

NextGen Air/Ground Integration Human Factors Research Program

Semiannual update to the REDAC Human Factors Subcommittee

Presenter: Dr. Victor Quach, NextGen Human Factors Division (ANG-C1)Budget Line Item (BLI) Number: 111110Date: August 16, 2022



NextGen Air/Ground Integration Human Factors Research Program

Program Scope

 This program addresses research, engineering, and development requirements defined by technical sponsors in the Aviation Safety (AVS) organization. Requirements are driven by intersection points between FAA policy documents, NextGen changes, and enabling flight deck technologies and procedures.

FAA Benefits

- Program outputs are transferred to AVS technical sponsors who develop and maintain, as appropriate, human factors-related regulations, guidance, procedures, Orders, standards, job aids, and other materials
- Work products benefit Aircraft Certification (AIR) and Flight Standards (AFX) personnel who evaluate and approve emerging aircraft systems (e.g., displays, devices, controls), procedures, and operations which may not be covered by existing human factors documentation

Measures of Success

- 1. Sponsor Satisfaction did the research meet AVS's needs?
- 2. Access to Research is there sufficient awareness/access to results?
- 3. Application of Results did the research support or inform a data-driven decision?
- 4. Benefits how did the research contribute to safety, capacity, and/or efficiency?

NextGen Air/Ground Integration Human Factors Research Program

Team Members

- Tara Gibson, Division Manager (Tara.M.Gibson@faa.gov)
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Researchers and Laboratories

- FAA Civil Aerospace Medical Institute (CAMI)
- FAA William J. Hughes Technical Center (WJHTC)
- National Aeronautics and Space Administration (NASA) AMES Research Center
- Volpe National Transportation Systems Center, Department of Transportation
- MITRE Corporation, Center for Advanced Aviation System Development (CAASD)
- Honeywell Inc.
- University of Michigan

NextGen Air/Ground Integration Human Factors Program Accomplishments in FY2022 since Q2

Project		Description/Product					
Pilot Tasks, Skills, Procedures, and T	raining Research						
Draft Technical Report, Manual Flight Operations Phase 3	 Draft Technical NextGen chan (MFO) proficie Air carrier pilo be verified and Potential frequencies If operator po 	Report with results from analysis of human factors, safety, and operational data to understand: ges and enabling flight deck technologies that may limit opportunities for pilots to practice and maintain manual flight operation ency in a trajectory-based operations (TBO) environment. t tasks, knowledge, cognitive/psychomotor skills, and communication/coordination skills for 20 MFO maneuvers, of which a subset will d validated in a future phase of work. uency and performance of MFO in transport airplanes during 14 CFR Part 121/135 operations. icies and procedures encourage pilots to develop, practice, and maintain MFO knowledge and skills during line operations and training.					
Human Error and Complex Systems Research							
Draft Technical Report, Flightcrew Human Factors in Message Complexity and Clearance Negotiation	 Draft Technical Reports of me (gross navigat Guidance for a 	Report with results from analysis of current operations, safety, and research data to understand: ssage complexity (visual, cognitive, technical), air/ground clearance negotiation issues that result in a misunderstanding, pilot errors onal errors [GNEs], large height deviations [LHDs]), and resilient pilot behaviors. hir/ground clearance negotiation during en route domestic and oceanic flight operations.					
Advanced Vision Systems Research							
Enhanced Flight Vision System (EFVS) Visual Advantage Operational Data Collection	Developed an e Final Technical I • Pilot-reports c	lectronic flight bag (EFB) application and paired it to a <u>cloud-based research platform</u> to enable data collection and analysis. Report for AFS-410 sponsors with results from the analysis of operations data to understand: f actual (observed) EFVS performance during line operations via an electronic flight bag application.					



Pilot Tasks, Skills, Procedures, and Training Research

FY2022 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Objectives

- Provide research data to support the human factors needs of FAA personnel who evaluate, approve/accept, and oversee pilot training and qualification programs, operations, and procedures.
- Identify pilot tasks, skills, and proficiency needs for the operational use of flight deck systems, avionics equipment, and procedures.
- Examine operational effectiveness of training methods and related technology.

How Results are Use

• Research data informs FAA personnel who develop and incorporate evaluation criteria for pilot tasks, knowledge, skills, and other topics into regulations, guidance material, and other work products for FAA use and potential industry benefit.

Focus Areas

- Cognitive and psychomotor skills
- Monitoring



Pilot Tasks, Skills, Procedures, and Training Research

FY2022 Research and Potential Project Plans



Pilot Tasks, Skills, Procedures, and Training Research

FY2022 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Potential new research questions for consideration FY2026+

Advanced Technologies and Procedures

• **Research Question:** What tasks, knowledge, skills, and proficiency are needed to use systems and avionics equipment that enable Full/Dynamic trajectory-based operations (TBO), and the impact of these changes to pilot roles and expectations placed on them?

Extensible Traffic Management (xTM) – diverse flight operations and procedures

• **Research Question:** What pilot tasks, knowledge, skills, and proficiency needs are impacted by the dynamic separation of airspace to enable integration of highly automated aircraft?



Flightcrew Displays and Interfaces Research

FY2022 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Objectives

- Provide research data to support the human factors needs of FAA personnel who evaluate and approve current/emerging flight deck systems, equipment, displays, and controls, including their intended function and operation.
- Understand potential human factors installation and integration issues that could arise when introducing or combining next generation aircraft changes with current systems, equipment, displays, controls, and their respective modes of operation.

How Results are Use

 Research data informs FAA personnel who develop and incorporate human factors evaluation criteria for flight deck systems, equipment, displays, and controls into regulations, guidance material, and other work products for FAA use and potential industry benefit.

Focus Areas

- Multimodal controls for flight deck systems
- Information automation (IA) systems connected aircraft



Flightcrew Displays and Interfaces Research

FY2022 Research and Potential Project Plans



Flightcrew Displays and Interfaces Research

FY2022 Research and Potential Project Plans

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Potential new research questions for consideration FY2026+

Highly Automated Aircraft

• **Research Question:** What are the anticipated human-machine interface and pilot/crew interaction issues with novel control inceptors that support precise 4-dimensional trajectory (4DT) navigation accuracy requirements in highly automated rotorcraft and fixed-wing aircraft?

Avionics Standards Integration

• **Research Question:** What requirements in avionics standards developed by RTCA (SC-186, SC-227) should be retained or modified to support combined use of flight deck interval management and time of arrival control functions?





Instrument Flight Procedures Research

FY2022 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Objectives

- Provide research data to support human factors needs of FAA personnel who evaluate, approve, and oversee pilot procedures and flight deck operations for performance – based navigation (PBN) procedures
- Understand the human factors impact of advanced procedure flyability/acceptability, charting, use of automated systems, and pilot competencies

How Results are Use

- Informs FAA personnel who develop and maintain human factors portions of PBNrelated regulations, guidance material, procedures, standards, job aids, and other documentation to support the safety and efficiency of flight operations
 - Design of PBN procedures to ensure they can be flown safely
 - Documentation of PBN procedures (paper/electronic charting)
 - Other activities that support instrument flight procedure validation

Focus Area

• Advanced procedures



Instrument Flight Procedures Research

FY2022 Research and Potential Project Plans



Instrument Flight Procedures Research

FY2022 Research and Potential Project Plans

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Potential new research questions for consideration FY2026+

Advanced Procedures

• New research questions will be identified by technical sponsors



FY2022 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Objectives

- Provide research data to support human factors needs of FAA personnel who evaluate, approve/accept, and oversee technologies and equipment, pilot training and qualification programs, operations, and procedures
- Understand how aircraft systems, operations, and procedures will impact the role of pilots and the expectations placed on them

How Results are Use

 Research data informs FAA personnel who develop and incorporate evaluation criteria for pilot tasks, skills, systems, and equipment into human factors related regulations, guidance material, and other work products for FAA use and potential industry benefit.

Focus Areas

- Task management
- Flight deck information management
- Human-system safety
- Trajectory negotiation
- Digital communications



FY2022 Research and Potential Project Plans



FY2022 Research and Potential Project Plans

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Human-System Safety

Research Question: What methods, techniques, and approaches are available to factor human behavior in system-safety / risk assessments?

*ACSAA related research

Trajectory Negotiation

Research Question: What training and procedure mitigations can be used to avoid pilot errors related to the management of 4DTrajectory clearance negotiation risks?

Digital Communications

Research Question: What research data is currently available to inform equivalent level of safety decisions for the operational use of digital communication technologies below flight level (FL) 180?

FY2022 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Potential new research questions for consideration FY2026+

Resilient Behaviors

• **Research Question:** What are the resilient behaviors of automated flight deck systems and pilots/crews during aircraft operations in dynamic, trajectory-based operations?





FY2022 Research and Potential Project Plans

Potential project plans are subject to change based on FAA needs and availability of funds

Objectives

- Provide research data to support human factors needs of FAA personnel who evaluate, approve, and oversee the use of advanced vision systems.
- Understand the contribution of advanced vision system technologies to pilot performance during new low visibility concepts of operation.

How Results are Use

- Informs equivalent level of safety decisions and policy changes that can increase the number of viable airports/runways for low visibility approach, landing, rollout, and takeoff operations (expand operational credit)
- Informs FAA personnel who develop evaluation criteria for the use of advanced vision system technologies and incorporate this information into human factors – related regulations, guidance material, and other work products for FAA use. Outputs may also benefit industry.

Focus Areas

- Novel head-worn display technologies
- Hybrid display implementations
- Enhance flight vision system (EFVS) operations
- Combined vision system (CVS) operations



FY2022 Research and Potential Project Plans

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Novel Head-Worn Display (HWD) Technologies

Research Question: What is the contribution of a head-worn display (HWD) with and without EFVS or SVGS to pilot performance during low visibility takeoff, approach, landing, and rollout operations in visibilities lower than 1,000 RVR?

Hybrid Display Implementations

Research Question: What is the contribution of dual head-worn displays and hybrid headup display/head-worn display installations to pilot performance during low visibility takeoff, approach, touchdown, and rollout operations in visibilities lower than 1,000 RVR?

FY2022 Research and Potential Project Plans



FY2022 Research and Potential Project Plans

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Potential new research questions for consideration FY2026+

Operational Evaluation Aids

• **Research Question:** What human factors considerations should be included in an operational evaluation job aid for aircraft evaluation division (AED) pilots who evaluate Combined Vision System technologies, display types, and operations?





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