Federal Aviation Administration

REDAC / Human Factors

Review of FY 2022
Proposed Portfolio

Air Traffic Control / Technical Operations Human Factors

BLI Number: A11.h (was A11.i)

Date: March 10, 2020

What are the benefits to the FAA

- **Improving the safety and efficiency of complex ATC systems by application of R&D to address factors affecting human performance in air traffic control operations and ATC system maintenance through improved guidance, selection, and training.**
- **Recommending and testing improvements to design, procedures, training, selection and placement; and mitigations to address human performance shortfalls.**

What determines program success

- **R&D Sponsors and Stakeholders in the ATO are able to make important workforce policy, acquisition, and operational management decisions based on the results of thorough, timely, and focused R&D efforts.**
- **When programs embrace human factors processes and requirements during system acquisition, they reduce human factors risks.**
- **Reducing human factors risks increases the likelihood for successful system implementation and operation, while reducing the likelihood for system design and engineering rework.**

Overview Capabilities

People:

- Program Manager – Dan Herschler, ANG-C1
- Subject Matter Expert – Bill Kaliardos, ANG-C1

Laboratories:

- ANG-E25 Human Factors Branch, Aviation Research Division Research and Development Human Factors Laboratory
- AAM-520 NAS Human Factors Safety Research Laboratory

University Partners:

- University of Chicago

Air Traffic Control / Technical Operations Human Factors
A11.h – Accomplishments in Current FY (20)

- **Color Standard Implementation Demonstrations**
- **Completed Optimization of Information Display for the Controller (Phase 2) HITL**
- **Alarms and Alerts Handbook Kickoff and Lab Orientation**
- **Completed coordination of ATC Tech Ops HF FY20 Requirements**

Air Traffic Control / Technical Operations Human Factors
A11.h – Accomplishments in Current FY (20)

- **Color Standard Implementation Demonstrations**
  - Joint effort with the Tech Center Human Factors Branch and CAMI human factors experts applying the FAA ATC display color standard (FAA HF-STD-010) to demonstrate the new color palette that is designed to accommodate controllers who have color vision deficiencies.
  - The static and dynamic demonstrations on actual ATC displays provide users with opportunities to view and interact with the proposed color palette to gain controller acceptance for en route and terminal controller workstations.
  - The static and dynamic mockups include realistic traffic scenarios and supporting flight and other operational data on the display. Controllers were invited to view and interact with the mockups and to provide feedback on the suitability of the new colors.

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A11.h – Accomplishments in Current FY (20)

- **Completed Optimization of Information Display for the Controller (Phase 2) HITL**
  - Completed preparations for a HITL simulation examining the integration of multiple near-term enhancements onto the ERAM controller workstation.
    - Allows researchers to identify human factors issues in complex interactions among multiple systems, functions, and user interface elements
    - Many programs' enhancements are brought together onto a single controller workstation for the first time (see next slide for details).
  - Completed data collection activities at WJHTC during the week of February 7, 2020

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A11.h – Accomplishments in Current FY (20)

Optimization of Information Display for the Controller (Phase 2)
(HITL Capabilities Implemented)

Single Program Capabilities:

- **ERAM enhancements**
  - 43-inch UHD displays for the Radar Position
  - 24-inch displays for the Radar Associate position
  - Conflict Probe
    - integration on the R position (in addition to the RA Position)
  - Trial Planning
    - Integration on the on the R position (in addition to the RA Postion)
    - Probed menus
      - Altitudes, Routes
    - Probed trajectories
  - Electronic Coordination
    - Sector directed coordination: altitudes, heading, direct to fix, speed, reference aircraft
  - Electronic horse collars to replace the paper version
    - Including names of sectors, frequencies, etc.
  - Probe View
  - Route Display on R Position
  - Movable menus

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A11.h – Accomplishments in Current FY (20)

Optimization of Information Display for the Controller (Phase 2)
(HITL Capabilities Implemented)

Single Program Capabilities (continued):

- **DataCom Full Services**
  - Clearances
    - Altitude, Speed, Direct-To-Fix, Altimeter, Transfer of Communications, Full Route, Resume Normal Speed
    - Crossing Restrictions (cross fix at altitude and/or fix/speed
  - Reports: Confirm Assigned Altitude, Confirm Assigned Route, Confirm Speed
  - Advisory messages
  - Pilot Initiated Downlinks: Altitude, Direct to Fix, Reroute, Deviation
- **Time Based Flow Management**
  - Delay Countdown Time, GIM-S Speed Advisory
- **Traffic Flow Management System**
  - AirBorne ReRoute

Air Traffic Control / Technical Operations Human Factors
A11.h – Accomplishments in Current FY (20)

- **Alarms and Alerts Handbook**
  - A requirement sponsored by AJM which will identify and assess guiding documentation for how to develop or integrate alarms and alerts and how to properly train system users of alarms and alerts.
  - Completed kickoff meeting and lab orientation in December 2020. Initiating site visits in coordination with AJT.
  - Tech Transfer Note:
    - Principal investigator is highly regarded and experienced human factors expert in the medical domain (operating room anesthesiologist) with considerable work in the area of medical device signaling systems (i.e., alarms and alerts).
    - Technology transfer: Lessons learned in the high-consequence medical environment can be applied to develop recommended guidance for signaling systems and operator training in the air traffic control domain.

Air Traffic Control / Technical Operations Human Factors
A11.h –Anticipated Research in FY21

- Continue work for FAA's Program Management Organization (AJM):
  - Conduct research to develop design handbook guidance and user training for effective implementation of signaling systems (alarms and alerts) in ATC systems
  - Conduct operational simulation-based evaluation to validate updated ATC radar display color palette.

- Initiate new work for AJM sponsor:
  - Conduct initial research to evaluate touch-based user interface technologies and identify human factors considerations affecting air traffic controller performance
  - Update the Human Factors Job Aid (guide for acquisition programs' human factors leads)

- Continue work for ATO's Management Services (AJG):
  - Evaluate the ATCS selection process to identify better predictors of successful completion of training

- Initiate new work for AJG sponsor:
  - Support requirements development for an AHR contract effort to update the Air Traffic Selection Aptitude test battery
  - Conduct an analysis to align ATSS competencies using 2015 job task analysis data

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A11.h –Anticipated Research in FY21

- Continue work for ATO's Office of Safety and Technical Training (AJI):
  - Evaluate the effectiveness of ATO's controller fatigue mitigation strategies
  - Develop best practices, guidance, and recommended training for improved visual scanning for tower controllers
- Initiate new work for AJI sponsor:
  - Conduct a workload study to determine on-position fatigue effects and recommend mitigations
  - Develop additional "common competencies" Academy training for ATC new hires that will better prepare them to succeed in field

- Continue work for ATO's Air Traffic Services (AJT)
  - Conduct an information flow analysis and identify information sharing vulnerabilities with the Joint Air Traffic Operations Command (JATOC)*.

    *Note: As part of the FAA Air Traffic Control System Command Center (ATCSCC), the JATOC was developed in 2018 to improve the lines of communication by creating a single stream of operational reporting within the air traffic operation.

- Initiate new work for AJT sponsor:
  - Assess impact of facility realignment on ATC workforce
  - Identify research (in progress or completed) on the impact of TBO implementation on Air Traffic Control Specialists. Develop research plan to investigate TBO impacts.

Air Traffic Control / Technical Operations Human Factors *A11.h* Emerging FY22 Focal Areas

- **HUMAN FACTORS RESEARCH FOR <u>IMPROVED SAFETY, REDUCED HAZARDS, AND ERROR MITIGATION IN ATC</u>**
  - Develop a deployable human factors simulation capability enabling remotely sited controllers to review and comment on proposed new ATC technologies and procedures - ref. 49 USC 44505(b)(3)
  - Develop guidance for ATC alerts and information displays and controller training to address commonly occurring errors – ref. 49 USC 44505(b)(4)

- **HUMAN FACTORS RESEARCH ON <u>AUTOMATION EFFECTS AND CONTROLLER PERFORMANCE</u>**
  - Develop training and procedural guidance recommendations for mitigating the potential deskilling effects of long-term use of automation – ref. 49 USC 44506(a)
  - Develop facility operational guidance and training for recognition and mitigation of workload effects on controller fatigue and performance – ref. 49 USC 44506(a)(2)

- **HUMAN FACTORS RESEARCH FOR <u>IMPROVED DESIGN AND OPERATION OF ATC SYSTEMS</u>**
  - Update the Human Factors Design Standard (FAA HF-STD-HF-001) to incorporate the latest scientific and technical information in design requirements for information display and management, including use of colors in tower ATC displays – ref. 49 USC 44506(b)(2)
  - Update the Human Factors Design Standard (FAA HF-STD-HF-001) to incorporate the latest scientific and technical information in design requirements for automated ATC systems – ref. 49 USC 44506(b)

- **HUMAN FACTORS RESEARCH FOR <u>IMPROVED CONTROLLER SELECTION AND TRAINING</u>**
  - Evaluate training effectiveness ratio (TER) comparing controller training alternatives including full fidelity simulation, computer-based instruction with embedded simulations, and team training for basic radar vectoring skills and advanced trajectory operations – ref. 49 USC 44506(a)(1)
  - Develop recommendations for controller training that measurably increase use of ATC automation capabilities and controller performance (efficiency) – ref. 49 USC 44506(a)(4)

- **HUMAN FACTORS RESEARCH FOR <u>WORKFORCE OPTIMIZATION</u>**
  - Develop and execute a CAMI research plan to address key human factors research competencies and knowledge bases in areas supporting decisions to automate ATC tasks, reduce errors, improve system design, and enhance effectiveness of training – ref. 49 USC 44507(g)

- **<u>ATC RESEARCH HUMAN FACTORS COLLABORATIONS</u>**
  - DoD HFE TAG, DOT HFCC, Eurocontrol/FAA CP1.7, FAA and NASA Human Factors Coordination, etc. to set common standards and facilitate human factors technology transfer – ref. 49 USC 40104(b)

Air Traffic Control / Technical Operations Human Factors *A11.h* Emerging FY22 Focal Areas (continued)

Title 49 United States Code References

	49 USC Section
HUMAN FACTORS RESEARCH FOR IMPROVED SAFETY, REDUCED HAZARDS, AND ERROR MITIGATION IN ATC	
• Research on Human Factors in Air Safety and Accident Investigation	44505(b)(1)
• Research on Analysis of Human Factors Hazards in New ATC Technologies	44505(b)(3)
• Research to Identify Innovative and Effective Measures to Correct Human Error	44505(b)(4)
• Research to Develop an Understanding of Human Factors and UAS Safety	44505(b)(6)
• Research on Aviation Safety and Security	44505(c)(4)

Air Traffic Control / Technical Operations Human Factors *A11.h* Emerging FY22 Focal Areas (continued)

Title 49 United States Code References (continued)

	49 USC Section
HUMAN FACTORS RESEARCH ON AUTOMATION EFFECTS AND CONTROLLER PERFORMANCE	
• Human Factors Research to Enhance Controller Performance	44505(b)(2)
• Research on Human Performance in the Air Transportation Environment	44505(c)(3)
• Research on Effects of Automation on Performance of Air Traffic Controllers and the ATC System	44506(a)
• Research on the Role of Automation in the ATC System and its Physical and Psychological Effects on Controllers	44506(a)(2)
• Research on Human Perceptual Capabilities and the Effect of Computer-Aided Decision Making on Workload and Performance of Controllers	44506(b)(1)
• Research on Air Traffic Controller Workload and Performance Measures, Including Development of Predictive Models	44506(b)(3)
HUMAN FACTORS RESEARCH FOR WORKFORCE OPTIMIZATION	
• Research on Agency Work Force Optimization, Including: Training, Equipment Design, Reduction of Errors, and Identification of Candidate Tasks for Automation	44507(g)

Air Traffic Control / Technical Operations Human Factors *A11.h* Emerging FY22 Focal Areas (continued)

Title 49 United States Code References (continued)

	49 USC Section
HUMAN FACTORS RESEARCH FOR IMPROVED DESIGN AND OPERATION OF ATC SYSTEMS	
• Research on Human Factors Aspects of the Highly Automated Environment for Air Traffic Controllers	44506(b)
• Research on Information Management Techniques for Advanced Air Traffic Control Display Systems	44506(b)(2)
• Research on Vision and its Relationship to Human Performance and Equipment Design	44507(e)
• Research on Air Traffic Controllers, Airway Facility Technicians, and Others on Human Factors in Operation and Maintenance of ATC Equipment	44507(f)
HUMAN FACTORS RESEARCH FOR IMPROVED CONTROLLER SELECTION AND TRAINING	
• Research to Establish Appropriate Selection Criteria and Training Methodologies for Air Traffic Controllers	44506(a)
• Research on Methods for Improving and Accelerating Controller Training using Advanced Training Techniques	44506(a)(1)
• Research on Attributes and Aptitudes Needed in a Highly Automated ATC System and Development of Appropriate Testing Methods for Identifying Individuals with Those Attributes and Aptitudes	44506(a)(3)
• Research on Innovative Methods for Training Controllers to Enhance the Benefits of ATC Automation	44506(a)(4)

Air Traffic Control / Technical Operations Human Factors
A11.h

Research Requirement

SUPPORTS FAA STRATEGIC GOALS:
Priority 1: Make Aviation Safer and Smarter
Priority 2: Deliver benefits through Technology and Infrastructure
Priority 4: Empower and innovate with the FAA's people

The ATC/TO Human Factors research program supports FAA strategic goals for increased safety and greater capacity by developing research products and promoting the use of those products to meet the future demands of the aviation system.

Outputs/Outcomes

Human Factors Research Products:

Guidance – informs ATO sponsors using human factors scientific and technical information for improved design of ATC systems, identifying and mitigating human factors hazards and human error

Selection – provides data-driven analyses and recommendations for improving the effectiveness (i.e., predictive utility) of FAA controller selection measures and supports compliance with merit principles and EEO Uniform Guidelines

Training – provides scientific basis for measuring performance in training and recommended improvements in training methods

FY 2022 Planned Research

IMPROVED SAFETY, REDUCED HAZARDS, AND ERROR MITIGATION IN ATC

AUTOMATION EFFECTS AND CONTROLLER PERFORMANCE

IMPROVED DESIGN AND OPERATION OF ATC SYSTEMS

IMPROVED CONTROLLER SELECTION AND TRAINING

WORKFORCE OPTIMIZATION

ATC RESEARCH HUMAN FACTORS COLLABORATIONS

Out Year Funding Requirements

FY20	FY21	FY22
$1.6M	TBD	TBD