REDAC / Human Factors

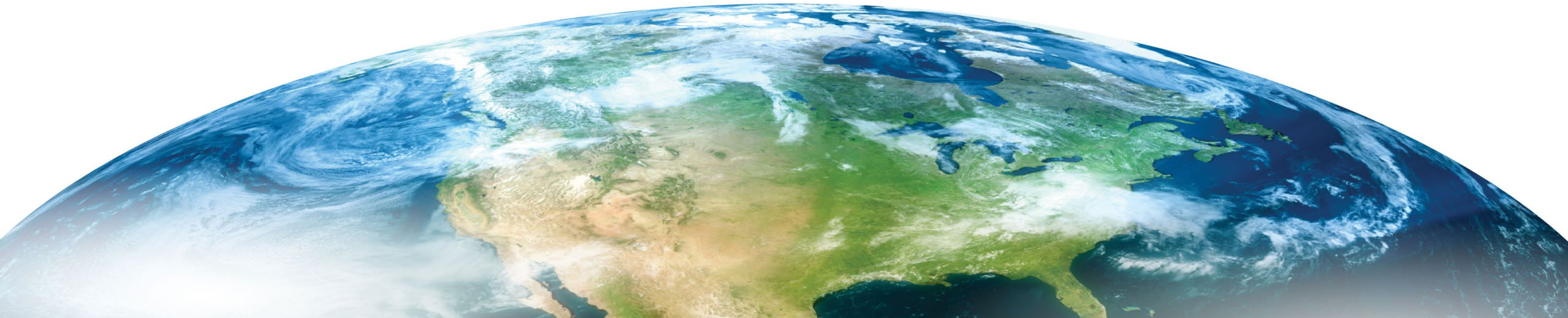
Air Traffic Control / Technical Operations
Human Factors

BLI Number: A11.i

Presenters' Names:
Dan Herschler

Review of FY 2021 - 2023
Proposed Portfolio

Date: March 24, 2021



Air Traffic Control / Technical Operations Human Factors **Overview**

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.**

Air Traffic Control / Technical Operations Human Factors

Program Support

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
- The Ohio State University

Current FY21 Accomplishments

Research Activities	Research Products
Optimization of Air Traffic Control Information Presentation (OAIP) in the En Route Environment – Baseline Simulation	Completed final draft final report
ATCS Selection Process Evaluation	Developed research plans for collecting relevant data in the ATC longitudinal data base and elsewhere
Assessment and Evaluation of Transition of Initial Qualification En Route Course from Resident Training to Virtual/Blended Learning	Completed literature review: Blended learning principles and best practices
Evaluation and Validation of a Stress Management Training Course for Air Traffic Control Trainees	Published final report DOT/FAA/AM-20/17

Anticipated Research in FY21-22

Planned Research Activities	Expected Research Products
ATCSCC Training Needs Analysis	A report documenting air traffic control command center job task requirements and training gaps
Develop and document an efficient and cost effective job analysis methodology	A job analysis technique that the ATO can use to rebaseline the position requirements for 50 different jobs, and apply to the development of employee selection and training.
Color palette for high ambient lighting conditions	Expanded color vision standard to include a recommended color palette for ATC towers (where ambient lighting is high)
Human Machine Teaming	Report on state-of-the-art with guidelines for design and controller training recommendations to address future automation improvements that include artificial intelligence and machine learning agents.
Evaluation of the Virtual Air Traffic Training Environment	Report on the effectiveness of remote learning technologies in air traffic controller field training
Assessment and Evaluation of transition of Initial Qualifications En Route course from resident training to virtual/blended learning	Report on the effectiveness of remote learning technologies in early stages of air traffic controller training (in conjunction with or in lieu of in-person instruction at the FAA Academy)
Identifying NOTAM specialist job requirements to align with training and certification needs	Analysis report featuring the NOTAM specialist job and its relation to training and certification requirements

Anticipated Research in FY21-22 (continued)

Planned Research Activities	Expected Research Products
Controller Visual Scanning Instructional Methods Research	Visual scanning prototype training tool and training effectiveness evaluation report
ATC Fatigue Mitigation Effectiveness	Report correlating controller work shifts and actigraph measures of sleep, with inferences about the effectiveness of ATO's mitigations of controller fatigue
Workload Effects on Fatigue	Report identifying both subjective reports of fatigue and correlating them with objective measure of traffic load and complexity at high and medium levels of controller workload
Update FAA HF-STD-HF-001 on design requirements	Updates to FAA HF-STD-001, the Human Factors Design Standard (HFDS) guidance and requirements in sections pertaining to automated ATC systems, information display and management, workstation arrangement and display, and touch-based user interfaces
Gap analysis - previous experience ATC hires	Report identifying training emphasis areas to address knowledge and skill gaps noted for controller new hires who have previous ATC experience
ATSS Competency Alignments (ICAO & Competency Model development)	Report linking the knowledge, skill, and ability requirements in the Technical Operations workforce with relevant International Civil Aviation Organization (ICAO) defined competencies, focusing on the Airway Transportation System Specialist (ATSS)

Anticipated Research in FY21-22 (continued)

Planned Research Activities	Expected Research Products
Color Palette and Palette Deployment	Report of the completion of a dynamic demonstration with field ATC participants to validate the suitability of the revised color palette
Integration of Alarms and Alerts Into Air Traffic Systems	Report providing a human factors handbook to assist in the development of system design and associated training requirements for integration of alarms and alerts into air traffic systems https://rip.trb.org/View/1670686
Effective Integration of Human Factors Engineering into System Development Acquisition Programs	Report providing recommendations for an update to the Human Factors (HF) Job Aid and the HF practitioner training course https://rip.trb.org/View/1761880
Training for ATC New Hires on Common Competencies: Proficiency Level of Academy Graduates	Report identifying ATC knowledges and skills of recent graduates of FAA Academy initial training relative to facility training organization expectations

Emerging FY23 Focal Areas

- For AJI (ATO Safety and Technical Training):
  - Facility operational guidance and training for recognition and mitigation of workload effects on controller fatigue and performance
  - Training and procedural guidance recommendations for mitigating the potential deskilling effects of long-term use of automation
  - Recommendations for controller training that measurably increase use of ATC automation capabilities and controller performance (efficiency)

- For AJM (ATO Program Management Office):
  - Deployable human factors simulation capability enabling remotely sited controllers to review and comment on proposed new ATC technologies and procedures
  - Guidance for ATC alerts and information displays and controller training to address commonly occurring errors
  - Develop human supervisory control interactions and performance measures for shared computer-human ATC methods using advanced artificial intelligence decision aiding approaches

- For AJG (ATO Management Services):
  - Develop comprehensive task domain model for air traffic controllers using job task analysis and cognitive task analysis data with current and anticipated technologies and procedures enabling capabilities for terminal and en route ATC
  - Develop ATC maintenance task guidance and standards for Technical Operations personnel
  - Develop new selection tests, ATC option placement guidance, and training approaches for air traffic controllers using job task analysis (JTA) and cognitive task analysis (CTA) data for technologies and procedures in terminal and en route ATC, considering the latest training technologies

Air Traffic Control / Technical Operations Human Factors

Research Requirements

1. Improved Safety, Reduced Hazards, And Error Mitigation In ATC
2. Automation Effects And Controller Performance
3. Improved Design And Operation Of ATC Systems
4. Improved Controller Selection And Training
5. Controller And Technical Operations Workforce Optimization

Outputs/Outcomes

- Deployable simulation tools for remote data collection and evaluation of proposed new ATC capabilities
- Training and procedural guidance to mitigate deskilling effects from long-term use of automation
- Analysis of job tasks and cognitive tasks for ATC and technical operations to support improved selection, placement, and training of new hires
- Recommendations for controller training for better use of automation capabilities

FY 2023 Planned Research

- Develop a deployable human factors simulation capability
- Develop guidance for ATC alerts and information displays and controller training
- Develop training and procedural guidance to mitigate potential deskilling effects of long-term use of automation
- Develop facility operational guidance and training for recognition and mitigation of workload effects on controller fatigue and performance
- Develop recommendations for controller training that measurably increase use of ATC automation capabilities and controller performance (efficiency).

Out Year Funding Requirements

RE&D

FY20	FY21	FY22	FY23
$5.9M	$5.9M	$ 5.9M	$ 5.9M

F&E

FY20	FY21	FY22	FY23	FY24	FY25
$ 0	$ 0	$ 0	$ 0	$ 0	$ 0

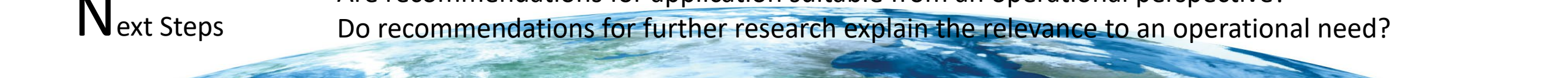
Note: RE&D FY23 and beyond is notional.

Backup slides

- Statutory basis for ATC / Technical Operations Human Factors RE&D

Defining a Quality Research Product – The 7 Ns

Criterion	Description
K**N**owledge	How well does the product establish its rationale and relevance based on linkages to past research, current operational challenges, and application of expertise in the HF domain?
I**N**novation	How does the product advance HF research and application practices, or develop the state-of-the-art in a specific area within the HF domain?
Observatio**N**	What is the nature of the data that are reported in the research product? Are the measures well-accepted as appropriate for the area of study? Are all data subjective in nature, or are there also measured observations?
A**N**alysis	What kind of analysis was done and was it appropriate for the kinds of data that were obtained? Are statistical corrections used when appropriate? Power analysis reported?
Nuance	Does the product address all main effects, interactions, and post-hoc tests that enable full understanding of the results? Does the product effectively integrate findings, including subjective and objective data? Study execution factors that could have affected the results are described?
Narrative	Does the product describe how the findings and conclusions follow from the analysis of the data? How well does the product link conclusions to the relevant context or research requirement?
Next Steps	Are recommendations for application suitable from an operational perspective? Do recommendations for further research explain the relevance to an operational need?



Statutory basis for ATC / Technical Operations Human Factors RE&D

HUMAN FACTORS RESEARCH FOR IMPROVED SAFETY, REDUCED HAZARDS, AND ERROR MITIGATION IN ATC	49 USC Section
• 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)

Statutory basis for ATC / Technical Operations Human Factors RE&D (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)

Statutory basis for ATC / Technical Operations Human Factors RE&D (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)