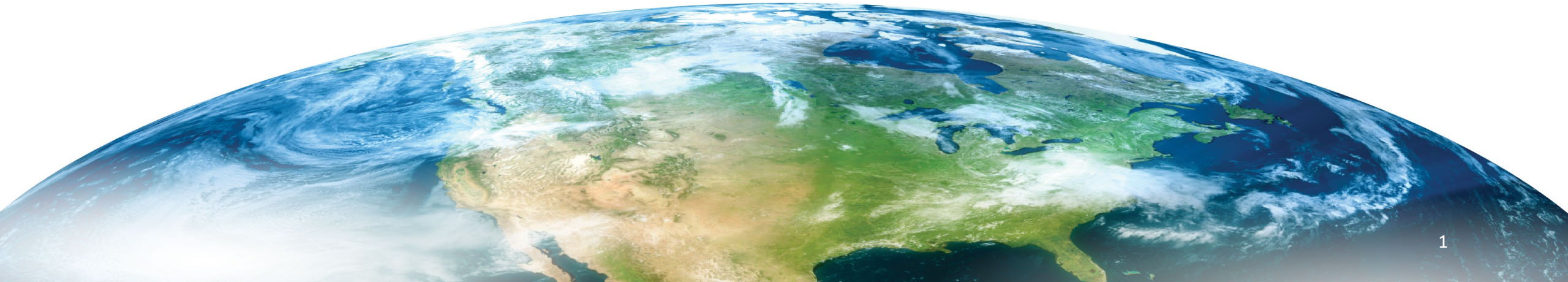
NextGen Air/Ground Integration Human Factors Research Program

Semiannual update to the REDAC Human Factors Subcommittee

Presenter: Dr. Victor Quach, NextGen Human Factors Division (ANG-C1)

Budget Line Item (BLI) Number: 111110

Date: August 29, 2023



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 (AFS) 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 Program Accomplishments since FY2023 Q2

Project	Description/Product
Pilot Tasks, Skills, Procedures, and Training Research	
Verification & Validation Study – Criteria to Evaluate Manual Flight Operations Tasks, Knowledge, Skills, Proficiency	Provide empirical data that could indicate how often air carrier pilots should practice a set of manual flight operation maneuvers to maintain skill proficiency. • **Milestone #1:** Completed a human-in-the-loop (HITL) study with 22 pilot participants in the AFS-430 B737NG simulator between May 2023 and July 2023. • **Milestone #2:** Completed preparations for a HITL study with pilot participants in the AFS-430 Airbus simulator between September 2023 and November 2023.
Cognitive Skill Degradation	Provide empirical data that could indicate which cognitive skills and knowledge for certain flightpath management (FPM) tasks that might be more susceptible to decay, and why. • **Milestone #1:** Developed a human factors test and evaluation plan for a HITL study with pilot participants in a B737 simulator and the AFS-430 Airbus simulator.
Pilot Monitoring	Provide research data that might encourage operationally effective methods to train and evaluate pilot monitoring. • **Technical report:** Subset of training and evaluation methods that may warrant refinement and additional study.
Flightcrew Displays and Interfaces Research	
Speech Recognition/Voice Activated Controls – Rotorcraft	Provide empirical data that could indicate how single and multiple control modalities contribute to pilot task performance. • **Milestone #1:** Developed a test and evaluation plan based on information learned while observing a diverse set of rotorcraft flight operations, semi-structured interview with 25 rotorcraft pilots, and a literature review of research/engineering data. • **Milestone #2:** Initiated a HITL study with pilot participants in a rotorcraft simulator equipped with speech recognition technology.
Instrument Flight Procedures Research	
New Operations Enabled by PBN – Emerging Flight Deck Human Factors Issues	• **Milestone #1:** Developed a research plan to assess operational flight deck human factors considerations in development and expansion of area navigation (RNAV) / required navigation performance (RNP) routes, procedures, and concepts with reduced areas of separation – departure operations.

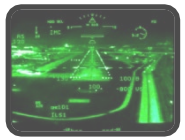
Relationship to Flight Deck/Maintenance/System Integration Human Factors Research Program

AVS sponsors **11 human factors research requirements** managed by the NextGen Human Factors Division (ANG-C1). Information in this briefing aligns with operational capability 8 (OC8) in the AVS budget line-item (BLI) plan for A11G.

OC 1: Improving Pilot Training, Operations, and Procedures
Primary Sponsor: AFS-280, Air Transportation Division, Training and Simulation Group

OC 2: Mitigating Human Fatigue
Primary Sponsor: AFS-220, Air Carrier Operations Branch

OC 3: Supporting Improvements in Aviation Maintenance
Primary Sponsor: AFS-320, Aircraft Maintenance Division



OC 4: Advanced Vision Systems, Head-Up Display, Head-Worn Display: Operation Standards & Approval Criteria
Primary Sponsor: AFS-410, Flight Technologies and Procedures Division

OC 5: Human Factors Considerations and Emerging Trends in Helicopter Air Ambulance Operations
Primary Sponsor: AFS-220, Air Carrier Operations Branch – Part 135 Operations Section

OC 6: Improving General Aviation Pilot Response to Unexpected Events
Primary Sponsor: AVP-230, Office of Accident Investigation and Prevention - Integrated Safety Teams

OC 7: Advances and Innovation in New Technology and Operations
Primary Sponsor: AIR-626, Human Machine Interface Section

OC 8: Air/Ground Integration of Technology, Systems, Operations, and Procedures for Trajectory-Based Operations
Primary Sponsor: AFS-410; AFS-280, AIR-626

OC 9: Integrating Human Factors into Aircraft Certification and Flight Standards Policies and Processes
Primary Sponsor: AFS-100, Aircraft Evaluation Division (AED); AIR-600 Policy and Innovation Division

OC 10: Pilot Physiological State Monitoring Technologies and Mitigations
Primary Sponsor: AAM2, Office of the Deputy Federal Air Surgeon; AIR-626

OC 11: Current Flight Deck Operations and Pilot Procedures: Arrival, Approach, Departure
Primary Sponsor: AFS-410

NextGen Air/Ground Integration Human Factors Research Program

Team Members

- Tara Gibson, Division Manager (Tara.M.Gibson@faa.gov)
- Victor Quach, Program/Project Manager (Victor.K.Quach@faa.gov)
- Karl Kaufmann, Bill Kaliardos, and Alexis Jones, Project Managers
- Contractor Support

Researchers and Laboratories

- FAA Civil Aerospace Medical Institute (CAMI)
- FAA William J. Hughes Technical Center (WJHTC)
- Volpe National Transportation Systems Center, Department of Transportation (DOT)
- NASA AMES Research Center
- MITRE Corporation, Center for Advanced Aviation System Development (CAASD)
- Academia: University of Michigan
- Industry

Pilot Tasks, Skills, Procedures, and Training Research

FY2023 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

FY2023 Research and Potential Project Plans

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Cognitive and Psychomotor Skills

Research Question: What are the cognitive skills and knowledge for flightpath management tasks in a transport airplane?

****ACSAA related research***

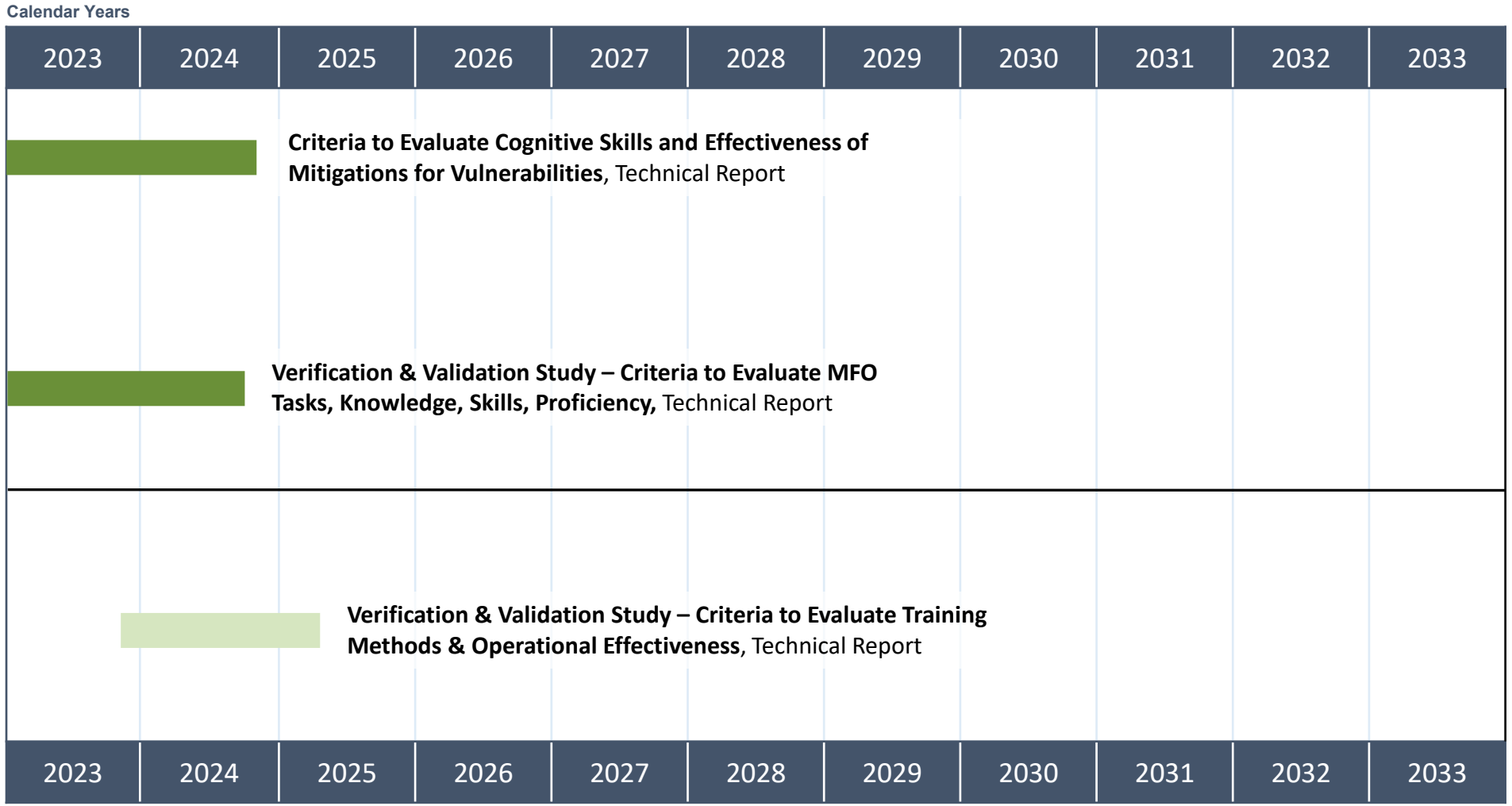
Research Question: What are the tasks, knowledge, and skills for manual flight operation (MFO) maneuvers in a transport airplane?

****ACSAA related research***

Monitoring

Research Question: What are human factors considerations for evaluating monitoring performance in training/line operations, and operational effectiveness of training and training methods for monitoring tasks?

****ACSAA related research***



Flightcrew Displays and Interfaces Research

FY2023 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

FY2023 Research and Potential Project Plans

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Multimodal Controls for Flight Deck Systems

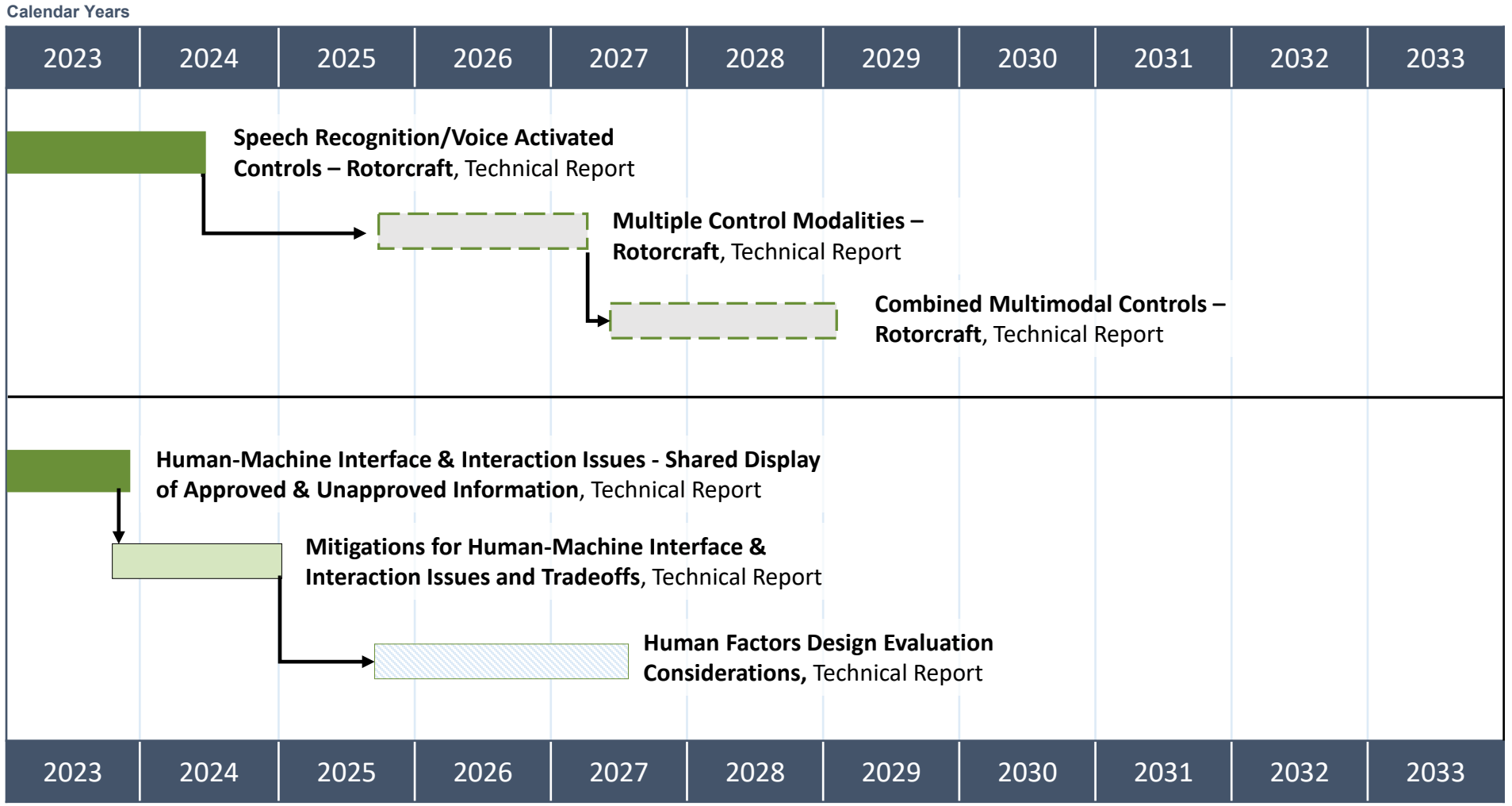
Research Question: What are human factors design evaluation considerations for multimodal controls in a rotorcraft equipped with advanced communication, navigation, and surveillance capabilities?

***ACSAA related research**

Information Automation Systems – Connected Aircraft

Research Question: What evaluation methods and human factors criteria are needed to identify pilot interaction issues with information wholly or partially derived from unapproved data?

***ACSAA related research**



Instrument Flight Procedures Research

FY2023 Research and Potential Project Plans

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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 PBN-related 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

FY2023 Research and Potential Project Plans

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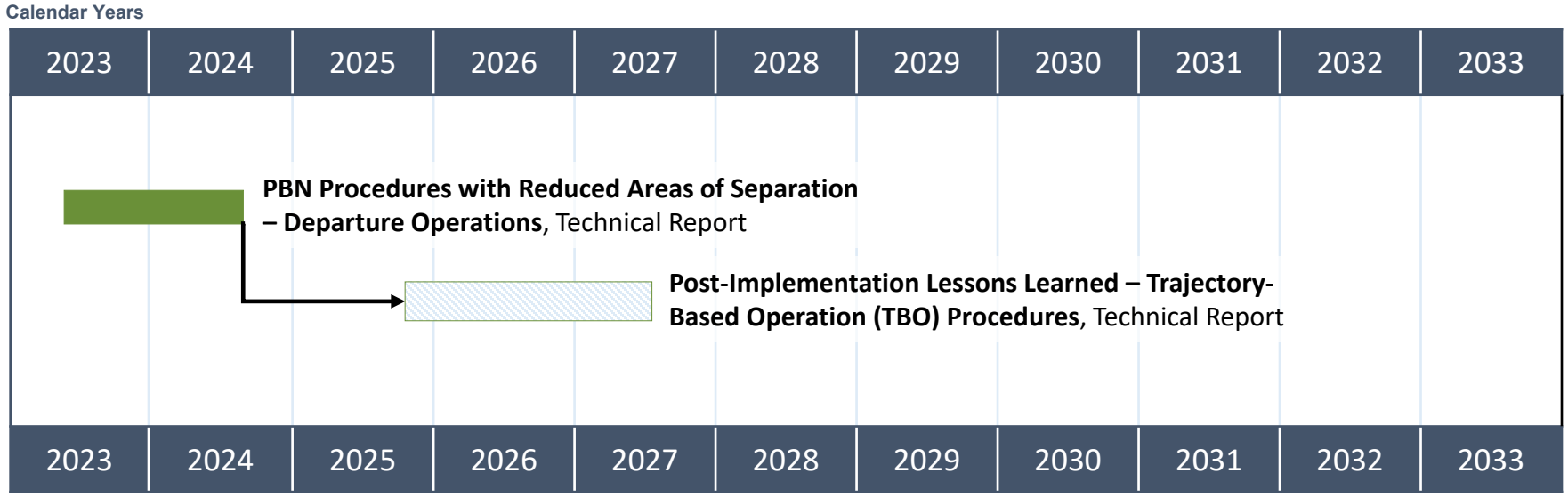
Advanced Procedures

Research Question: What are the flyability/human factors operational acceptability impacts of new arrival/departure procedure concepts enabled by performance-based navigation (PBN)?

***ACSAA related research**



Human Error and Complex Systems Research

FY2023 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

Human Error and Complex Systems Research

FY2023 Research and Potential Project Plans

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

Task Management

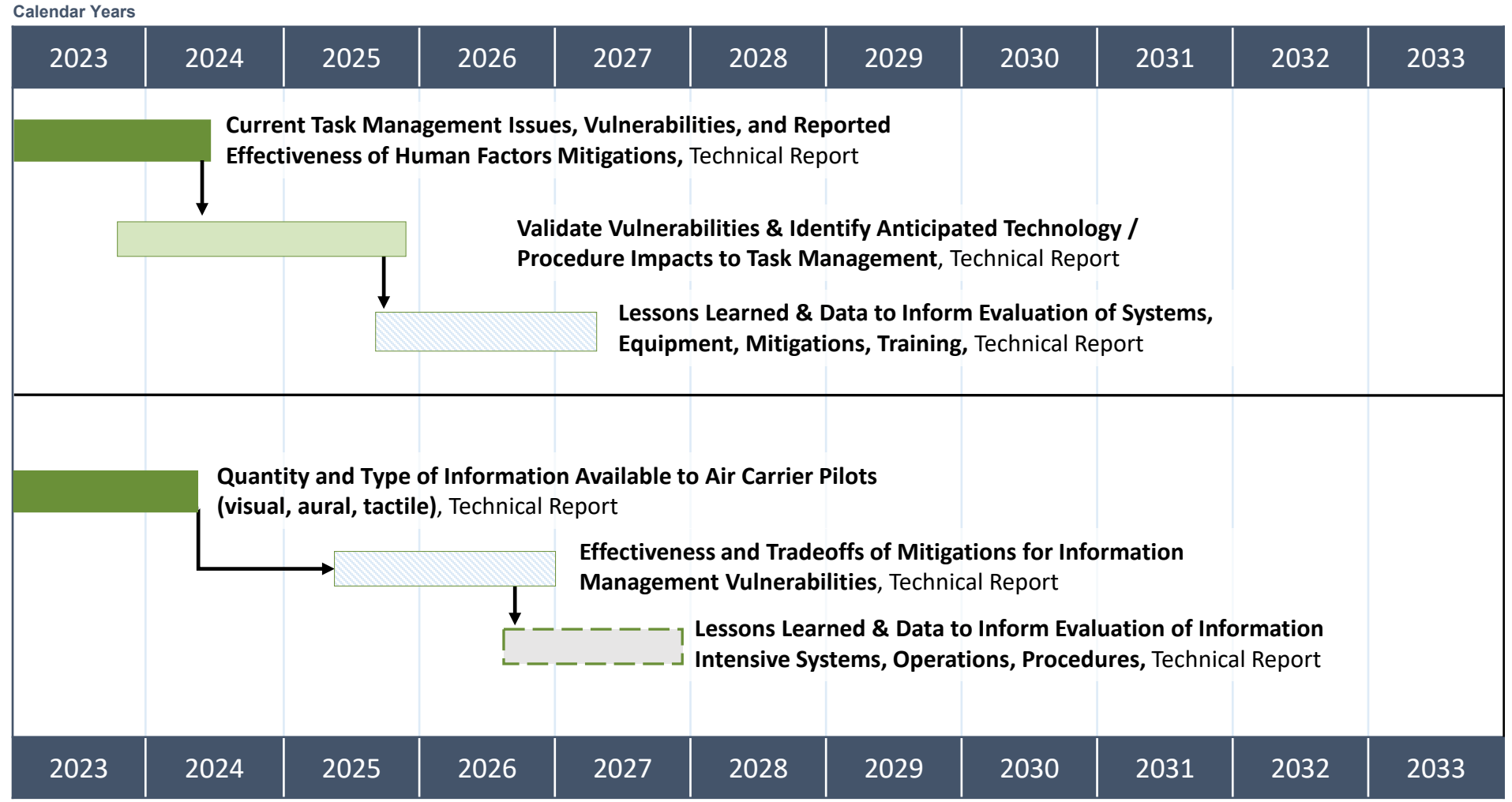
Research Question: What evidence-based criteria, data, and methods can be used to evaluate operational effectiveness of training and procedure mitigations for task management vulnerabilities which affect flight path management (FPM)?

ACSAA related research

Flight Deck Information Management

Research Question: What criteria, data, and methods can be used to evaluate information management vulnerabilities and operational acceptability of mitigations for design and use of highly integrated systems and enabling avionics equipment?

ACSAA related research



Active — Funded research

Starting Soon — Funds available for research

Future Plans — Funds requested for research

Potential Need — Funds might be requested for research

Technical Dependency — Reliance on data between projects

Human Error and Complex Systems Research

FY2023 Research and Potential Project Plans

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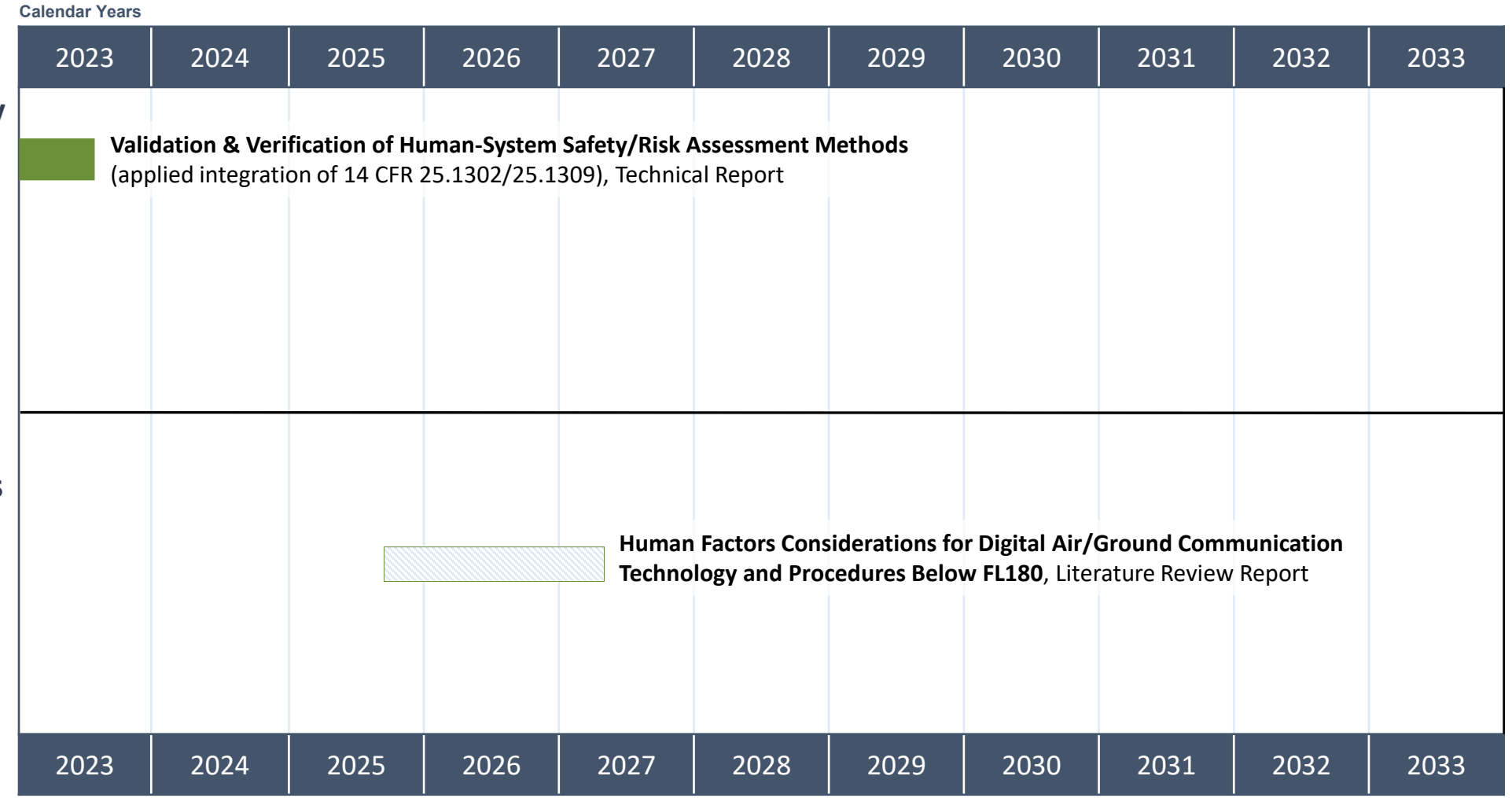
Human-System Safety

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

ACSAA related research

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?



Advanced Vision Systems Research

FY2023 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

Advanced Vision Systems Research

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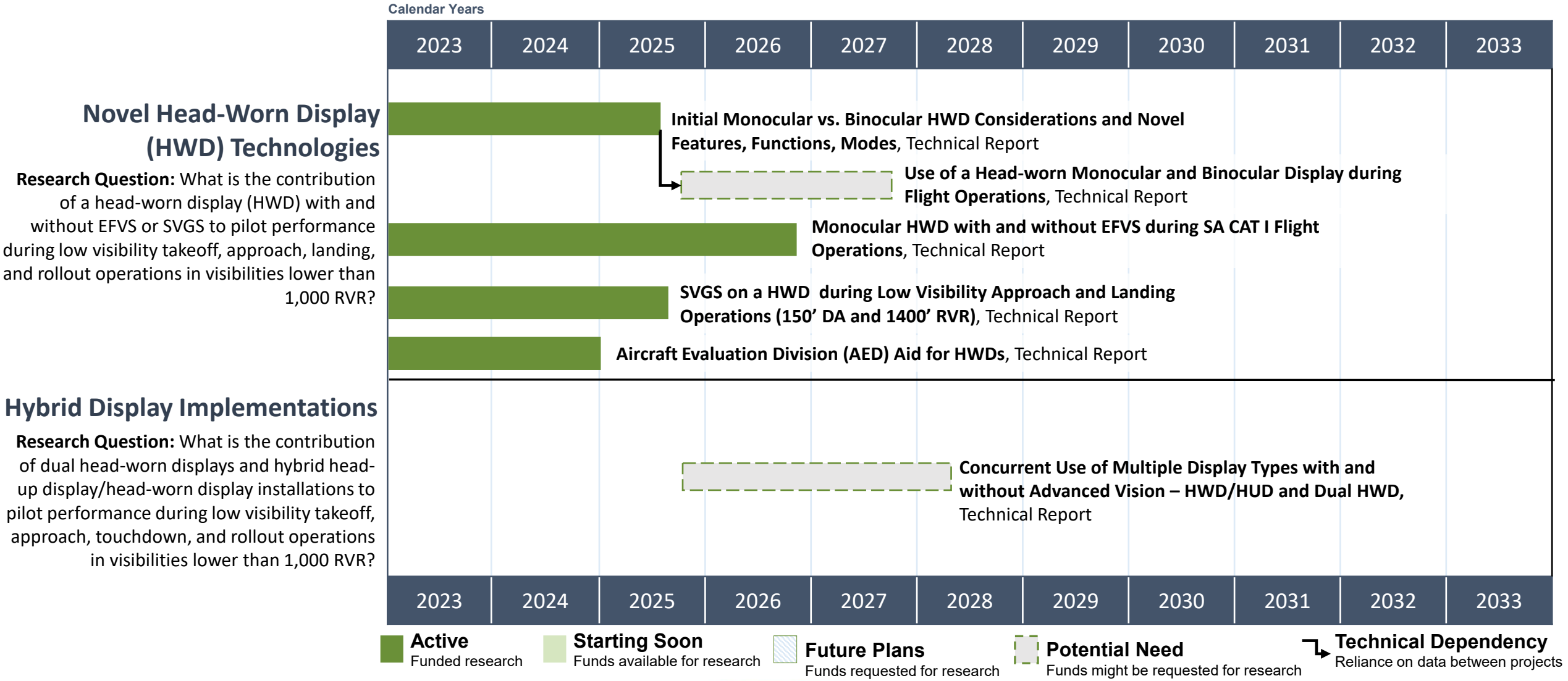

Advanced Vision Systems Research

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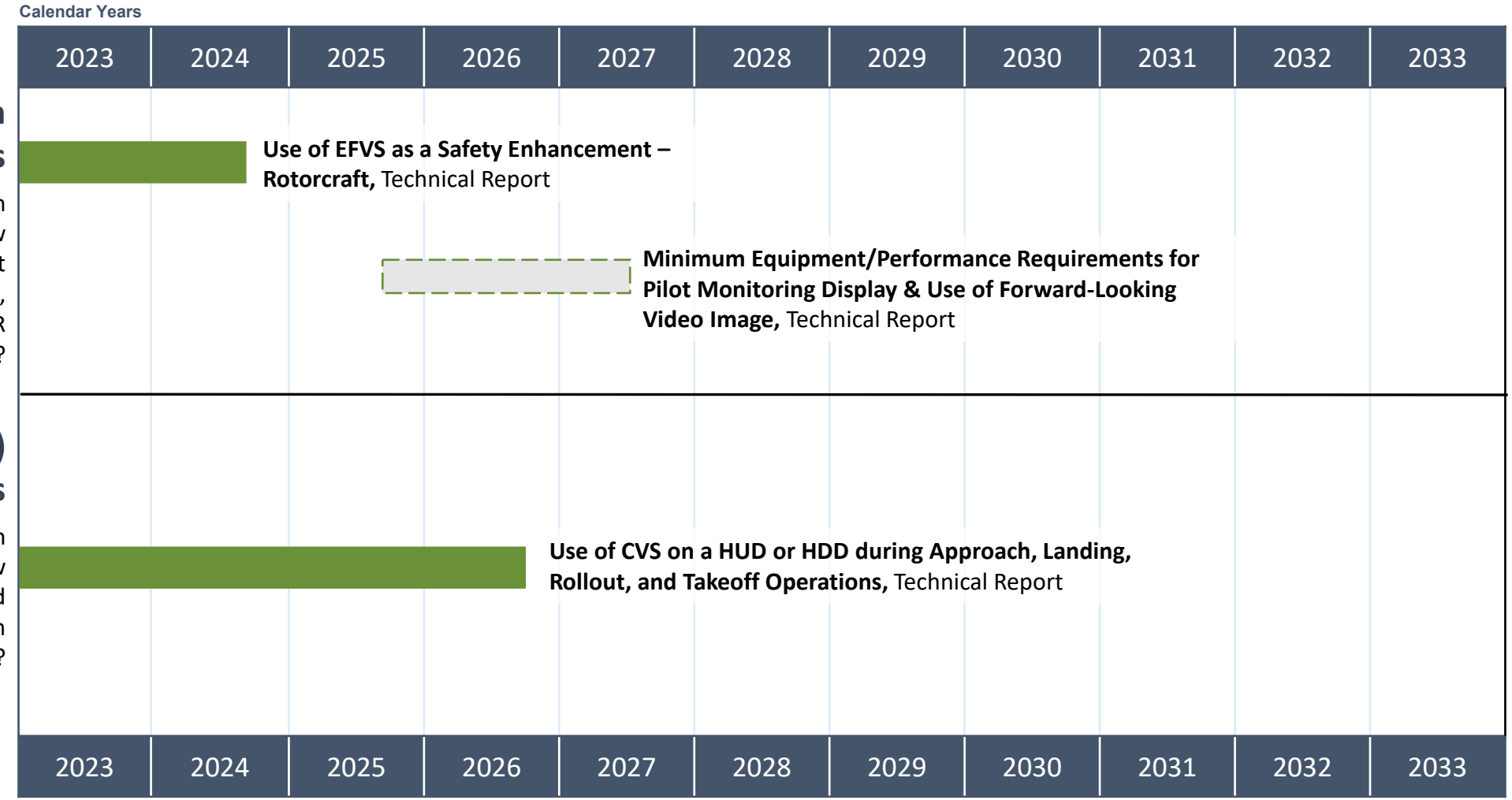
Enhanced Flight Vision System (EFVS) Operations

Research Question: What is the contribution of EFVS to pilot performance during low visibility approach, landing, and rollout operations in visibilities lower than 1,000 RVR, down to 600 RVR, and down to 300 RVR with/without runway visual aids?

Combined Vision System (CVS) Operations

Research Question: What is the contribution of CVS to pilot performance during low visibility takeoff, approach, landing, and rollout operations in visibilities lower than 1,000 RVR?



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