EMBRY-RIDDLE Aeronautical University

FAA REDAC Subcommittee on Human Factors

Findings and Recommendations

Summer/Fall 2024

Barbara E. Holder Ph.D., FRAeS

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Subcommittee on Human Factors Summer/Fall Meeting

Held at FAA Headquarters
August 20-21, 2024

Agenda:

- Opening Remarks, Dr. Eric Neiderman, FAA Technical Center Deputy Director
- Human Factors Research Portfolios:
  - Flight Deck
  - Air Traffic
- FAA Budget
- Discussion:
  - AVS Safety Strategy Document
  - AI Safety Assurance Roadmap
- Invited Presentations

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Subcommittee on Human Factors Summer/Fall Meeting

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Invited Presentations:

The New FAA Aviation Safety R&D Program, Mr. Bruce DeCleene/Mr. Mark Orr

Human Factors in the FAA Reauthorization Act, Dr. Kathy Abbott

Artificial Intelligence/Machine Learning (AI/ML) across the FAA

- Kanvasi “TJ” Tejasen, FAA, ANG, Technology and Adv. Concepts
- Natesh Manikoth, FAA, AFN, Deputy Assistant Administrator for Information & Technology Services and Chief Information Officer
- Bruce DeCleene, FAA, AVS, Director, Office of Senior Technical Experts

Runway/Surface Safety: historical and current R&D

- Robert Higginbotham, FAA, ANG Technology and Adv. Concepts
- Matthew McCann, FAA, ATO Surface Team

1. New Uses for Heads-Up-Displays

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Finding: Heads-Up Displays (HUDs) have become a common user interface in the operational environment since their initial introduction in the 70's.

The evolution of HUD technologies is enabling even more complex information to be displayed on the HUD (Enhanced Vision, Synthetic Vision, flight path guidance, navigation data, visual alerts). The management of information displayed on the HUD is often addressed by allowing the user to swap between view modes, or by certain decluttering functions.

However, with ever more information being displayed, view modes and decluttering functions are also increasing in number and complexity, adding cognitive workload to the already numerous information management tasks.

The combination of these factors may have a direct impact on human machine interactions, exposing flight crews to conditions that may have not previously been identified

1. New Uses for Heads-Up-Displays

Recommendation: The FAA should conduct research to systematically review the increase in the amount, types, access, and complexity of information being added to the HUD.

The research should identify the drivers for increasing HUD content versus displaying the information elsewhere in the flightdeck and include aircraft-mounted as well as head-worn devices.

The research should evaluate how much information is too much for a given task, activity, or type of operation, and how the information display degrades or declutters effectively. The outputs of this research could be used to update FAA guidance for the display and management of information on HUDs that has not be updated since 2017.

Consequences: The emerging trend to increase the amount, types, access, and complexity of information provided through the HUD needs to be understood for its impact on human performance and operational safety. Otherwise, the industry may continue adding functionality and data without understanding its potential operational impact.

2. Information Management Strategy

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Finding: The subcommittee was pleased to see several research projects planned to investigate ways to differentiate information in the flight deck that originates from certified avionics sources versus operationally approved sources.

The subcommittee recognizes this distinction is important for understanding the reliability of the presented information. However, this is only part of the current information management challenge faced by flight crews today.

For example, the new Boeing 777, Airbus A350, and Gulfstream 700 are investigating ways to integrate information from non-approved avionics sources (e.g., software applications contained in portable electronic devices) with operationally approved sources and display them on various flight deck displays as an integrated resource.

2. Information Management Strategy

Recommendation: Research is needed to develop information management guidance for Original Equipment Manufacturers (OEMs) and FAA personnel to effectively assess the impact of advanced information integration strategies on pilot performance.

This research could also be used to inform a broader information management strategy for flight deck design and its operation. Research should also investigate degradation of information resources and ways for flight crew to be alerted or informed of an information issue.

Consequences: Lack of information management guidance may result in (1) inconsistency across different OEMs and aircraft models, and (2) poor integration and management, and use of information from different sources. All of which may negatively impact performance of flight crew (e.g., cognitive overload) and ultimately operational safety.

3. Advanced Flight Deck Alerting Systems

Finding: The Subcommittee was pleased to see a new project is planned to develop Design Standards for New and Advanced Alerting Systems. However, this project is still awaiting confirmation for funding.

Due to the complexity of this challenging research, it is anticipated the project may take several years to complete. There is an urgent need to define empirically how to design alerting systems to best direct appropriate flight crew attention and guide their response to system failures and flight path deviations.

With new aircraft on the horizon, there is an urgent and timely need for updated guidance that accounts for new forms of information integration, combinations of systems, and utilization of advanced technologies.

3. Advanced Flight Deck Alerting Systems

Recommendation: Due to the criticality and urgency for guidance and design standards for new and advanced crew alerting systems, the Human Factors Subcommittee reiterates that this project should be assigned high priority to ensure research begins as soon as possible to meet industry and FAA needs.

The project should also include a mechanism for obtaining input from industry experts (e.g., Original Equipment Manufacturers, Suppliers, Academia, Airline operators, Pilots, etc.) to ensure the needed industry expertise is utilized in the research.

The outputs of this research should be used to support FAA guidance but also could inform industry standards groups.

Consequences: The current guidance for flight deck alerting systems is woefully out of date. Without new guidance to develop effective advanced alerting systems, the FAA and industry will have to work the issues simultaneously as they develop these systems. This could potentially result in divergent standards and designs that could negatively impact safety and certification standards.

4. Complexity and New Human-automation interactions

Finding: OEMs are proposing software changes to existing technologies/systems that provide new automated functions such as automated taxi and takeoff.

These capabilities will automate tasks to initiate the rotation, manage the rate of rotation up to a max pitch angle, and manage the risk of a tail strike. One OEM has publicized that its automatic takeoff function will require manual pilot-control inputs for directional (yaw), roll, and thrust control during the takeoff roll, automating only pitch control.

This represents a significant change in demands on pilots, in terms of control inputs, monitoring tasks/activities (vertical flightpath, user expectations of a technology, etc.), responses to malfunctions/unexpected events/performance, etc.), and flight path / energy management.

According to information provided to the REDAC, policy/guidance for automatic takeoff/taxi operations does not yet exist. This may be an example of technology outpacing FAA data/documentation. It should be noted that these issues also apply to proposed designs with remote pilots for Advanced Air Mobility which may introduce additional considerations.

4. Complexity of New Human-automation interactions

Recommendation: Research is needed to understand human-automation interactions for emerging automated capabilities (such as automated takeoff and taxi) being investigated by OEMs and how they will impact pilot tasks and change the human-machine interfaces/interactions.

The research should identify new automation capabilities on the horizon, potential vulnerabilities and emerging risks due to the introduction of these new automated systems and the complexity that the introduction of these systems adds to the system overall (e.g., air traffic, etc).

The research should explore the need for alerting, normal and non-normal transitions between automation and pilot, operational implications associated with changes in the airspace system and how these factors impacts safety and performance.

Further the research should determine the limits of manageable complexity in the flight deck. The results of this research should guide future FAA policy on managing increasingly complex automated systems, operations, and operational use of these new automated capabilities.

4. Complexity and New Human-automation interactions

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Consequences: Industry innovation continues to introduce new automated capabilities for which there is little or no guidance for mitigating the additional complexity it bring to the operation nor measuring its impact on pilot performance. Consequently, new vulnerabilities resulting from added automation complexity may remain unknown and pose latent safety risks.

Action 1: Briefing on AAM/UAS Status

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The Human Factors Subcommittee requests a briefing from the AAM/UAS Automation Working Group (and possibly other groups that may have insight) to outline the progress toward defining guidance or requirements for remote pilot operations.

Our areas of interest include aircraft and avionics certification, airspace and vertiport design, Passenger Service Units (PSUs) and flight operations. The briefing should include a discussion of human factors research that has been completed or that needs to be conducted to support such guidance or requirements.

The subcommittee requests this briefing be provided at the March Winter/Spring 2025 meeting.

Observation 1: FAA Roadmap for AI Safety Assurance

The REDAC HF Subcommittee was delighted to see the release of the FAA Roadmap for Artificial Intelligence (AI) Safety Assurance. The HF subcommittee asks the FAA to please consider updating the roadmap with the following wording adjustment:

Original statement: “For these reasons, this roadmap avoids the use of human-centric language when referring to AI. For example, AI cannot be a part of crew-resource management (CRM) but can affect crew responsibilities. AI cannot be a copilot but can perform autopilot functions and affect how a pilot performs their duties.”

Suggested Revision: For these reasons, this roadmap avoids personification when referring to AI. For example, AI cannot be a (human) copilot but can perform autopilot functions and affect how a pilot performs their duties. As a system/tool, AI can affect crew responsibilities, and consequently is part of resources to be managed via Crew Resource Management (CRM). A Human-centered Design (HCD) approach is suitable and recommended to ensure the AI is designed and developed to best support human pilots’ performance and to optimize overall system performance.

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Observation 1: FAA Roadmap for AI Safety Assurance

The sentence: *"This roadmap avoids the use of human-centric language when referring to AI"* is problematic due to the following reasons:

(1) Human-center design (HCD) is a foundational approach for HF and is also an ISO standard (ISO 9241-210:2019).

(2) "Human-centric" means design/development for the human end users. It doesn't mean "personification of an object/thing." If the intent of the roadmap is to "avoid personification or avoid anthropomorphizing" (a point the Subcommittee supports) the roadmap should just clearly state "avoid personification or anthropomorphizing."

(3) The current wording may cause unintended misinterpretation by practitioners at the operators/MROs who have no or not much HF knowledge.

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Upcoming Meetings

Winter/Spring: March 25-26, 2025

Summer/Fall: August 12-13, 2025