



**Federal Aviation
Administration**

REDAC / HF

Review of FY 2019 Accomplishments and Future Planned Portfolio

*Flight Deck/Maintenance/System
Integration Human Factors*

BLI Number: 8AA (Core)

Chuck H. Perala, Ph.D.

August 27, 2019



Flight Deck/Maintenance/System Integration Human Factors

What are the benefits of the program

- Provides the research foundation for FAA guidelines, handbooks, Orders, Advisory Circulars (AC), Technical Standards Orders (TSO), and regulations that help ensure the safety and efficiency of aircraft operations.
- Develops human performance information that the Agency provides to the aviation industry for use in designing and operating aircraft, and training pilots and maintenance personnel.

Flight Deck/Maintenance/System Integration Human Factors *Overview Capabilities*

Team Members:

- Program Manager – Dr. Chuck Perala, ANG-C1
- Project Manager – Shallu Darhele, ANG-C1

Performers:

- Civil Aerospace Medical Institute (CAMI)

University Partners:

- University of Central Florida
- Auburn University

Core Human Factors Research Requirements

		Allocated Funds by FY		
Requirement	Sponsor	FY17	FY18	FY19
Advanced Vision Systems (EFVS, EVS, SVS, and CVS), Head Up Displays (HUD), Head Mounted Displays (HMD): Certification and Operational Approval Criteria (A11G.HF.4)	Flight Standards – Flight Technologies and Procedures (AFS-410)	X	X	X
Avionics & New Technologies - Certification and Operational Approval Criteria (A11G.HF.2)	Aircraft Certification (AIR-6B0)	-	X	-
Enhancing Aviation Safety Through Advanced Procedures, Training & Checking Methods , to Include Loss of Control Detection, Avoidance, and Recovery (A11G.HF.1) Pilot Training, Qualification, Procedures, and Flight Operations (A11F.HF.11) – starts FY20	Flight Standards – Air Carrier Training and Voluntary Safety Programs (AFS-280)	X	-	-
General Aviation Safety Improvement Research – A Multi-Method Approach to Accident Reduction (A11G.HF.6)	Small Airplane Directorate, Standards Office - Programs and Procedures Branch (ACE-114)	-	-	-
Human Factors R&D for Improved Rotorcraft Operational Safety (A11G.HF.7)	Flight Standards – General Aviation and Commercial Division (AFS-820)	-	-	-
Fatigue Mitigation in Flight Operations (A11G.HF.8)	Flight Standards – Air Transportation Division (AFS-220)	-	-	X
Maintenance Human Factors to Support Risk-Based Decision Making (RBDM) and Maintenance Safety Culture (A11G.HF.10)	Flight Standards – Aircraft Maintenance Division (AFS-360)	X	-	X

Flight Deck/Maintenance/System Integration Human Factors – FY2019 Accomplishments

- **Advanced Vision Systems (A11G.HF.4)**
 - Quantifying the contribution of HUD to Pilot Performance on Approaches Where HUD is Used, But Not Required, to Transition to Landing (visual segment of SA CAT I approach)
 - Evaluation of HF & Crew Coordination Aspects of Dual HUD CAT III Operations Compared to Single HUD CAT III Operations. Evaluate Whether Active Monitoring Improves Crew Performance Over a Baseline Condition.
 - Synthetic Vision (SV) Technology Comparison between Head-up & Head-down Displays in Part 121 Operations
- **Procedures, Training & Checking Methods (A11G.HF.1)**
 - Identifying Crew Resource Management (CRM) Training Techniques in the Airline Industry
 - Training the Emerging Pilot Workforce
 - Recommendations for Effective Air Carrier Training Metrics and Technologies, Including Distance Learning

Flight Deck/Maintenance/System Integration Human Factors – FY2019 Accomplishments

- **Maintenance Human Factors to Support Risk-Based Decision Making (RBDM) and Maintenance Safety Culture (A11G.HF.10)**
 - Maintenance Human Factors to Support Risk-Based Decision Making (RBDM) and Maintenance Safety Culture
 - Human Factors Maintenance Risk Management - Fatigue
- **Human Factors R&D for Improved Rotorcraft Operational Safety (A11G.HF.7)**
 - Scenario Based Training (SBT) for Improved Rotorcraft Operational Safety

Quantifying the contribution of HUD to Pilot Performance on Approaches Where HUD is Used, But Not Required, to Transition to Landing (visual segment of SA CAT I approach)

Advanced Vision Systems
A11.G.HF.4

Training & Checking Methods
A11.G.HF.1

Maintenance / RBDM
A11G.HF.10

Improved Rotorcraft Op Safety
A11.G.HF.7

Task Profile

Program Manager: Chuck Perala/ANG-C1

Research Performer: Daniela Kratchounova, Colleen Fercho (CAMI)

AVS Sponsor: Chris Hope/AFS-410

Human Factors Task Description

- How does the use of HUD during the visual segment of an SA CAT I approach impact pilot performance?

Recent Accomplishments

- Completed project kick-off meeting with AVS sponsors
- Initiated a literature review on pilot performance while using HUD

Planned Work Activities

- Complete literature review
- Initiate a pilot task analysis to identify the sub-tasks executed during the visual segment of an SA CAT I approach
- Identify potential contributors to pilot performance when using HUD vs. OTW views
- Apply interim results to develop the experiment test plan

Benefits

- Results of this research will support the expanded use of existing technologies, such as HUD, during low visibility flight operations which may reduce head-down time, leading to increased situation awareness and pilot confidence.

Research to Reality

- Flight Standards will develop new requirements & guidance for using HUD during times when HUD is not required during CAT I operations. Information to develop job aids & evaluation tools will also be provided to Flight Standards inspectors.

Deliverable	Due Date	Revised Due Date	Status
Document Literature Review & Task Analysis Results, Including Potential Research Gaps	8/1/19		G
Experiment Test Plan	3/31/20		G
Final Report	9/30/22		G

 Complete  On Track/Low Risk  Delayed/Medium Risk  Late/High Risk

Risks, Issues, Opportunities (RIO)

- CAMI is negotiating sim schedules w/ AFS-430 & industry to address impacts introduced by the shutdown & routine sim maintenance plans.

Evaluation of HF & Crew Coordination Aspects of Dual HUD CAT III Operations Compared to Single HUD CAT III Operations. Evaluate Whether Active Monitoring Improves Crew Performance Over a Baseline Condition.

Advanced Vision Systems
A11.G.HF.4

Training & Checking Methods
A11.G.HF.1

Maintenance / RBDM
A11G.HF.10

Improved Rotorcraft Op Safety
A11.G.HF.7

Task Profile

Program Manager: Chuck Perala/ANG-C1

Research Performer: Daniela Kratchounova, David Newton (CAMI)

AVS Sponsor: Chris Hope/AFS-410

Human Factors Task Description

- Does the use of dual HUD provide the pilot monitoring (PM) with active monitoring capabilities (e.g. early detection of flightpath changes) during CAT III flight operations?
- How does the use of dual HUD impact pilot performance and crew coordination compared to single HUD operations?

Recent Accomplishments

- Completed project kick-off meeting with AVS sponsors

Planned Work Activities

- Conduct a task analysis to evaluate how the use of dual HUD during CAT III flight operations will change pilot monitoring tasks and crew coordination versus single HUD operations (baseline condition)

Benefits

- Results of this research will support the expanded use of existing technologies, such as HUD, during low visibility flight operations which may improve crew coordination, leading to increased situation awareness and pilot confidence during approaches in low instrument meteorological conditions.

Research to Reality

- Flight Standards will use results to develop new requirements & guidance for using dual HUD during CAT III flight operations. Information to develop job aids & evaluation tools will also be provided to Flight Standards inspectors.

Deliverable	Due Date	Revised Due Date	Status
Task Analysis Technical Report	8/1/19		G
Experiment Test Plan	3/31/20		G
Final Report	9/30/22		G

 Complete  On Track/Low Risk  Delayed/Medium Risk  Late/High Risk

Risks, Issues, Opportunities (RIO)

- CAMI is negotiating sim schedules w/ AFS-430 to address impacts introduced by the shutdown & routine sim maintenance plans.

Synthetic Vision (SV) Technology Comparison between Head-up & Head-down Displays in Part 121 Operations

Advanced Vision Systems
A11.G.HF.4

Training & Checking Methods
A11.G.HF.1

Maintenance / RBDM
A11.G.HF.10

Improved Rotorcraft Op Safety
A11.G.HF.7

Task Profile

Program Manager: Chuck Perala/ANG-C1

Research Performer: Dennis Berringer (CAMI)

AVS Sponsor: Chris Hope, Janet Greenwood / AFS-410

Human Factors Task Description

- Manufacturers are developing & seeking operational credit for new SV HUD & HMD applications not covered by existing rules & guidance (e.g. alerting, color-coding, symbology, installation, etc.)

Recent Accomplishments

- Continued to develop preliminary report on 1st phase of comparative research:
- Identified new SV technologies planned for development within the next 5 years including enhancements, features, functions, & designs
- Identified potential pilot-system interface issues & potential HF needs associated with new SV applications
- Identified the HF research needed to resolve identified system issues
- Evaluated current guidance & procedures to determine if the existing FAA framework can sufficiently address new SV technologies, including their use during single pilot operations

Planned Work Activities

- Conduct a HITL simulation to evaluate proposed systems & identify unique pilot system interface issues and broader HF operational integration issues

Benefits

- Results of this research will support the expanded use of existing technologies, such as HUD, during low visibility flight operations which may reduce head-down time, leading to increased situation awareness and pilot confidence.

Research to Reality

- Flight Standards will develop operational credit approval criteria and guidelines for evaluating head-up, head-down, and head-mounted displays for use in Part 121 operations. Information to develop job aids & evaluation tools will also be provided to Flight Standards inspectors.

Deliverable	Due Date	Revised Due Date	Status
Literature Review	9/30/18		B
Market Survey	9/30/18		B
Preliminary Report	6/30/19		G
Executive report - SVS human performance impacts (SA CAT I/II)	12/30/19		G
Executive Report - SV Comparison of HDD/HUD Differences	12/30/19		G
Executive report- minimum training, recent flight experience, & proficiency requirements for SVS on SA CAT I approaches	12/30/19		G



Complete



On Track/Low Risk



Delayed/Medium Risk



Late/High Risk

Risks, Issues, Opportunities (RIO)

- None at this time

Identifying Crew Resource Management (CRM) Training Techniques in the Airline Industry

Advanced Vision Systems
A11.G.HF.4

Training & Checking Methods
A11.G.HF.1

Maintenance / RBDM
A11.G.HF.10

Improved Rotorcraft Op Safety
A11.G.HF.7

Task Profile

Program Manager: Shallu Darhele/ANG-C1

Research Performer: Florian Jentsch (UCF)

AVS Sponsor: Kathy Abbott/AVS, Rob Burke/AFS-280

Human Factors Task Description

- Are there gaps in Part 121 CRM training programs?
- How do line pilots perceive CRM training in current operations?

Benefits

- CRM training methods will evolve on the basis of human factors data

Research to Reality

- The results of this research will serve to provide information that will be used by the FAA to augment specific CRM guidelines, principles, procedures, and tools that have been developed to improve CRM training and assessment across US airlines, including the update to Advisory Circular 120-51E, Crew Resource Management Training

Recent Accomplishments

- Adjudicated final report comments provided by AVS technical sponsors

Planned Work Activities

- Final report publication
- Complete grant close-out process

Deliverable	Due Date	Revised Due Date	Status
Task 2 Survey Draft	11/28/17		B
Task 1 Interim Report (Highlights Report)	5/3/18		B
Task 1 and Task 2 Technical Report	9/30/18		B
Survey Draft	9/30/18		B
Survey Technical Report	03/28/19		B
SRM Technical Report	03/28/19		B



Complete



On Track/Low Risk



Delayed/Medium Risk



Late/High Risk

Risks, Issues, Opportunities (RIO)

- None

Training the Emerging Pilot Workforce

Advanced Vision Systems A11.G.HF.4	Training & Checking Methods A11.G.HF.1	Maintenance / RBDM A11G.HF.10	Improved Rotorcraft Op Safety A11.G.HF.7
---------------------------------------	---	----------------------------------	---

Task Profile

Program Manager: Shallu Darhele/ANG-C1

Research Performer: Auburn University

AVS Sponsor: Kathy Abbott/AVS

Human Factors Task Description

- How should training and checking methods for the future pilot workforce evolve to best include information management, aeronautical decision making, and pilot judgment?

Recent Accomplishments

- Acquisition & Grants Group (AAQ-610) is working with OST to accelerate the review and approval of this grant

Planned Work Activities

- Grant award
- Project kick-off meeting
- Initiate literature review of learning science and best practices for training millennials and future generations
- Apply literature review findings to develop draft recommendations

Benefits

- Training and checking methods will evolve on the basis of human factors data

Research to Reality

- Data will support updates to training and checking guidance used by FAA inspectors and operators
- Updates to 14 CFR Part 121, Subparts N, O & Y, AC 120-54 Advanced Qualification Program, AC 120-71 Standard Operating Procedures, AC 120-51 Crew Resource Management Training, AC 120-35 Line Operational Simulation, and FAA Order 8900.1

Deliverable	Due Date	Revised Due Date	Status
Draft Recommendations - Review learning science & best practices on effective training for millennials & future generations	11/1/18		R
Examine emerging workforce issues & trends; Identify training programs to address issues	3/1/19		R
Field test new methods for training with select cert. holders	2/1/20		Y
Summarize results & propose new training/checking methods	6/1/20		Y
Final Technical Report	9/1/20		Y

■ Complete
 ■ On Track/Low Risk
 ■ Delayed/Medium Risk
 ■ Late/High Risk

Risks, Issues, Opportunities (RIO)

- The length of the new grants process has put project funding at-risk

Recommendations for Effective Air Carrier Training Metrics and Technologies, Including Distance Learning

Advanced Vision Systems
A11.G.HF.4

Training & Checking Methods
A11.G.HF.1

Maintenance / RBDM
A11G.HF.10

Improved Rotorcraft Op Safety
A11.G.HF.7

Task Profile

Program Manager: Shallu Darhele/ANG-C1

Research Performer: Florian Jentsch (UCF)

AVS Sponsor: Kathy Abbott/AVS

Human Factors Task Description

- Examine the effectiveness & appropriateness of distance learning, particularly with respect to tablet technologies, for pilots and flight attendants in current operations

Benefits

- The Agency's knowledge of distance learning limitations and effectiveness will keep pace with the proliferation of distance learning applications used by certificate holders

Research to Reality

- Recommendations will be made on the basis of human factors scientific and technical data to revise training and checking guidelines for FAA field inspectors and operators

Recent Accomplishments

- Acquisition & Grants Group (AAQ-610) is working with OST to accelerate the review and approval of this grant

Planned Work Activities

- Grant award
- Project kick-off meeting
- Initiate literature review of current airline distance learning programs, current research, and recommended practices on pilot training effectiveness

Deliverable	Due Date	Revised Due Date	Status
Report summarizing current airline distance learning programs, current research, & recommended practices on pilot training effectiveness	10/1/18		R
ID training techniques & technologies	2/1/19		R
Collect data from airlines - determine methods & metrics for evaluating training effectiveness	6/1/19		R
Study - Compare task training w/ technologies like virtual/augmented reality & traditional FTDs for skill transfer evaluated in full-flight sims	5/1/20		Y
Summarize findings, recommendations	10/1/20		Y
Final distance learning tech. report	6/1/21		Y



Complete



On Track/Low Risk



Delayed/Medium Risk



Late/High Risk

Risks, Issues, Opportunities (RIO)

- The length of the new grants process has put project funding at-risk

Maintenance Human Factors to Support Risk-Based Decision Making (RBDM) and Maintenance Safety Culture

Advanced Vision Systems A11.G.HF.4	Training & Checking Methods A11.G.HF.1	Maintenance / RBDM A11G.HF.10	Improved Rotorcraft Op Safety A11.G.HF.7
---------------------------------------	---	----------------------------------	---

Task Profile

Program Manager: Chuck Perala/ANG-C1

Research Performer: Kylie Key (CAMI)

AVS Sponsor: Bill Johnson/AIR-100, Time Shaver/AFS-430

Human Factors Task Description

- What scalable tools and interventions can be developed to assess, monitor, and improve human factors in maintenance applications such as Safety Management System (SMS) Programs, Safety Culture, General Aviation, and RBDM?

Benefits

- Research products will further the implementation and consistent use of the RBDM concept in aviation maintenance safety programs.

Research to Reality

- Apply science-based and empirically tested approaches/tools to proactively develop interventions for identifying and managing maintenance safety risk.
- The target user for the research results are corporate safety and engineering departments, and FAA Airworthiness Safety Inspectors (ASI). End products will be useful for airlines, repair stations, and general aviation maintenance environments.

Recent Accomplishments

- Completed RBDM Draft Report and Sponsor Briefing (March 2019)
- Submitted SMS-HF Integration and GA Maintenance Error draft reports to AVS for review (December 2018)

Planned Work Activities

- Incorporate technical feedback provided by AVS into the RBDM, SMS-HF Integration, and GA Maintenance Error draft reports

Deliverable	Due Date	Revised Due Date	Status
RBDM Draft Report and Sponsor Briefing	12/30/18	3/30/19	G
SMS – HF Integration Draft Report and Sponsor Briefing	12/30/18		G
GA Maintenance Error Draft Report and Sponsor Briefing	12/30/18		G



Complete



On Track/Low Risk



Delayed/Medium Risk



Late/High Risk

Risks, Issues, Opportunities (RIO)

- None

Human Factors Maintenance Risk Management - Fatigue

Advanced Vision Systems
A11.G.HF.4

Training & Checking Methods
A11.G.HF.1

Maintenance / RBDM
A11G.HF.10

Improved Rotorcraft Op Safety
A11.G.HF.7

Task Profile

Program Manager: Chuck Perala/ANG-C1

Research Performer: Katrina Avers, Kylie Key (CAMI)

AVS Sponsor: Bill Johnson/AIR-100, Tim Shaver/AFS-430

Human Factors Task Description

- How can existing tools, methods, and interventions be tailored and used to manage the risk of fatigue in aviation maintenance?

Recent Accomplishments

- Airlines 4 America (A4A) approved the 'Best Practices Report'

Planned Work Activities

- Publication of the approved report is expected to occur this summer

Benefits

- Research products will provide data-driven modifications to existing tools, methods, and interventions to address the unique needs of aviation maintenance organizations and aviation maintenance safety programs

Research to Reality

- FAA will update guidance and future requirements aimed at managing fatigue risk in maintenance operations
- Industry may use research products to evolve how their organization's monitor and manage maintenance fatigue risk

Deliverable	Due Date	Revised Due Date	Status
Best Practices Report for Part 121 Operations for Fatigue Risk Management Implementation	09/30/18		B

 Complete  On Track/Low Risk  Delayed/Medium Risk  Late/High Risk

Risks, Issues, Opportunities (RIO)

- None

Scenario Based Training (SBT) for Improved Rotorcraft Operational Safety

Advanced Vision Systems
A11.G.HF.4

Training & Checking Methods
A11.G.HF.1

Maintenance / RBDM
A11G.HF.10

Improved Rotorcraft Op Safety
A11.G.HF.7

Task Profile

Program Manager: Chuck Perala/ANG-C1

Research Performer: Kevin Williams (CAMI)

AVS Sponsor: John Drago, AFS-800

Human Factors Task Description

- Will the use of SBT result in improved pilot performance (Parts 61, 91, 141, 135) in off-nominal conditions including inadvertent flight into IMC, LOC prevention & emergency procedures (e.g. white-/brown-out recovery), and scenarios with sudden or gradual onset (e.g. engine loss at cruise speed, auto-rotation)?

Benefits

- Results of this research will support the development and implementation of human factors interventions that aim to reduce the recent spike in rotorcraft accidents.

Research to Reality

- Flight Standards will use research results to identify criteria for evaluating equipment and procedures not presently contained in applicable regulations, to address proper function, use, and potential hazards. These criteria will help Flight Standards to define policies, generate guidance, and modify regulations pertaining to rotorcraft safety.

Recent Accomplishments

- Identified candidate flight deck display technologies to be evaluated. These technologies are intended to increase awareness of: Aircraft Performance; Known hazards to navigation/flight (e.g. low altitude obstacles); Flight Deck Alarms & Alerts (e.g. mode effectiveness).
- Documented operational rotorcraft threats, hazards, events, consequences, & barriers.
- Completed a literature review and survey of SBT implementations across aviation and non-aviation domains (e.g. training for off nominal conditions).

Planned Work Activities

- Incorporate sponsor feedback into deliverables 1-3
- Develop a framework for the evaluation of rotorcraft technologies, procedures, and training methods/interventions
- Create operational rotorcraft SBT lesson plans
- Conduct HITL simulation(s) to evaluate SBT lesson plan effectiveness

Deliverable	Due Date	Revised Due Date	Status
Identification of potential cockpit technologies to be evaluated	4/30/18	7/31/19	G
Document threats, hazards, events, consequences, & barriers	4/30/18	7/31/19	G
Lit. review & survey of current SBT implementations in Part 91, 61, etc.	7/20/18	7/31/19	G
Develop generalizable framework for the evaluation of technologies, procedures, and training methods	1/30/19	8/31/19 (est.)	G
Creation of SBT lesson plans	1/30/19	8/31/19 (est.)	G
Proof-of-concept evaluation of the effectiveness of SBT lesson plans	1/30/20		G

 Complete
  On Track/Low Risk
  Delayed/Medium Risk
  Late/High Risk

Risks, Issues, Opportunities (RIO)

- None

Flight Deck/Maintenance/System Integration Human Factors – Future Planned Work

Avionics & New Technologies- Certification and Operational Approval Criteria

Task 1: General Guidance Document Update. Planned Period of Performance: 04/2019 – 02/2021.

Task 2: Pilot Distraction Due to the Information Automation, Phase II. Planned Period of Performance: 04/2019 – 12/2019.

Task 3: EFB ALPA Safety Survey. Planned Period of Performance: 05/2019 – 08/2019.

Task 4: HF Visual Scanning Study. Planned Period of Performance: Under development.

Advanced Vision Systems (EFVS, EVS, SVS, CVS), Head-Up Displays (HUD), and Head Mounted Displays (HMD): Op. Standards & Approval Criteria

HUD Task 1: Pilot Performance Using Flight Director, HUD, and SVGS in the Instrument Segment to Inform Lowering Standard CAT I Minima. Planned Period of Performance: 09/2019 – 03/2021.

HUD Task 2: Identify Potential Pilot Performance and Operational Impacts Associated with Using HUD to Conduct CAT II and CAT III Approaches Using Other than ALSF I or ALSF II Approach Lighting System. Planned Period of Performance: 09/2019 – 03/2021.

SVGS Task 1: Pilot Performance and Human Factors Considerations Using SVGS on an SA CAT I Approach with Less than a MALSR Approach Lighting System. Planned Period of Performance: 09/2019 – 03/2021.

Flight Deck/Maintenance/System Integration Human Factors – Future Planned Work

Fatigue Mitigation in Flight Operations

Fatigue Task 1: Analyze the fatigue risk management programs' databases on day-to-day operational fatigue to evaluate the effectiveness of fatigue mitigation outcomes both before and after implementation of 14 CFR Part 117. Provide recommendations for updating relevant AC guidance and educational materials. Planned Period of Performance: 09/2019 – 09/2020.

Fatigue Task 2: Document the development of research studies to investigate the impact of short, long, and ultra long-range flight operations on pilot performance and human factors under 14 CFR Part 117 and 117.7. Planned Period of Performance: 09/2019 – 09/2020

Human Factors to Support Risk-Based Decision Making (RBDM) and Maintenance Safety Culture

Mx Safety Culture Task 1: Document methods used to develop, evaluate, and enhance safety culture in aviation and other industries. Planned Period of Performance: 09/2019 – 09/2020.

Mx RBDM Task 1: Document the review and categorization of support tools for risk-based decision making. Planned Period of Performance: 09/2019 – 09/2020.

Mx SMS Task 1: Document which human performance issues should be integrated into safety management systems (SMS). Planned Period of Performance: 09/2019 – 09/2020.

Mx GA Maintenance Task 1: Document the types of maintenance human errors involved in general aviation accidents and incidents. Planned Period of Performance: 09/2019 – 09/2020.

Questions?

**Chuck Peralá, ANG-C1 Core Flight Deck
Human Factors BLI Manager**

Chuck.Peralá@faa.gov

202.267.0768