REDAC / HF

Review of FY 2019 Accomplishments and Future Planned Portfolio

NextGen Flight Deck Air/Ground Integration

Karl Kaufmann

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NextGen Flight Deck Air/Ground Integration Human Factors

Program Scope

- The NextGen – Air Ground Integration Human Factors Program provides the research foundation for FAA guidelines, handbooks, orders, advisory circulars (ACs), Technical Standards Orders (TSOs), and regulations that help ensure the safety and efficiency of future aircraft operations. Functionally, human factors research products support Aircraft Certification and Flight Standards personnel who evaluate and approve emerging flight deck displays, devices, procedures, and operations that leverage FAA investments in NextGen changes.

NextGen Flight Deck Air/Ground Integration Human Factors

NextGen HF team members:

- Division Manager – Tara Holmes
- Program Manager – Karl Kaufmann
- Project Manager – Dr. Bill Kaliardos
- Project Manager – Shallu Darhele
- Project Manager – Sabreena Azam
- Project Manager – Dr. Victor Quach

Performers:

- Civil Aerospace Medical Institute (CAMI)
- William J. Hughes Technical Center (Tech Center)
- Volpe National Transportation Systems Center
- National Aeronautics and Space Administration (NASA)
- University of Michigan
- Florida Institute of Technology
- MITRE
- Honeywell
- ECS

NextGen Flight Deck Air/Ground Integration Human Factors – Sponsors

AVS Sponsors	Functional Role/Areas of Interest
Kathy Abbott	CSTA Flight Deck Human Factors
Cathy Swider	Aircraft Cert. (Avionics & ADS-B applications)
Michelle Yeh	Aircraft Cert. (Avionics, EFBs, ADS-B applications)
John Stuber	Aircraft Cert. (Aircraft Energy/System State Awareness)
Jeff Kerr	Flight Standards (NAS & Flightdeck Procedures)
Chris Hope	Flight Standards (Advanced & Enhanced Vision Systems)
Janet Greenwood	Flight Standards (Fixed-wing SVGS, SVS)
Scott McLellan	Flight Standards (Fixed-wing EFVS, EVS)
Mike Webb	Flight Standards (Rotorcraft Advanced Vision)
Rob Burke	Flight Standards (Training, Error Management)

NextGen Flight Deck Air/Ground Integration Human Factors - Research Requirements

NextGen Flight Deck Human Factors Research Requirement Titles	Aviation Safety (AVS) Principal Technical Sponsor
NextGen: Human Factors Guidelines for Advanced Instrument Procedure Design and Use	Flight Standards – Flight Technologies and Procedures
NextGen: Procedures, Tasks, Skills and Training for NextGen Air Carrier Pilots and Dispatchers	Flight Standards – Air Carrier Training and Voluntary Safety Programs
NextGen: Flight Deck Systems: Flight Crew Interfaces, Installation, Integration and Operations	Aircraft Certification Flight Standards – Flight Technologies and Procedures
NextGen: DataComm Human Factors R&D	Flight Standards – Flight Technologies and Procedures
NextGen: Human Error and Complex Systems	Aircraft Certification
NextGen: Advanced Vision Systems (EFVS, EVS, SVGS, SVS, CVS) Sensor-Based Technologies, Head-Mounted/Head-Worn Displays, and Other Flight Deck Systems	Flight Standards – Flight Technologies and Procedures

NextGen Flight Deck Air/Ground Integration Human Factors – FY2019 Accomplishments

- **Human Factors Guidelines for Advanced Instrument Procedure Design and Use**
  - Impact of NAS Complexity Factors on Flightcrew Compliance with NextGen Terminal Procedures
- **Procedures, Tasks, Skills, and Training for NextGen Air Carrier Pilots**
  - Human Factors Recommendations to Address Flightpath Management System Dependencies (phase 2)
- **Flight Deck Systems: Flightcrew Interfaces, Installation, Integration and Operations**
  - EFB/PED Information Security Human Factors Considerations
  - EFVS During LVO Taxi Operations at Airports with Less Than SMGCS Infrastructure

NextGen Flight Deck Air/Ground Integration Human Factors – FY2019 Accomplishments

- **Data Comm Human Factors R&D**
  - Oceanic Conditional Clearances and Large Height Deviations
  - Human Error Prevention and Mitigation Strategies for TBO Concepts that May Rely on Defining Waypoints (Lat./Long.) in ½ Degrees
- **Human Error and Complex Systems**
  - System Complexity: Definitions, Empirical Findings, and Recommendations for Training and Design

HF Recommendations to Address the Impact of NAS Complexity Factors on Compliance with NextGen Terminal Procedures

HF Guidelines for Advanced Instrument Procedure Design & Use	NextGen Procedures, Tasks, Skills & Training for NextGen Air Carrier Pilots	NextGen Advanced Vision Systems, Sensor-Based Technologies, HMD, Other FD Systems	Data Comm Human Factors R&D	NextGen Human Error & Complex Systems

Task Profile

Project Manager: Sabreena Azam (NextGen HF)

Research Performers: Divya Chandra, Andrea Sparko (Volpe Center)

Sponsors: Kathy Abbott (Aviation Safety Organization), Jeff Kerr (Flight Standards Service)

NextGen Relationship: 108209: Increase Capacity & Efficiency Using RNAV and RNP

Human Factors Task Description

- Examine the impact of operational complexity factors on flightcrew performance and terminal NAS procedure compliance

Benefits

- Human factors research will help FAA anticipate, mitigate, & reduce potential pilot performance issues to related to flying NextGen IAPs.

Applications

- AC-120-FPM (Airspace Operations section of new FPM AC)
- Updates to FAA Orders in the 8260 series on instrument procedures as needed including 8260.19, 8260.46, and 8260.58
- FAA Aeronautical Charting Forum reference materials
- Potential input to future FAA Inspector Guidance (8900.1)
- Comm., Nav., Surveillance (CNS) Task Force
- Pilot Controller Phraseology System Integration (PCPSI) Work Group

FY19 Accomplishments

- Led guided discussions with technical pilots to identify procedures frequently impacted by operational complexity (Jan. 2019)
- Analyzed 1777 MORs to identify additional IFPs, locations, and complexity factors to evaluate (April 2019)

Planned Activities

- Develop a final list of operational complexity factors and flight deck task impacts (Sept. 2019)
- ASRS analysis to identify complexity factors patterns, factor-to-factor interactions, and their impact to IFP compliance (Oct. 2019)
- Develop final report and data-driven HF recommendations for ANG-C1 and AVS review (Nov. 2019)
- Publish final technical report (Jan. 2020)

Deliverable	Due Date	Status
Interim Report: Potential NAS complexity factors affecting flightcrew compliance with NextGen terminal procedures	February 2019	B
Interim Report: Leading causal factors impacting flightcrew compliance with complex NextGen terminal procedures	August 2019	B
Final Report with HF recommendations to mitigate causal factors & support updates to FAA regulatory and guidance materials	January 2020	G

Complete | On Track | Delayed

System Complexity: Definitions, Findings, and Training and Design Recommendations

Task Profile

Project Manager: Shallu Darhele (NextGen HF)

Research Performer: Nadine Sarter (University of Michigan)

Sponsors: Kathy Abbott (Aviation Safety Organization), Jeff Kerr (Flight Standards Service), Paul Sigmund (Transport Airplane Directorate)

NextGen Relationship: Cross Cutting

Human Factors Task Description

- Improve understanding of system complexity and how it affects flight crews on modern flight decks

Benefits

- This research will help FAA and industry to be better able to take into account complexity impacts while designing and evaluating systems and training programs

Applications

- This research will be used to determine if a new Advisory Circular is required

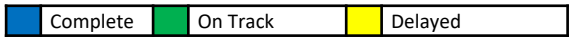
FY19 Accomplishments

- Simulator study on performance effects of system complexity (January 2019)

Planned Activities

- Project completed

Deliverable	Due Date	Status
Final Report on Complexity: Definitions, Empirical Findings, and Recommendations for training and design	April 2019	B



EFB/PED Information Security Human Factors Considerations

HF Guidelines for Advanced Instrument Procedure Design & Use	NextGen Procedures, Tasks, Skills & Training for NextGen Air Carrier Pilots	**NextGen Advanced Vision Systems, Sensor Based Technologies, HMD, Other FD Systems**	Data Comm Human Factors R&D	NextGen Human Error & Complex Systems

Task Profile

Project Manager: Dr. Chuck Perala (NextGen HF)

Research Performers: Mark Brown (ECS), Meredith Carroll (FIT)

Sponsors: Cathy Swider, Michelle Yeh), Will Gonzalez (Aircraft Certification Service

NextGen Relationship: Cross Cutting

Human Factors Task Description

- Perform a simulator study comparing pilot responses to information conflicts between certified and uncertified information presented with varying degrees of integration

Benefits

- Most EFB applications supply information from uncertified sources. This research provides pilot responses to information conflicts between certified and uncertified sources and due to cybersecurity events.

Application

- This research will be used as a means for Flight Standards to develop new guidance on information security requirements in the flight deck

FY19 Accomplishments

- Executed simulator study (May 2019)

Planned Activities

- Technical report publication

Deliverable	Due Date	Status
Final report on EFB/PED Information Security human factors considerations	August 2019	B

Complete | On Track | Delayed

Oceanic Conditional Clearances and Large Height Deviations

HF Guidelines for Advanced Instrument Procedure Design & Use	NextGen Procedures, Tasks, Skills & Training for NextGen Air Carrier Pilots	NextGen Advanced Vision Systems, Sensor-Based Technologies, HMD, Other FD Systems	**Data Comm Human Factors R&D**	NextGen Human Error & Complex Systems

Task Profile

Project Manager: Karl Kaufmann (NextGen HF)

Research Performers: Kim Cardosi, Tracy Lenertz (Volpe Center)

Sponsors: Mark Patterson (Flight Standards Service), Kathy Abbott (Aviation Safety Organization), Kevin Kelley (Flight Standards Service)

NextGen Relationship: 104123-23: Complex Clearances

Human Factors Task Description

- Evaluate the impact of multi-modal conditional clearance factors on the occurrence of large height deviations

Benefits

- Human factors interventions may be implemented to reduce the opportunity for LHDs associated with complex conditional ATC clearances issued via CPDLC.

Applications

- This research will contribute to preventing current issues from adversely affecting data link reliant NextGen concepts (e.g. Dynamic Required Navigation Performance, 4DT, precise metering). It can also be used to inform future FMS user interface design approaches.

FY19 Accomplishments

- Conducted an ASRS analysis to identify the potential relationship between conditional clearance and altitude deviations
- Evaluated CPDLC communications in oceanic airspace from 2014-2017
- Analyzed LHDs in North Atlantic airspace and the New York oceanic control area
- Identified HF issues that contribute to LHDs with complex clearances

Planned Activities

- Projected completed (May 2019)

Deliverable	Due Date	Status
Interim Report on Oceanic Large Height Deviation (LHD) causal factors	November 2018	B
Interim Report documenting the relationship between conditional ATC clearances, Controller Pilot Data-Link Communications (CPDLC), and LHDs in U.S. Oceanic Airspace	March 2019	B
Final Report on NextGen HF recommendations to address current and future conditional clearance – data link risks/issues that could impact the domestic implementation of data comm. enhancements	May 2019	B

Complete | On Track | Delayed

Human Error Mitigation Strategies for TBO Concepts that May Rely on ½ (Lat./Long.) Degree Waypoints

Task Profile

Project Manager: Chuck Perala (NextGen HF)

Research Performers: Divya Chandra, Andrea Sparko (Volpe Center)

Sponsors: Mark Patterson (Flight Standards Service), Kathy Abbott (Aviation Safety Organization), Kevin Kelley (Flight Standards Service)

NextGen Relationship:

Human Factors Task Description

- There is wide variance in how ½ degree waypoints are presented. This project examines the prevalence of navigation errors associated with these waypoints and mitigation strategies for these errors.

Benefits

- In the far-term, capabilities will be introduced that may rely on defining non-database waypoints in less than full degrees to reduce lateral route offsets. This research will identify the human-system performance risks, limitations, and opportunities that are associated with the use of ½ degree non-database waypoints.

Applications

- This project will provide HF-based design, error prevention, and mitigation strategies to be considered in future flight deck system user interfaces and waypoint labelling standards for flight plans, clearances, and NAT track messages.

FY19 Accomplishments

- Compile and analyze information from research to develop findings and recommendations (May 2019)

Planned Activities

- Organize and document findings and recommendations (December 2019)

Deliverable	Due Date	Status
Final Report documenting recommendations for human factors mitigation strategies to address ½ degree waypoint risks	December 2019	G

Complete | On Track | Delayed

Human Factors Recommendations to Address Flightpath Management System Dependencies

HF Guidelines for Advanced Instrument Procedure Design & Use	NextGen Procedures, Tasks, Skills & Training for NextGen Air Carrier Pilots	NextGen Advanced Vision Systems, Sensor-Based Technologies, HMD, Other FD Systems	Data Comm Human Factors R&D	**NextGen Human Error & Complex Systems**

Task Profile

Project Manager: Shallu Darhele (NextGen HF)

Research Performer: Claudia McKnight (MITRE)

Sponsors: Kathy Abbott (Aviation Safety Organization), Rob Burke (Flight Standards Service)

NextGen Relationship: Cross Cutting

Human Factors Task Description

- Develop a current definition for manual flight operations
- Evaluate the current state of manual flight operations
- Identify the impact of NextGen changes that could limit the opportunity for manual flight in NAS operations

Benefits

Applications

FY19 Accomplishments

- Completed manual flight operations data collection and analysis plan (June 2019)

Planned Activities

- Conduct guided discussions with technical pilots and industry SMEs to understand the current state of manual flight operations and how operators are maintaining manual flight proficiency

Deliverables	Due Date	Status
Research plan	June 2019	B
Interim report	March 2020	G
Final report	July 2020	G

Complete | On Track | Delayed

NextGen Flight Deck Air/Ground Integration Human Factors– Future Planned Work (FY20+)

Human Factors Guidelines for Advanced Instrument Procedure Design and Use
Evaluate Future NextGen and NAS Procedure Concepts to Identify Potential Impacts on Flight Deck Procedures and Pilot Performance Identify Emerging Flight Path Management Needs Introduced by Complex NextGen Flight Procedures
Procedures, Tasks, Skills and Training for NextGen Air Carrier Pilots and Dispatchers
Continue Manual Flight Operations Research – Terminal Environment Identify Changes to Required Cognitive Skills as a Result of NextGen NAS Improvements