item #4- FAA Response to prior F&R on Training Air Traffic Controllers for Increased Automation | FAA

Bill provided an overview of the Action Item on prior F&R on Training Air Traffic Controllers and skill degradation (from March 2022 REDAC HF meeting). Specifically, FAA was asked to discuss the feasibility of performing skill degradation research at air traffic facilities (vs lab), and over a long timeframe, such as months or years. Is it possible, if you don't want to intrude on operational aspects? Are there any barriers to doing this? Phil said the major barrier is the NATCA (National Air Traffic Controllers Association) agreement to participate. Adam Rhodes from NATCA said he didn't really see any barriers but there are many things to consider when you want to collect the data. He thought logistically there are the normal challenges—similar to other research that is conducted at facilities. He would welcome research like this and thought Facilities would also and can see the feasibility of a long term study. Phil Bassett had a comment on scoping and facility selection being very important. Steve Lang talked about TRACON and the learning curve as you transfer around the NAS, it takes time to see how the different facilities do things. He thought it would be complex to compare the different facilities.

Action Item #5- FAA Response to Prior F&R Flight Crew Alerting Systems | FAA

Bill gave an overview on the Flight Crew Alerting Action Item (from March 2022 REDAC HF meeting) regarding updates to the FD Alerting Standards. More detail on the research will be provided in this meeting, as requested. Bill asked Kathy about the Flight Deck research going now and asked Kelene Fercho (HF researcher at FAA CAMI) if the

research is outside of ANG- C1 (she said yes it is). Kathy talked about two activities looking at Accidents and Incidents intended to update research from 2010 on Pilot responses to failures, and the larger activity being planned that we talked about last meeting, the Update to the Alerting System standardization study from the 80's.

Kelene gave a short review of their project on FD Alerting. They anticipate a number of deliverables for this project and it has several phases (literature review, regulatory review and a gap analysis). Kathy wanted to add that this is a response to the 737 Max to look at pilot response time, for example. Barbara asked if any work was being done in the area of design of alerting systems and the scientific basis to update that standard, is there any work being done in that area?

Barbara asked Kathy if an F&R would benefit her. Kathy said it can't hurt since we just had an Action Item regarding it. Bill reminded the subcommittee to be mindful of the F&R from a year ago on this issue.

Angel had a question on the current work that Kelene described, has it started or is it for 2024? His perception is there is concerns on the current designs? He had a question on the Pilot Response to System Failures, Malfunctions and System not functioning, slide (OC1). Angel also had a question about the time response and how dependent it is on tasks.

Dave had a question on the OC7 slide from Chuck's presentation: has there been any discussion on if there are any new alerts in regards to UAS/AAM? Do we need to do research on those type of operations? Dave asked if we anticipate any changes to the Part 121 world based on those operations. Kathy said, no but with new tech we will have to look at what is being proposed.

WRAP UP of the DAY | All

Findings and Recommendations or Action Items.

Barbara provided a summary of the Findings & Recommendations and asked the subcommittee to draft their F&Rs, circulate, and she will compile them.

- Phil will write a positive F&R on "Portfolios"
- Chris DeSenti will draft an F&R on the "Strategic Automation Issue" which might become an Action Item or an Observation
- Chris Reed will draft an F&R on "EFB"
- Angel agreed to draft the F&R on "Alerting"
- Maggie Ma will draft something on "Competency based training for Maintenance"

There were no Action Items. The subcommittee would have liked a briefing on the Info-Centric NAS which might become an action under the Automation F&R so Barbara will delay it until they decide what they will do. Lastly, Barbara asked the subcommittee for comments on UAS Research plan and they will be circulated.

Phil asked if it's useful to build on the action reporting on the longitudinal study action of ATC for increased automation. Bill asked Dan and Karl for their response. Dan doesn't think it would hurt but they would have to convince a sponsor to do that. Bill asked Phil what type of response he would like to see. Bill asked Chinita if they can do a finding rather than a recommendation. Chinita said that's more of an observation because you need to have a recommendation with every finding so they can respond. Bill asked if we owe a response even if it isn't a recommendation if it's actionable. She said yes if it's actionable then that language has to be there. Dan requested if you make a recommendation please include rationale as to why it's a good idea, Chinita agreed because it will strengthen the position. Barb said it would be helpful to draft one as an observation, asked Phil to do that.

Kathy said in the chat: Maggie - there is an ICAO panel that is working on Competency-Based Training & Assessment standards for maintenance.

Barbara asked for any other comments.

F&R list for homework:

Phil - write a positive F&R on “Portfolios”

Chris DeSenti - draft an F&R on the “Strategic Automation” issue

Chris Reed - draft an F&R on “EFB”

Angel - draft an F&R on “Alerting”

Maggie Ma - draft something on Competency based training for Maintenance

Phil - draft an F&R on “Reporting on the longitudinal study of ATC for Increased Automation”.

Meeting Adjourned-4:00pm ET

End of Day 2

REDAC Human Factors Meeting Agenda

DAY 1 – Tuesday, Aug 16, 2022

Time	Topic	Presenter
10:00 ET (30 min)	Welcome / Introductions	Shelley Yak , FAA Director of William J. Hughes Technical Center, REDAC Co-Chair Barbara Holder , Embry-Riddle University, HF Subcommittee Chair; Bill Kaliardos , FAA Designated Federal Official (DFO)
	Update from REDAC Full Committee meeting	Barbara Holder , HF Subcommittee Chair
	Opening subcommittee discussion	All
10:30 ET (15 min)	Overview of Budget Line Item (BLI) plan for A11G, Flight Deck HF Research	Rany Azzi , FAA, Flight Standards RE&D Program Manager Kathy Abbott , FAA, AVS Chief Scientific and Technical Advisor, Flight Deck HF
10:45 ET (15 min)	Buffer/TBD	
11:00 ET (15 min)	FAA budget briefing	Elizabeth Delarosby , FAA, RE&D Budget Analyst, Manager
11:15 ET (45 min)	FAA Flight deck HF research, NextGen	Victor Quach , FAA, Flight Deck NextGen HF Portfolio Manager
noon ET (60 min)	Break	
1:00 ET (60 min)	FAA Flight deck HF research, Core	Chuck Perala , FAA, Flight Deck Core HF Portfolio Manager
2:00 ET (30 min)	Preliminary flight deck HF research recommendations by HF Subcommittee	HF Subcommittee
2:30 ET (15 min)	Break	
2:45 ET (15 min)	F&R #1 (prior mtg): AVS HF Research Roadmap	Hannah Baumgartner , FAA AVS HF Specialist
3:00 ET (30 min)	F&R #2 (prior mtg): Immersive Technologies for Training	FAA (various)
3:30 ET (15 min)	F&R #3 (prior mtg): UAS Beyond Visual Line-of-sight Update	FAA (various)
3:45 ET (15 min)	Homework assignments and Day 1 wrap-up	All
4:00 ET	Day 1 Adjourned	

DAY 2 – Wednesday, Aug 17, 2022

Time	Topic	Presenter
10:00 ET (15 min)	General, and review of Day 1	All
10:15 ET (60 min)	FAA air traffic HF Research, NextGen	Karl Kaufmann , FAA, NextGen Enterprise Air Traffic HF Portfolio Manager
	FAA air traffic HF Research, Core	Dan Herschler , FAA, Air Traffic Core HF Portfolio Manager
11:15 ET (30 min)	Preliminary air traffic HF research recommendations by Subcommittee	HF Subcommittee
11:45 ET (75 min)	Break	
1:00 ET (45 min)	Feedback on the FAA UAS/AAM Integration Research Plan	HF Subcommittee
1:45 ET (60 min)	Action Item #1 (prior mtg): Air traffic HF research roadmap	FAA (various)
	Action Item #2 (prior mtg): Prior FAA electronic flight bag research	FAA and Volpe (various)
	Action Item #3 (prior mtg): FAA research on reduced crew ops	FAA (various)
	Action Item #4 (prior mtg): Potential for ATC field research on skill degradation	FAA (various)
	Action Item #5 (prior mtg): Flight crew alerting	FAA (various)
2:45 ET (15 min)	Break	
3:00 ET (60 min)	Final flight deck and air traffic HF research recommendations by Subcommittee	HF Subcommittee
4:00 ET	Day 2 Adjourned	

HF = Human Factors

F&R = Finding and Recommendation by REDAC

RED/RE&D = Research, Engineering, and Development

AVS = FAA Office of Aviation Safety

UAS = Unmanned Aircraft Systems

BVLOS = Beyond Visual Line-of-sight

AAM = Advanced Air Mobility

Attendee List

DAY 1 – Tuesday, August 16, 2022

Name	Organization
Andrea Sparko	Volpe
Angel Millan	Boeing
Angela Campbell	FAA, ANG-E272
Anthony P Tvaryanas	FAA, AAM-600
Ashley Awwad	FAA, AAM-510
Barbara Holder	Embry-Riddle Aeronautical Univ.
Ben Willems	FAA, AJM-1310
Beth Delarosby	FAA, ABP-310
Bill Kaliardos	FAA, ANG-C1
Brett Torrence	FAA, AAM-520
Bridget Lewis	MITRE
Caprice Brown	FAA, AVP-300
Carla Hackworth	FAA, AAM-500
Cathy Swider	FAA, AIR-626
Chinita Roundtree-Co	FAA, ANG-E42
Chris Reed	JetBlue
Christopher DeSenti	MITRE
Chuck Perala	FAA, ANG-C1
Dan Brock	FAA, AFS-430
Dan Herschler	FAA, ANG-C1
Dave Guy	FAA, AFS-430
Dave McKenney	MITRE
Eddie Austrian	Fort Hill Group
Elly Smith	MITRE
Eric Carroll	FAA, AFS-140
Eric Roberts	FAA, AFS-110
Gary Pokodner	FAA, ANG-C61
Hannah Baumgartner	FAA, AAM-510
Ian Johnson	FAA, ANG-C61
Jack Barker	Air Line Pilots Association (ALPA)
Jason Coon	FAA, ANG-E42
Jeff Dressel	FAA, AAM-520
Jerry Crutchfield	FAA, AAM-520
Jessica Cruitt	Oasis
Joey Jaworski	FAA, AIR-712
Jon Schleifer	FAA, ANG-E4
Jorge Fernandez	FAA, AIR-670
Kathy Abbott	FAA, AIR-600

Katie Constant-Coup	FAA, AFS-410C
Katrina Avers	FAA, AAM-510
Kelene Fercho	FAA, AAM-510
Kelley Krokos	FAA, AHF-230
Kelvin L Courtney	FAA, AJT-222
Kenneth Allendoerfer	FAA, ANG-E25
Kevin Comstock	Air Line Pilots Association (ALPA)
Kevin Siragusa	Fort Hill Group
Kevin Williams	FAA, AAM-510
Kim Cardosi	Volpe
Kylie N Key	FAA, AAM-510
LaTasha Holloman	Booz Allen, supporting ANG-C1
Lauren Thomas	FAA, AIR-626
Lisa C Thomas	FAA, AIR-626
Lori Brown	Western Michigan Univ.
Maggie Ma	Boeing
Mandy Fiery	FAA, AJI-342
Mark Orr	FAA, AVP-300
Marlo E-Allen	FAA, ANG-C1
Meredith Carroll	Florida Institute of Technology
Mike Paglione	FAA, ANG-E27
Nadine Barbara Sarter	Univ. Michigan
Nichola Lubold	Honeywell
Oscar Bocanegra	FAA, AFS-100
Pam Munro	FAA, AFS-110
Patrick Kong	FAA, AVP-300
Phil Bassett	Cavan Solutions
Phil Smith	Ohio State
Randy Bone	MITRE
Rany Azzi	FAA, AFS-410
Rich Golden	FAA, AVP-300
Russ Tokarski	FAA, AJI-342
Sarah V Ligda	FAA, AAM-520
Shelley Yak	FAA, ANG-E
Stephanie Kreseen	FAA, AVP-220
Steve Lang	Cavan Solutions
Sujit Kalva	FAA, AIR-610
Svyatoslav (Slava) Guznov	FAA, AIR-626
Tara Gibson	FAA, ANG-C1
Thomas Van Dillen	FAA, AAM-520
Todd Lewis	FAA, AVP-300
Tony D Darnell	FAA, AMA-421
Tracy Lennertz	Volpe
Victor Quach	FAA, ANG-C1

Wes Olson	Lincoln Lab
William Penhallegon	MITRE

DAY 2 – Wednesday, August 17, 2022

Name	Organization
Abigail Post	FAA, AIR-620
Achal Singhal	FAA, AUS-320
Adam Rhodes	FAA/NATCA
Al Secen	RTCA
Andrea Sparko	Volpe
Angel Millan	Boeing
Ashley Awwad	FAA, AAM-510
Barbara Holder	Embry-Riddle Aeronautical Univ.
Ben Willems	FAA, AJM-1310
Bill Kaliardos	FAA, ANG-C1
Brett Torrence	FAA, AAM-520
Brian Hill	Cavan Solutions
Bridget Lewis	MITRE
Carla Hackworth	FAA, AAM-500
Cathy Swider	FAA, AIR-626
Chanda Sanders	FAA, AAM-520
Chinita Roundtree-Co	FAA, ANG-E42
Chris Reed	JetBlue
Christopher DeSenti	MITRE
Chuck Perala	FAA, ANG-C1
Dan Brock	FAA, AFS-430
Dan Herschler	FAA, ANG-C1
Danielle Hiltunen	Volpe
Dave Guy	FAA, AFS-430
Dave McKenney	MITRE
Eddie Austrian	Fort Hill Group
Eric Carroll	FAA, AFS-140
Erin Sunshine	FAA, AUS-320
Ferne Friedman-Berg	FAA, AUS-310
Ian Johnson	FAA, ANG-C61
Jack Barker	Air Line Pilots Association (ALPA)
Jason Coon	FAA, ANG-E42
Jeff Dressel	FAA, AAM-520
Jerry Crutchfield	FAA, AAM-520
Jessica Cruitt	Oasis
Jim Reynolds	FAA, AUS-310
Joey Jaworski	FAA, AIR-712
John Hansman	MIT

Jon Schleifer	FAA, ANG-E4
Karl Kaufmann	FAA, ANG-C1
Kathy Abbott	FAA, AIR-600
Katie Constant-Coup	FAA, AFS-410C
Katrina Avers	FAA, AAM-510
Kelene Fercho	FAA, AAM-510
Kelley Krokos	FAA, AHF-230
Kelvin L Courtney	FAA, AJT-222
Kenneth Allendoerfer	FAA, ANG-E25
Kerin Olson	FAA, AUS-320
Kevin Comstock	Air Line Pilots Association (ALPA)
Kevin Siragusa	Fort Hill Group
Kolie Lombard	FAA, AUS-310
LaTesha Holloman	Booz Allen, supporting ANG-C1
Lauren Thomas	FAA, AIR-626
Lisa C Thomas	FAA, AIR-626
Maggie Ma	Boeing
Mandy Fiery	FAA, AJI-342
Marlo E Allen	FAA, ANG-C1
Meredith Carroll	Florida Institute of Technology
Nadine Barbara Sarter	Univ. Michigan
Nichola Lubold	Honeywell
Patrick Kong	FAA, AVP-300
Phil Bassett	Cavan Solutions
Phil Smith	Ohio State
Randy Bone	MITRE
Rany Azzi	FAA, AFS-410
Sabreena Azam	FAA, ANG-C72
Sabrina Saunders-Hodge	FAA, AUS-300
Sarah V Ligda	FAA, AAM-520
Sherry Chappell	Self
Stafford Duncan	FAA, AUS-300
Stephanie Kreseen	FAA, AVP-220
Steve Lang	Cavan Solutions
Sujit Kalva	FAA, AIR-610
Svyatoslav (Slava) Guznov	FAA, AIR-626
Tara Gibson	FAA, ANG-C1
Thomas Van Dillen	FAA, AAM-520
Todd Lewis	FAA, AVP-300
Tony D Darnell	FAA, AMA-421
Tracy Lennertz	Volpe
Wes Olson	Lincoln Lab
William Penhallegon	MITRE