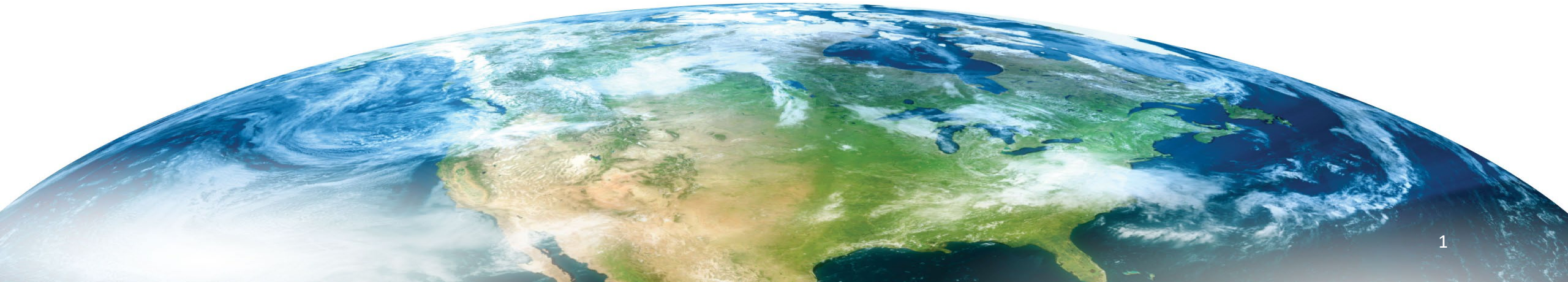
Flight Deck/Maintenance/System Integration Human Factors Research Program

Semiannual update to the REDAC Human Factors Subcommittee

Presenter: Dr. Chuck Perala, NextGen Human Factors Division (ANG-C1)

Budget Line Item (BLI) Number: A11G (8AA)

Date: August 16, 2022



Flight Deck/Maintenance/System 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 the human factors needs of FAA Aircraft Certification (AIR) and Flight Standards (AFX) personnel.
- This program also considers rapid changes to current-day technologies, procedures, and emerging issues

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 AIR and AFX personnel who are responsible for the evaluation, certification, approval, and continued airworthiness of aircraft; and certification of pilots and mechanics

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?

Flight Deck/Maintenance/System Integration Human Factors Research Program

Team Members

- Tara Gibson, Division Manager (Tara.M.Gibson@faa.gov)
- Dr. Chuck Perala, Program Manager (Chuck.Perala@faa.gov)

Researchers and Laboratories

- FAA Civil Aerospace Medical Institute (CAMI)
- Volpe National Transportation Systems Center, Department of Transportation (DOT)
- MITRE Corporation, Center for Advanced Aviation System Development (CAASD)
- Academia: University of Michigan, University of Central Florida (UCF), Massachusetts Institute of Technology (MIT), Auburn University (AU)
- FAA Center of Excellence for Technical Training and Human Performance (COE TTHP)

Flight Deck/Maintenance/System Integration Human Factors Research Program Accomplishments in FY2022

Project	Description/Product
Advanced Vision Systems Research	
Project #1: Evaluation of Human Factors and Crew Coordination Aspects of Dual Head-up Display (HUD) CAT III Operations Compared to Single HUD CAT III Operations **Project #2:** Pilot Performance Using Flight Director, HUD, and a synthetic vision guidance system (SVGS) in the Instrument Segment **Project #3:** Quantifying the contribution of HUD to pilot performance on approaches where HUD is used for transition to landing	**Research plan** to combine data collection activities for 3 advanced vision system projects • Finalized 98 data collection scenarios to support various aspects of each project • Completed human-in-the-loop (HITL) beta testing / dry-runs • Started in-person data collection June 2022
Pilot Training, Procedures, and Operations Research	
Emerging Pilot Workforce	**Draft literature review report** to inform research plan development • Examined research and operations data characterizing the emerging pilot workforce • Reviewed information on advanced learning technologies • Developed a draft test plan to examine effectiveness of training and checking methods
Maintenance Human Factors Research	
Failure to Follow Procedures (FFPs)	**Conference paper** on "Preliminary Findings: Application of Maintenance Instructions Displayed in Augmented Reality" • Aviation maintenance technician perceptions (n=4) using AR (maintenance instructions) on a head-worn device while conducting a landing gear lubrication task • Initial findings might suggest positive perceptions of usability and opportunities to address potential ergonomic, safety, and practical use considerations

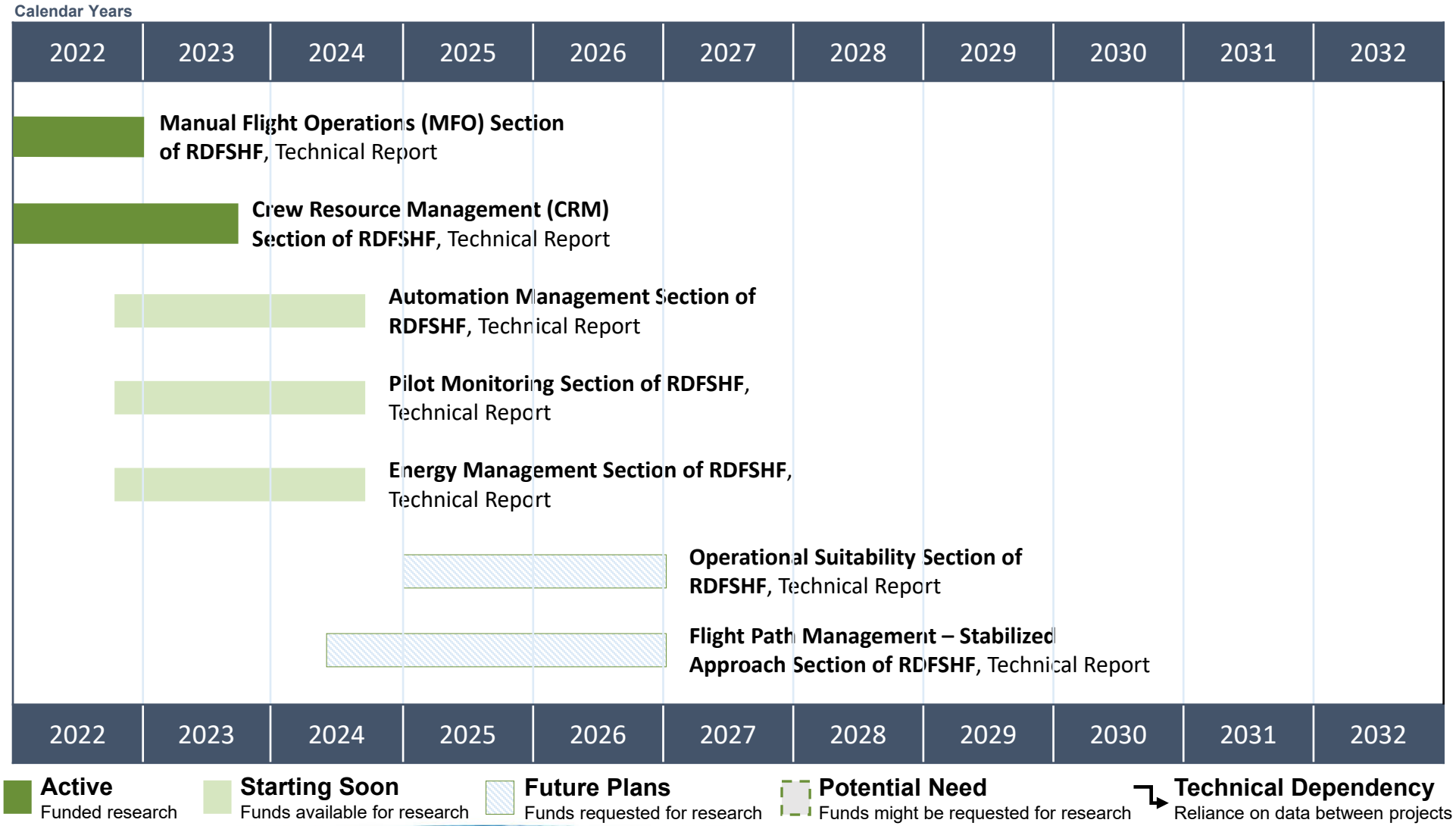
Operational Capability (OC) 1: Improving Pilot Training, Procedures, and Operations

FY2022 Research and Potential Project Plans

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

Single Source Reference Document for Flight Standards Human Factors (RDFSHF)

Research Question: What human factors research data would support the Flight Standards personnel who must evaluate and approve operational suitability, training, procedures, operations, and maintenance?
ACSAA related research



OC 1: Improving Pilot Training, Procedures, and Operations

FY2022 Research and Potential Project Plans

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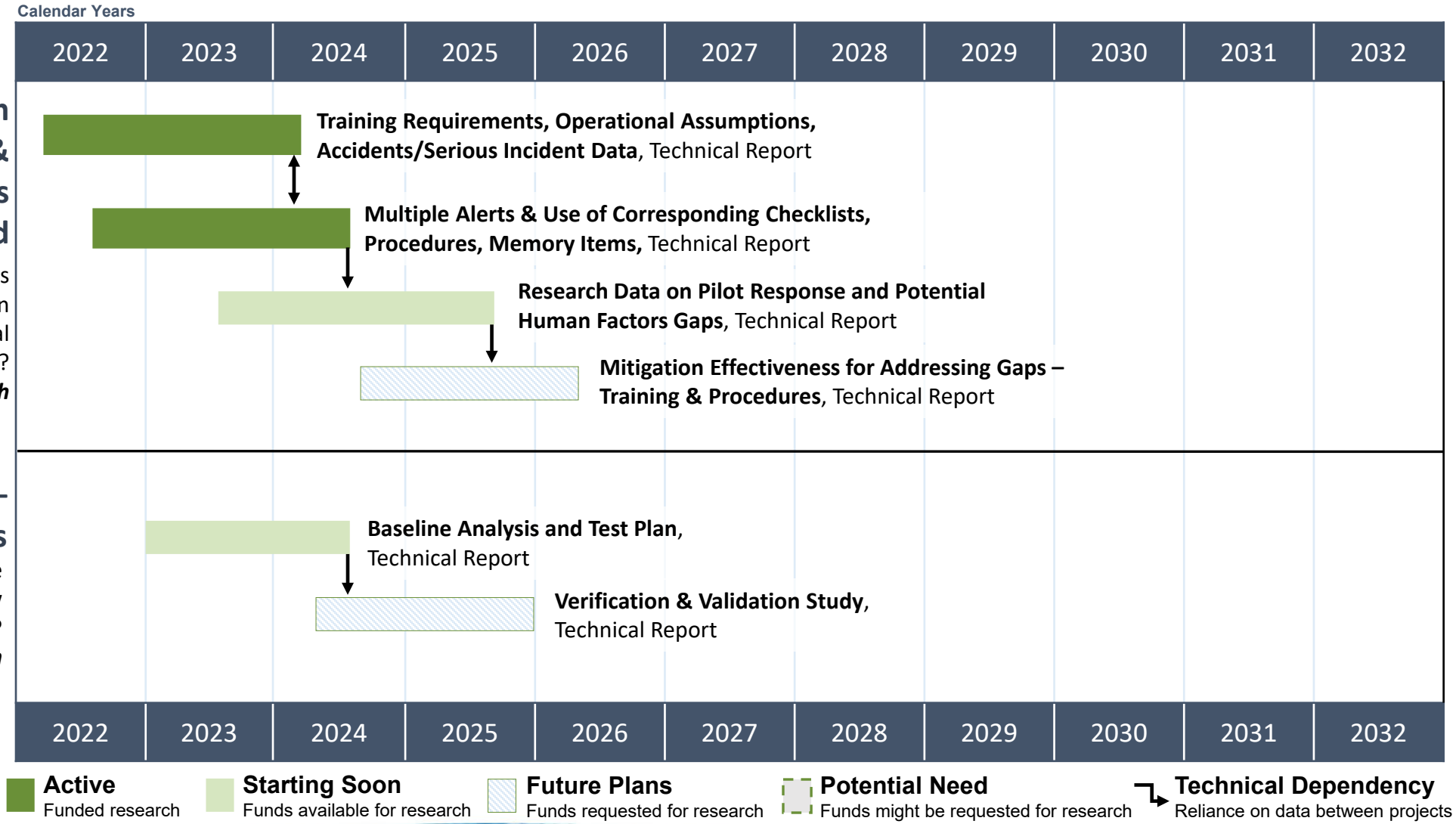
Pilot Response to System Failures, Malfunctions, & Systems Not Functioning as Expected

Research Question: How and why do pilots react incorrectly to system malfunctions in transport aircraft, and what are potential mitigations to reduce these responses?
ACSAA related research

Crew Resource Management – Cognitive Indicators

Research Question: What are cognitive indicators of pilot performance in Crew Resource Management (CRM)?
ACSAA related research



OC 1: Improving Pilot Training, Procedures, and Operations

FY2022 Research and Potential Project Plans

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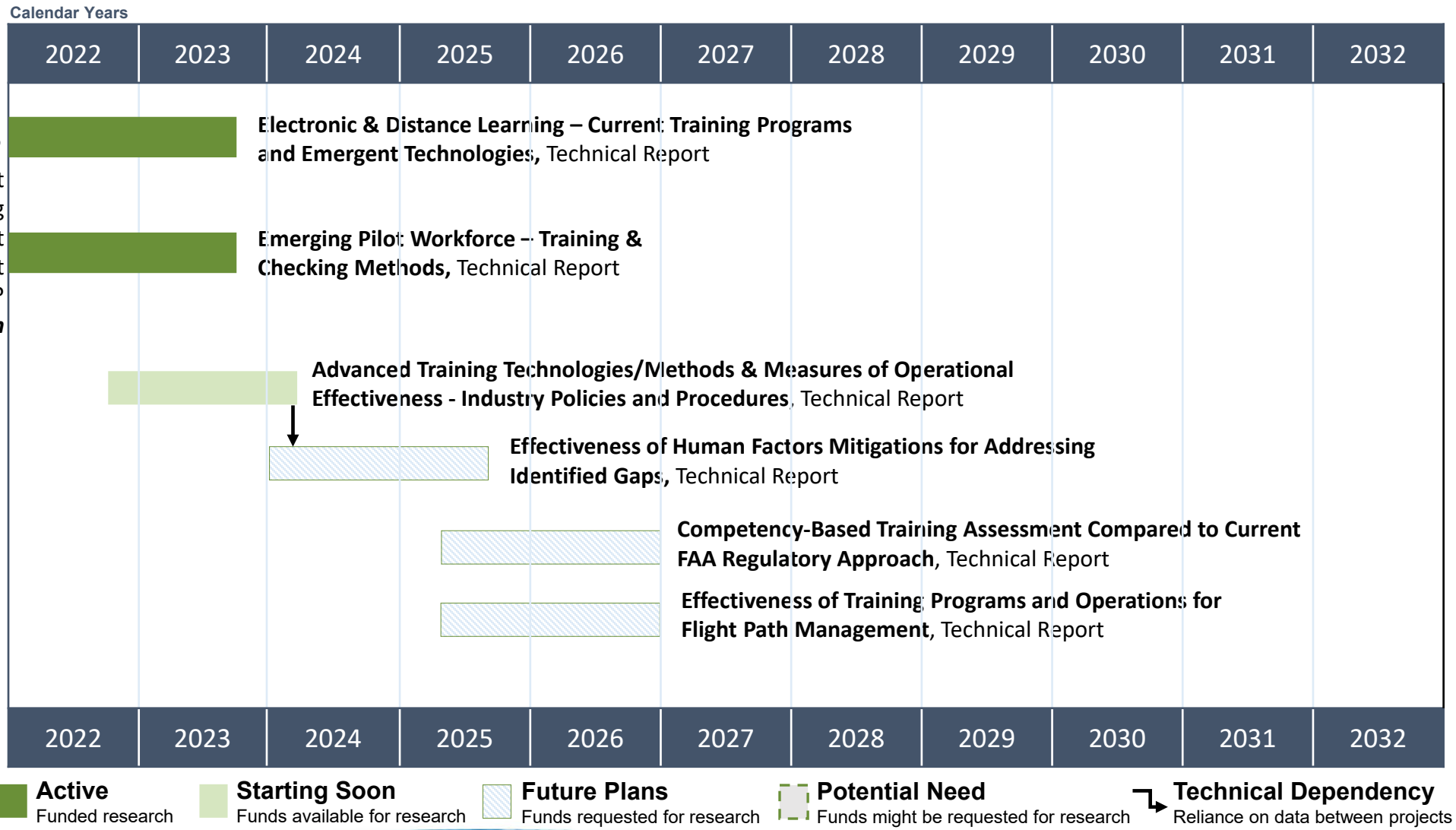
Training and Operational Effectiveness

Research Question: How effective are current pilot training programs, including those using new training technologies and methods? What technologies and methods are most appropriate for which pilot training tasks?

****ACSAA related research***



OC 1: Improving Pilot Training, Procedures, and Operations

FY2022 Research and Potential Project Plans

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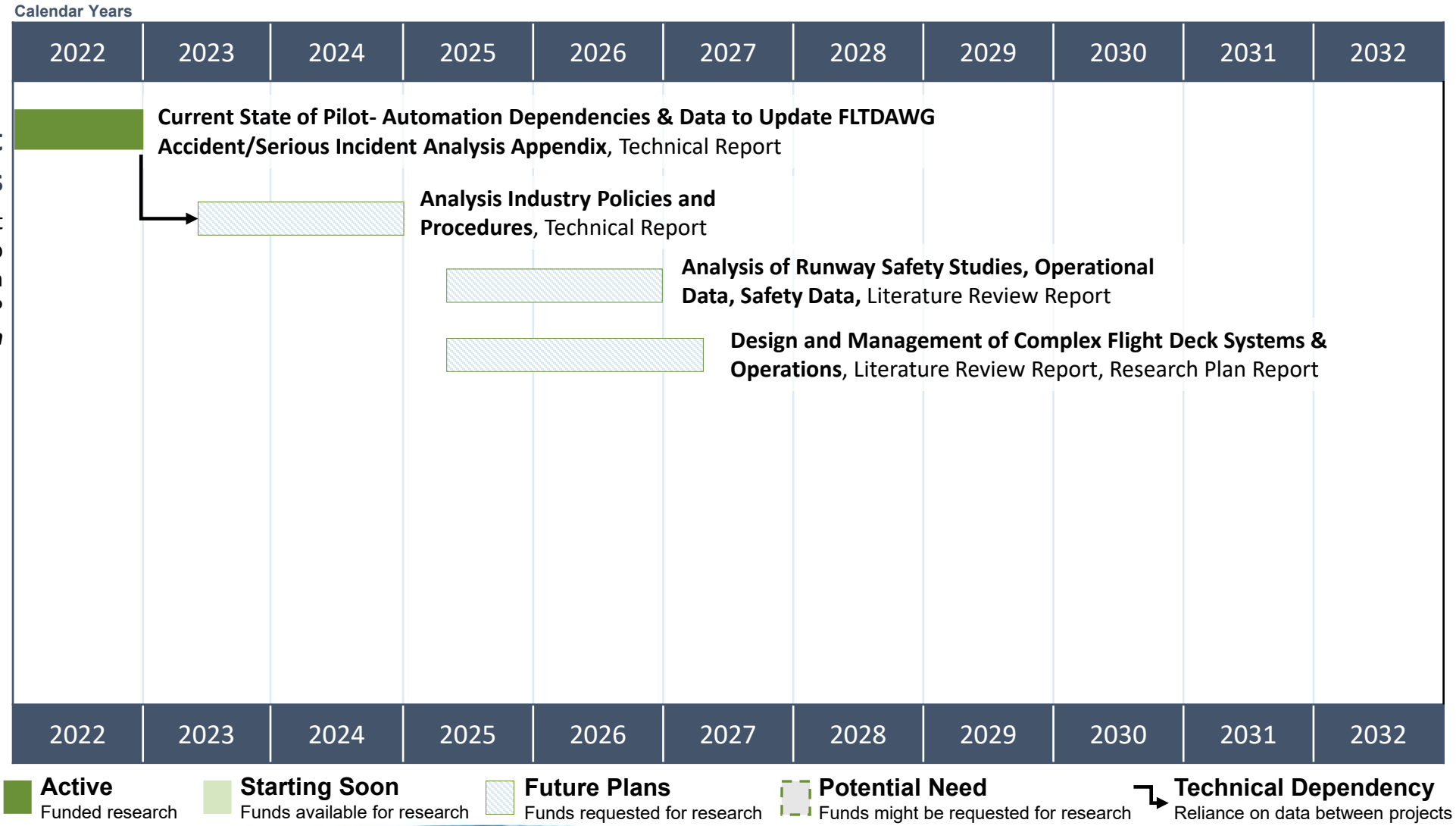
Adapting Training & Flight Operations to Emerging Risks

Research Question: How should we adapt training and flight operations to respond to emerging risks, including pilot automation dependencies?

ACSAA related research



OC 2: Mitigating Fatigue in Flight Operations

FY2022 Research and Potential Project Plans

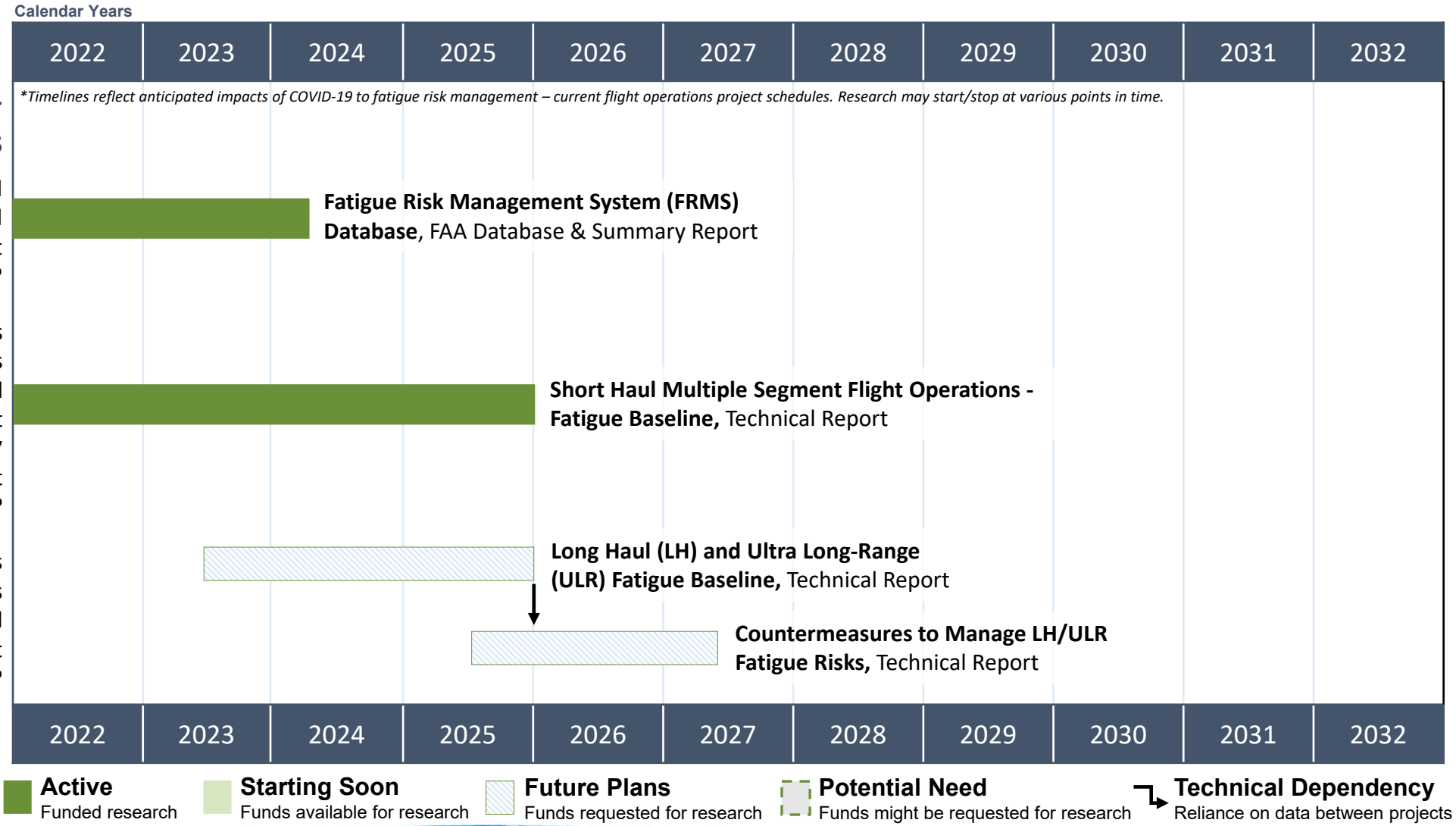
Potential project plans are subject to change based on FAA needs and availability of funds

Fatigue Risk Management - Current Flight Operations

Research Question: What standardized methods and analyses are needed to record and provide relevant Fatigue Risk Management System (FRMS) data with FAA stakeholders?

Research Question: What mitigations effectively manage impacts to human factors and pilot performance caused by long-haul and ultra-long-range flight operations that exceed the table limits of 14 CFR Part 117 "Flight and Duty Limitations and Rest Requirements for Flightcrew Members"?

Research Question: What mitigations effectively manage impacts to human factors and pilot performance caused by long-haul and ultra-long-range flight operations that exceed the table limits of 14 CFR Part 117?



OC 2: Mitigating Fatigue in Flight Operations

FY2022 Research and Potential Project Plans

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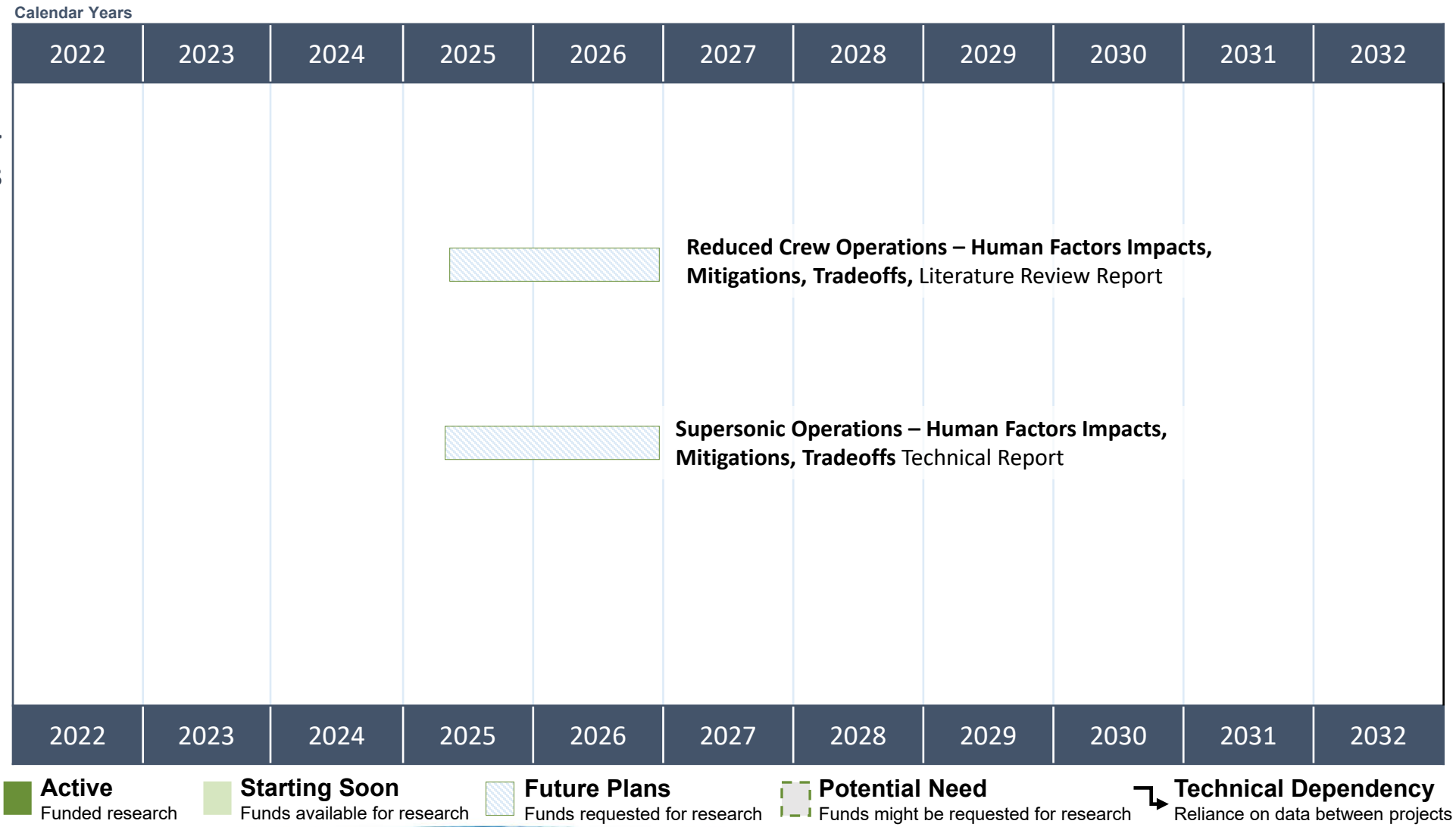
Fatigue Risk Management - Future Flight Operations

Research Question: What are current and recommended mitigations to manage fatigue effects on pilot performance in reduced crew operations in transport category aircraft?

Research Question: What are current and recommended mitigations to manage fatigue effects on pilot performance in supersonic flight operations?



OC 3: Improving Maintenance & Human Factors

FY2022 Research and Potential Project Plans

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

Maintenance Training

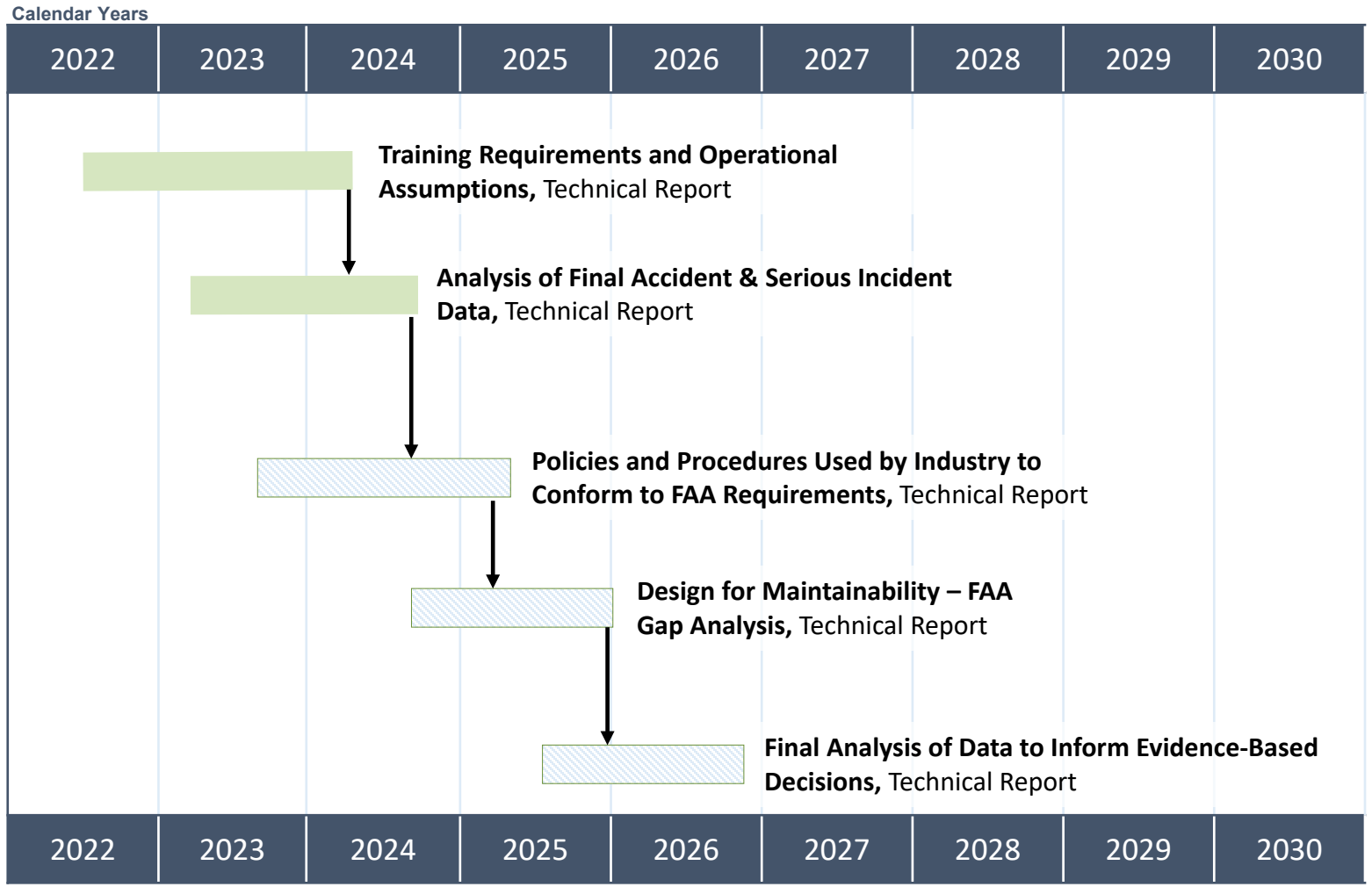
Research Question: What requirements & assumptions are currently used for aviation maintenance technician (AMT) knowledge, skills, experience, and training for transport category aircraft & airplane differences?
ACSAA related research

Research Question: What is the role and frequency of factors involving AMT knowledge, skills, experience, training, assumptions, & design for maintainability in global transport category aircraft accidents 2010-present?
ACSAA related research

Research Question: What training and operational policies/procedures are used by industry to conform to FAA AMT training requirements for transport category aircraft and airplane differences?
ACSAA related research

Research Question: What research & engineering data is needed to fill gaps in existing FAA guidance or to inform new guidance on design maintainability?
ACSAA related research

Research Question: Are FAA regulatory materials, guidance, and assumptions for maintenance training requirements for transport category aircraft adequate?
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

OC 3: Improving Maintenance & Human Factors

FY2022 Research and Potential Project Plans

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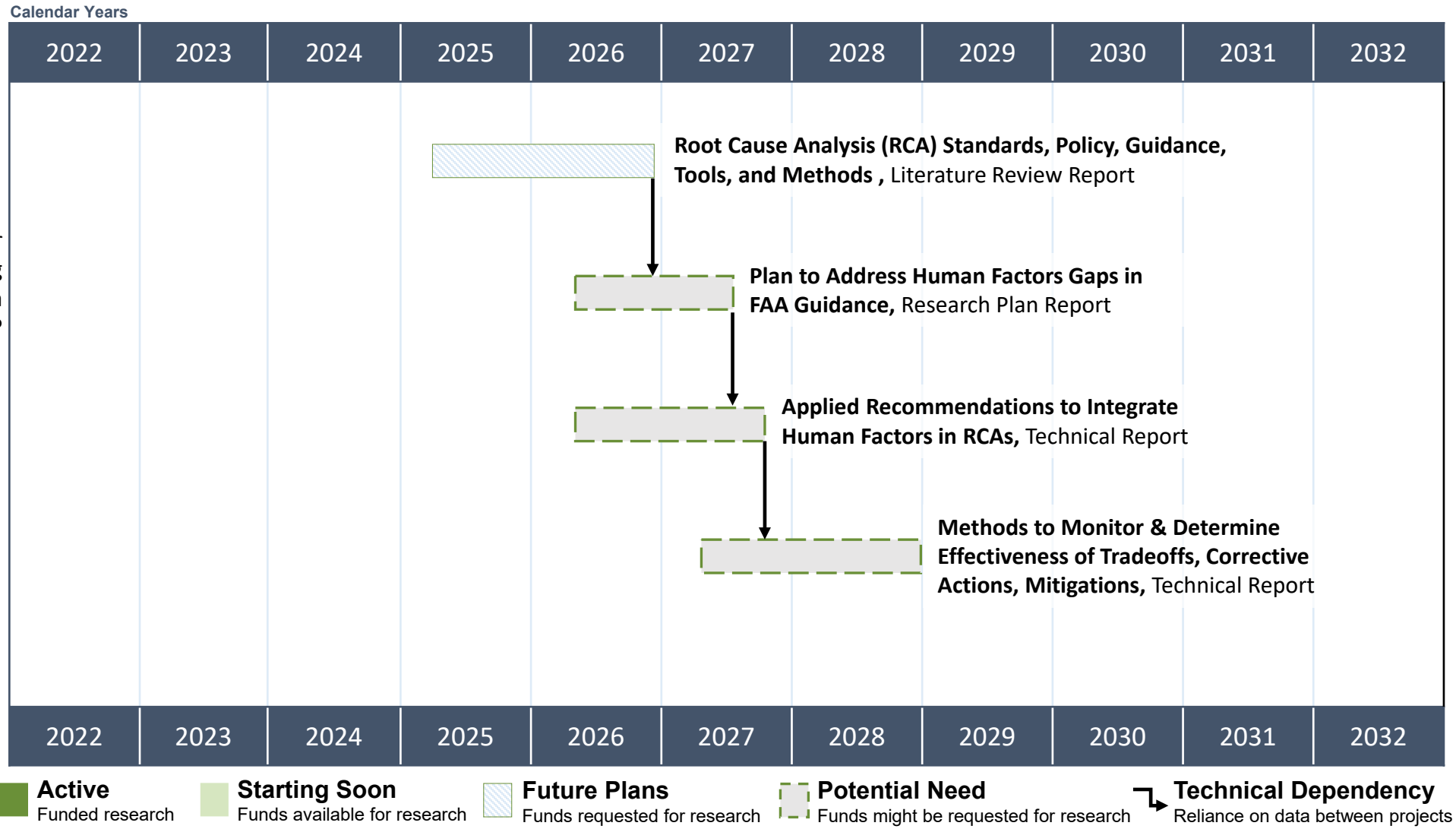
Methods to Identify Root Cause(s) of Human Factors Risks in Maintenance Programs

Research Question: Where are there gaps for human factors and operational data recording in existing Safety Assurance System (SAS) data collection tools (DCTs)?



OC 4: Advanced Vision Systems, Head-Up Displays, Head-Mounted Displays

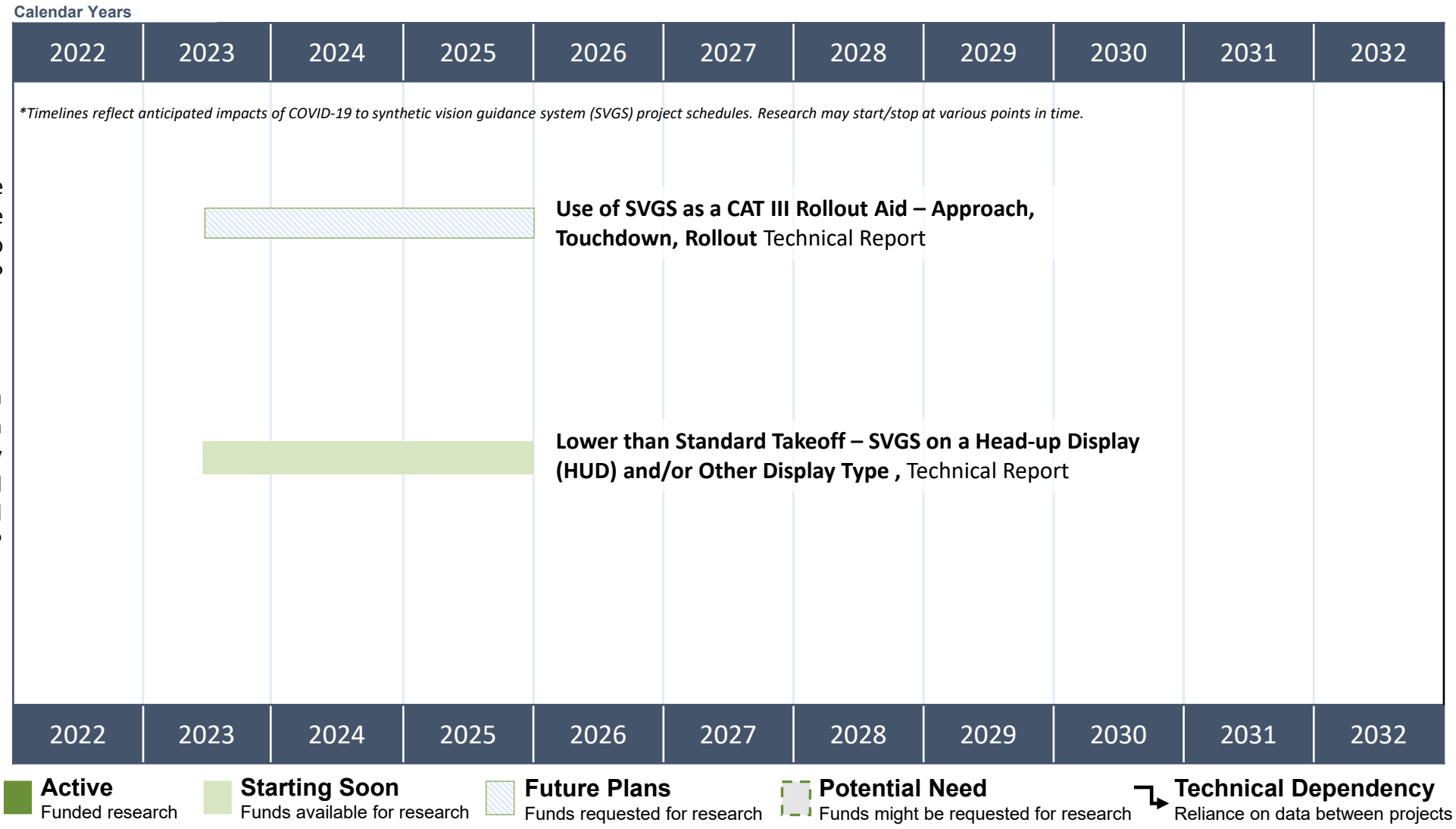
FY2022 Research and Potential Project Plans

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

Synthetic Vision Guidance System (SVGS)

Research Question: Can SVGS technology be used as a substitute for any of the equipage and/or NAS infrastructure required to conduct CAT III flight operations?

Research Question: Can SVGS technology can be used as a possible substitute for certain airport/runway infrastructure currently required to conduct lower than standard takeoff minima operations when using natural vision?



OC 4: Advanced Vision Systems, Head-Up Displays, Head-Mounted Displays

FY2022 Research and Potential Project Plans

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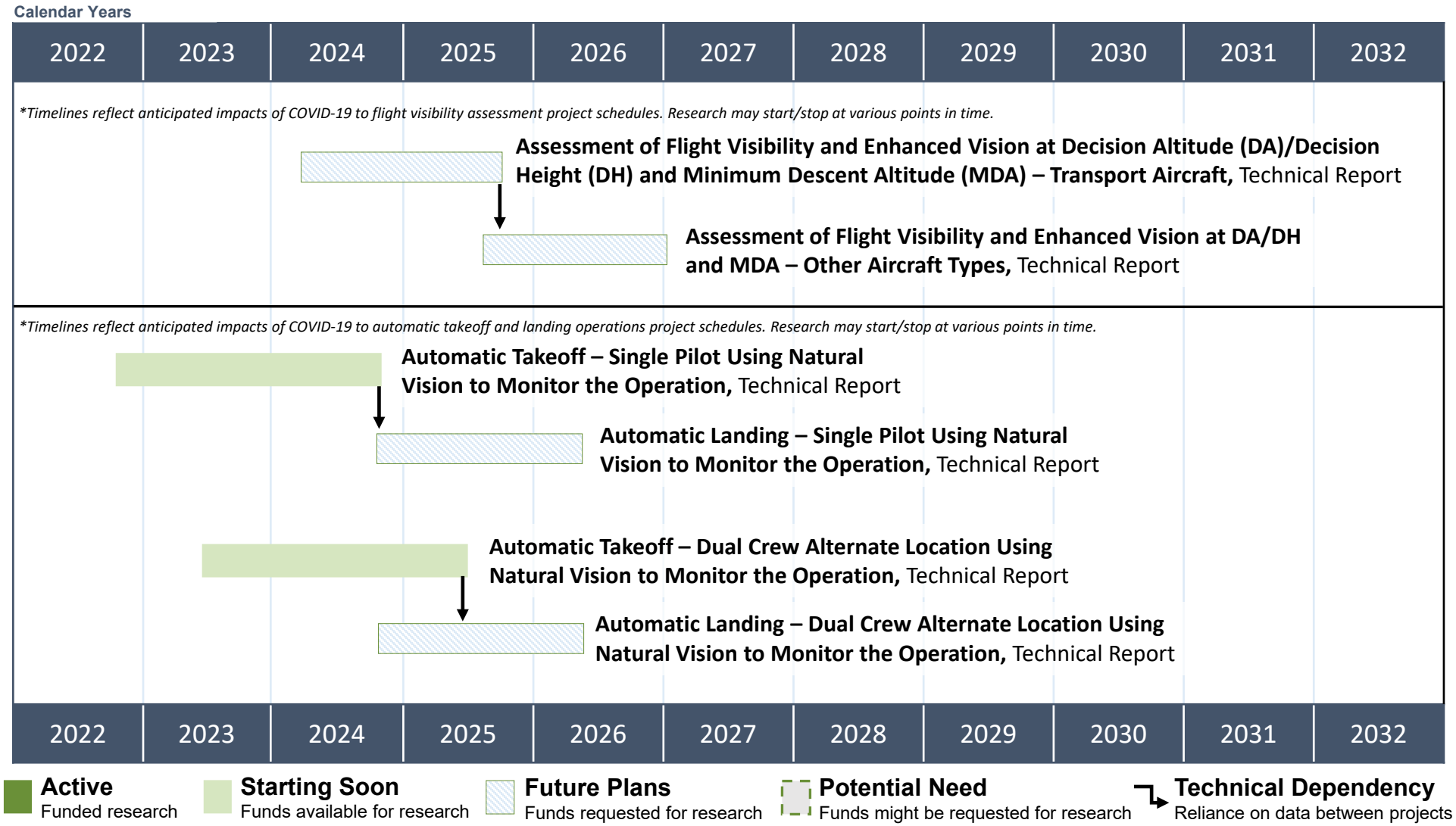
Flight Visibility Assessment

Research Question: Does the use of EFVS on a head-down display to 100' above TDZE support an equivalent level of safety and pilot performance versus EFVS on a head-up display?

Automatic Takeoff and Landing Operations

Research Question: Is single/dual pilot workload acceptable during new low visibility automatic takeoff and landing operations using unassisted vision or an emerging vision system technology to conduct and monitor the flight operation?



OC 4: Advanced Vision Systems, Head-Up Displays, Head-Mounted Displays

FY2022 Research and Potential Project Plans

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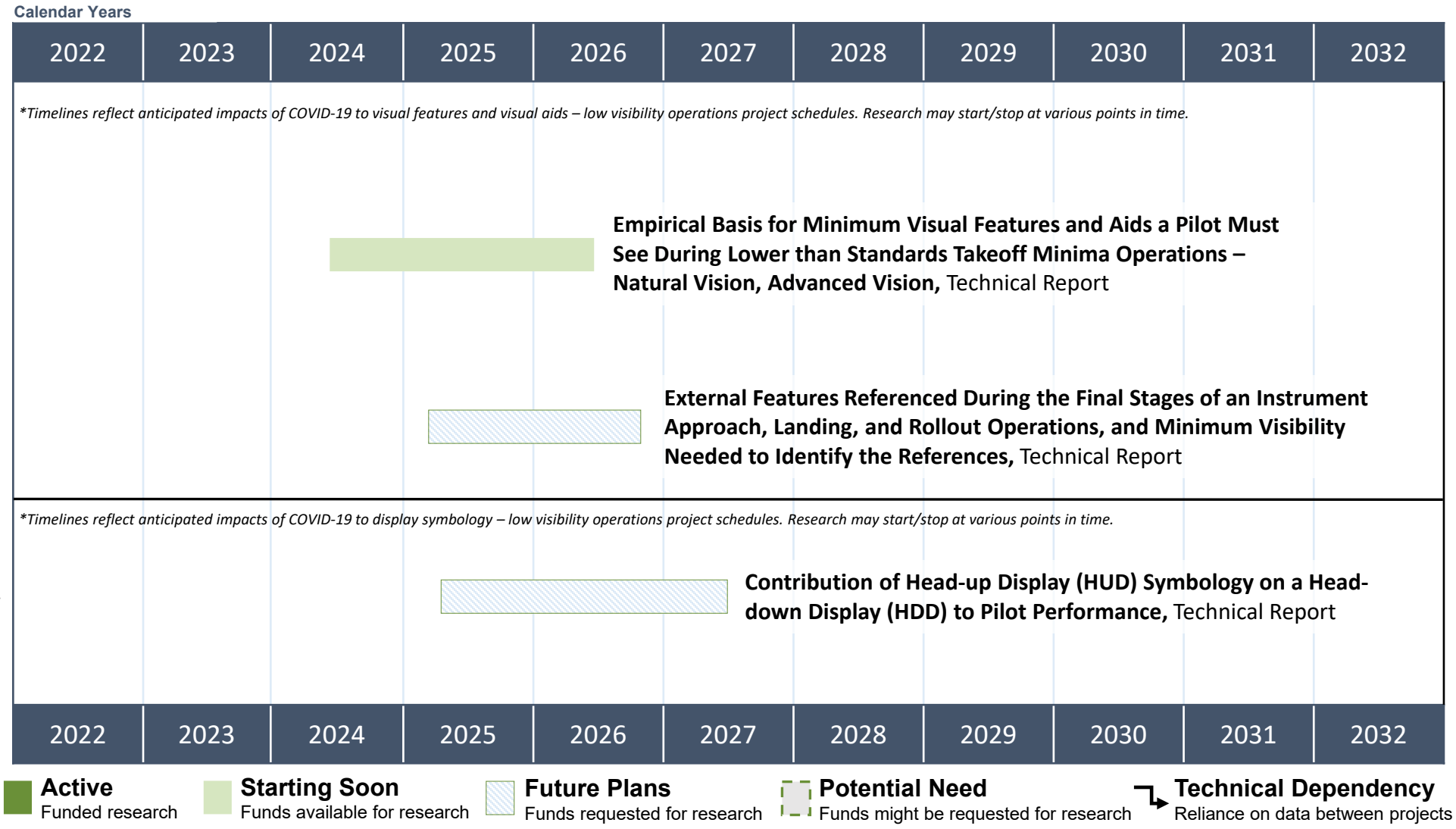
Visual Features and Visual Aids – Low Visibility Operations

Research Question: What are the minimum visual features and visual aids a pilot must see to safely takeoff in visibilities that range from 1600 RVR down to 300 RVR using both natural vision (with and without a HUD) and an advanced vision system (on a HUD)?

Research Question: What external features do pilots visually reference in the runway environment to manually land an aircraft, and the minimum visibility these references can be identified with natural vision?

Display Symbology – Low Visibility Operations

Research Question: What is the contribution of head-up display (HUD) symbology on a head-down display (HDD) to pilot performance during low visibility flight operations?



OC 5: Human Factors Considerations & Emerging Trends in Helicopter Air Ambulance Operations

FY2022 Research and Potential Project Plans

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Helicopter Air Ambulance (HAA) Operations

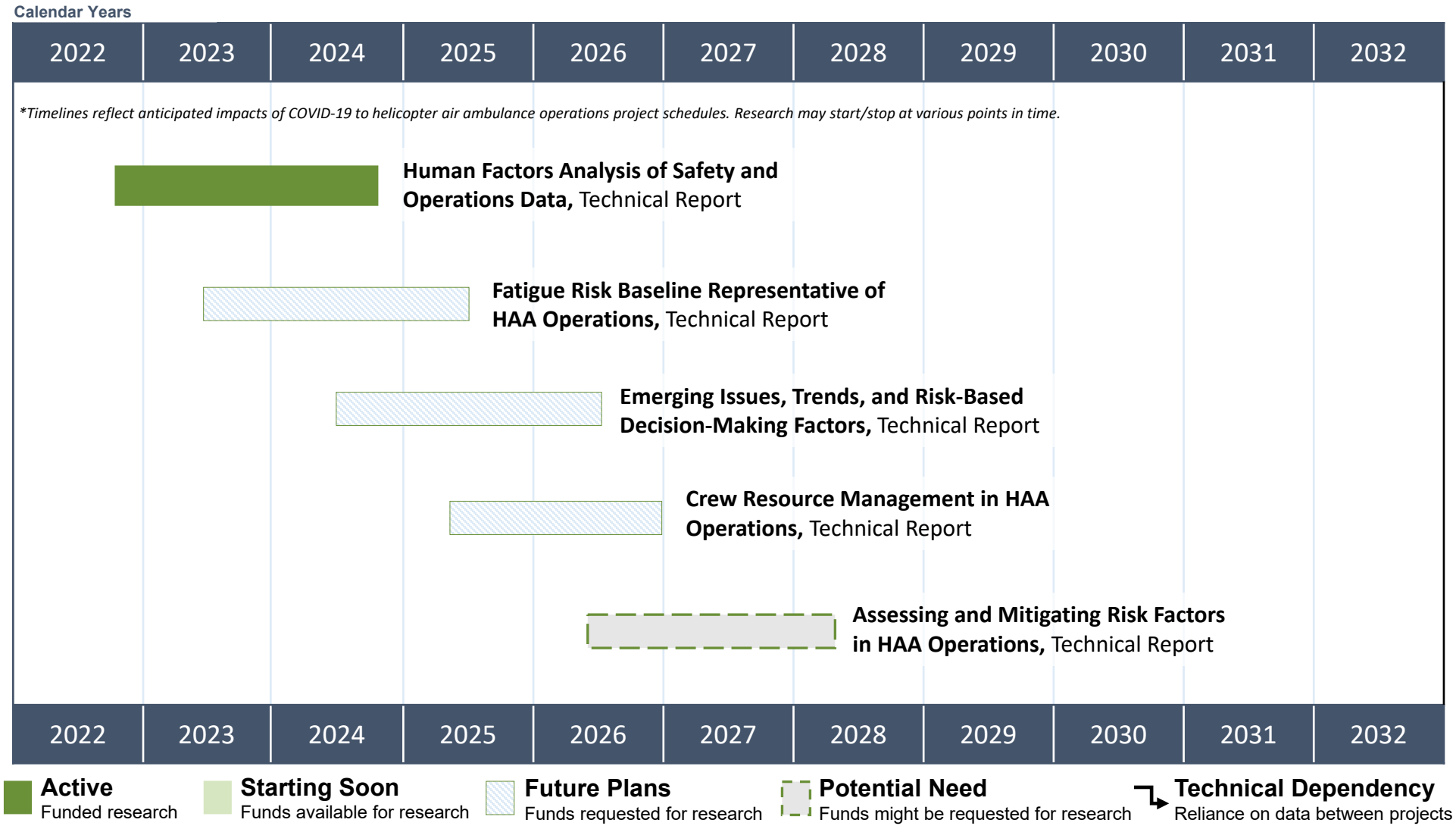
Research Question: What are casual or contributing human factors elements associated with HAA accidents and incidents?

Research Question: What are the current fatigue risks for the HAA Industry?

Research Question: What are human factors-related emerging issues and industry trends for HAA Operations?

Research Question: How Should HAA operations address crew resource management research recommendations?

Research Question: What are the industry best practices for assessing and mitigating risk factors in HAA Operations?



OC 6: Improving General Aviation Pilot's Response to Unexpected Events

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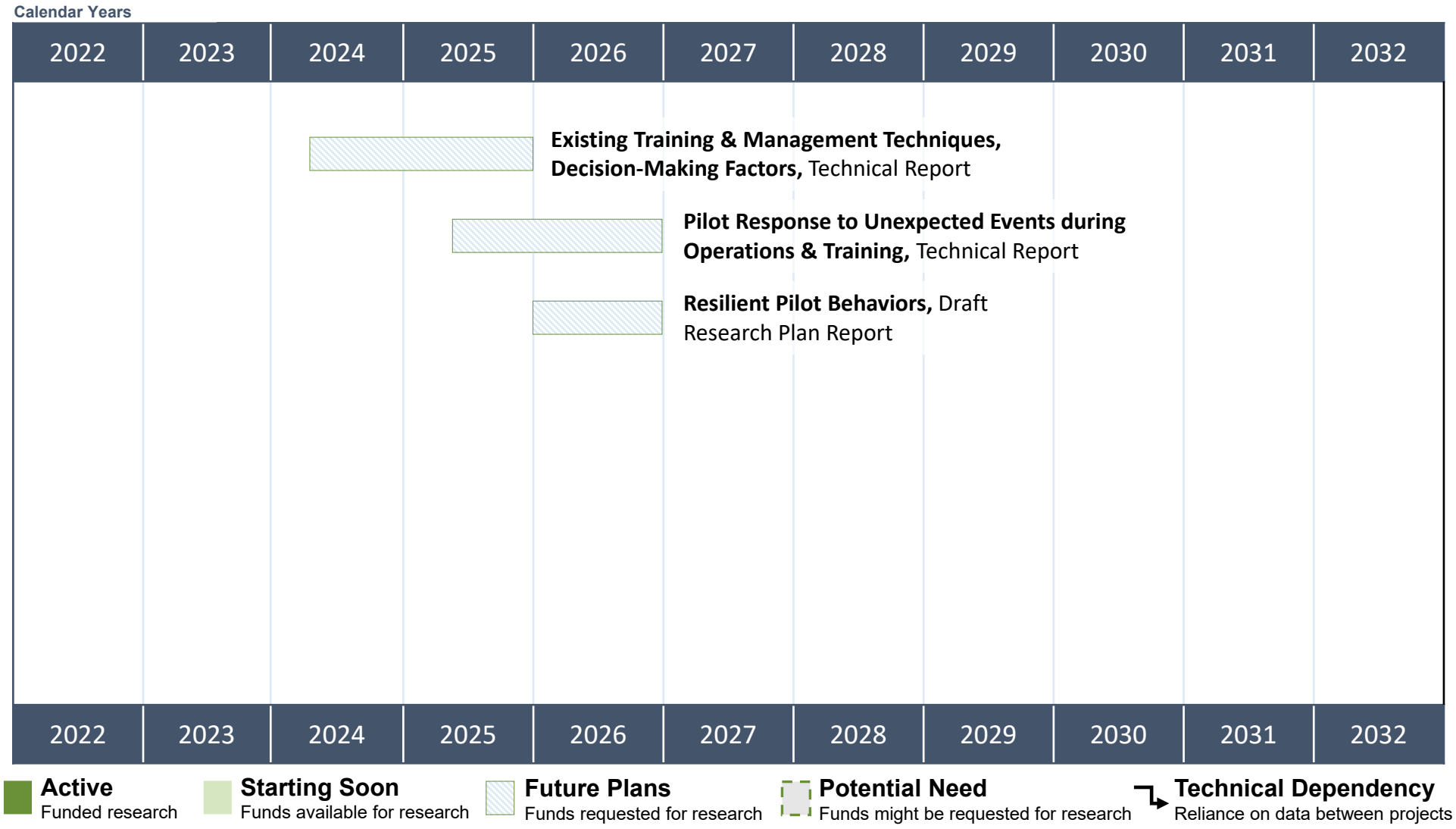
Unexpected Airplane State: General Aviation

Research Question: How do General Aviation pilots react to unexpected events and what are potential mitigations to supporting appropriate responses?



OC 7: Advances and Innovation in New Technologies and Operations

FY2022 Research and Potential Project Plans

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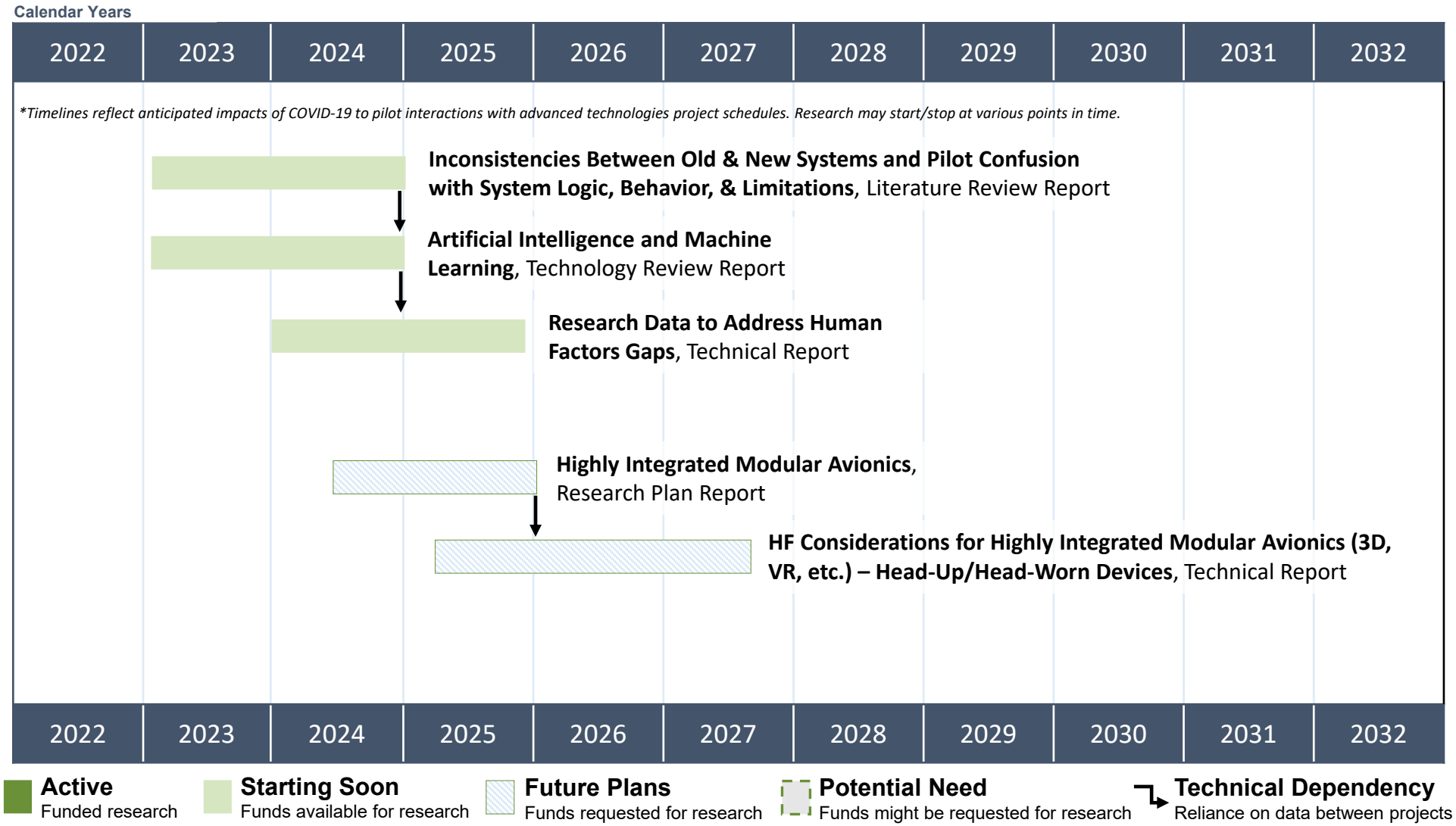
Pilot Interactions with Advanced Technologies

Research Question: What are the human factors considerations for new flight deck interface technologies?
ACSAA related research



OC 7: Advances and Innovation in New Technologies and Operations

FY2022 Research and Potential Project Plans

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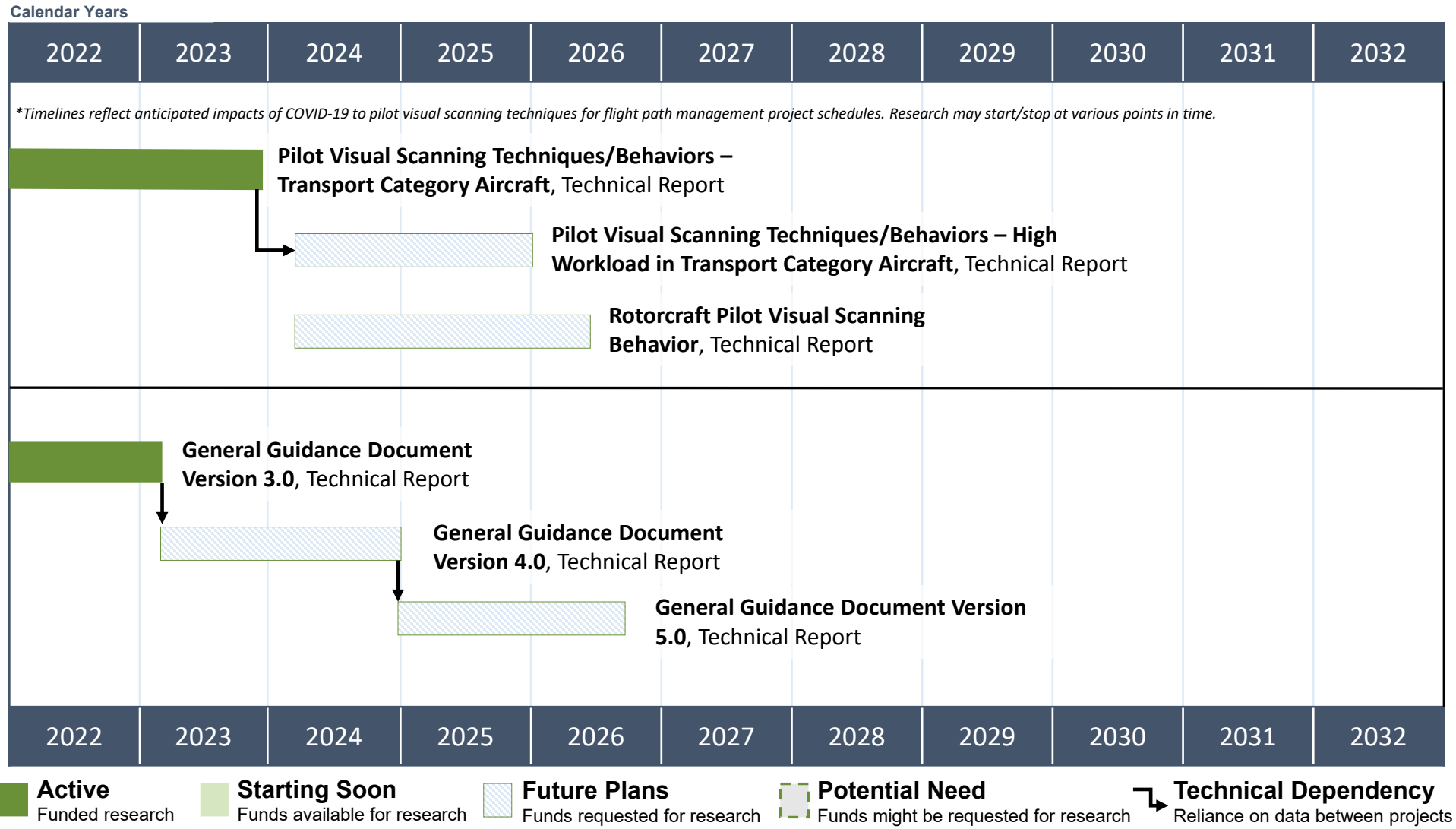
Pilot Visual Scanning Techniques for Flight Path Management

Research Question: What human factors aspects are involved in and affect flightpath management? What implications do these human factor aspects have on display design?
ACSAA related research

Human Factors General Guidance Document

Research Question: What human factors research data would support the engineers, test pilots, and human factors specialists in Aircraft Certification who must evaluate and approve flight deck systems and equipment?
ACSAA related research



OC 7: Advances and Innovation in New Technologies and Operations

FY2022 Research and Potential Project Plans

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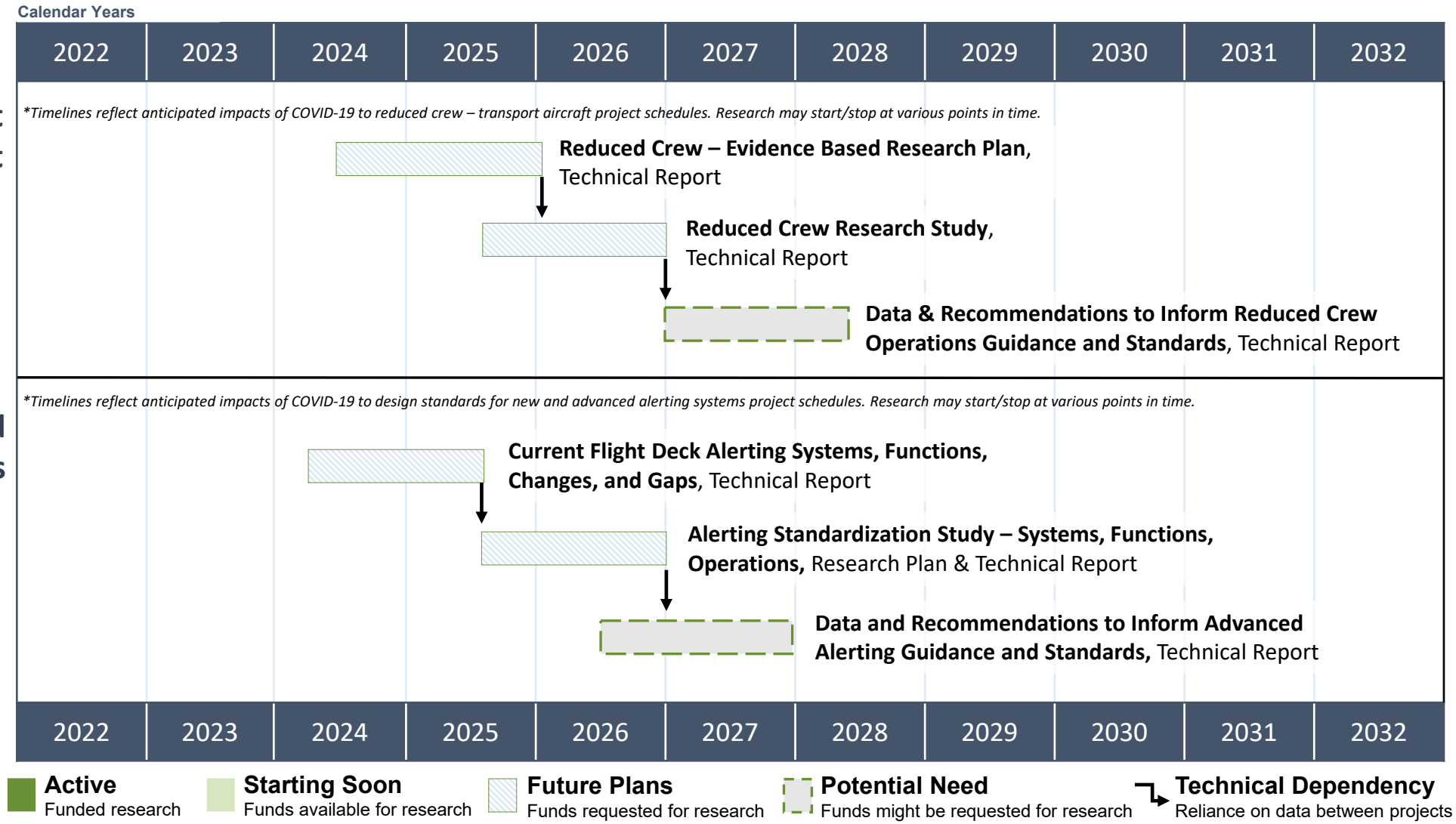
Reduced Crew - Transport Aircraft

Research Question: Can we safely enable reduced crew operations at an equivalent level of safety as transport category operations, and if so, how?
ACSAA related research

Design Standards for New and Advanced Alerting Systems

Research Question: How should alerting system design standards be updated to reflect new technology and functionality in flight deck alerting systems?
ACSAA related research

Relates to REDAC Action Item #5 - flightcrew alerting systems



OC 7: Advances and Innovation in New Technologies and Operations

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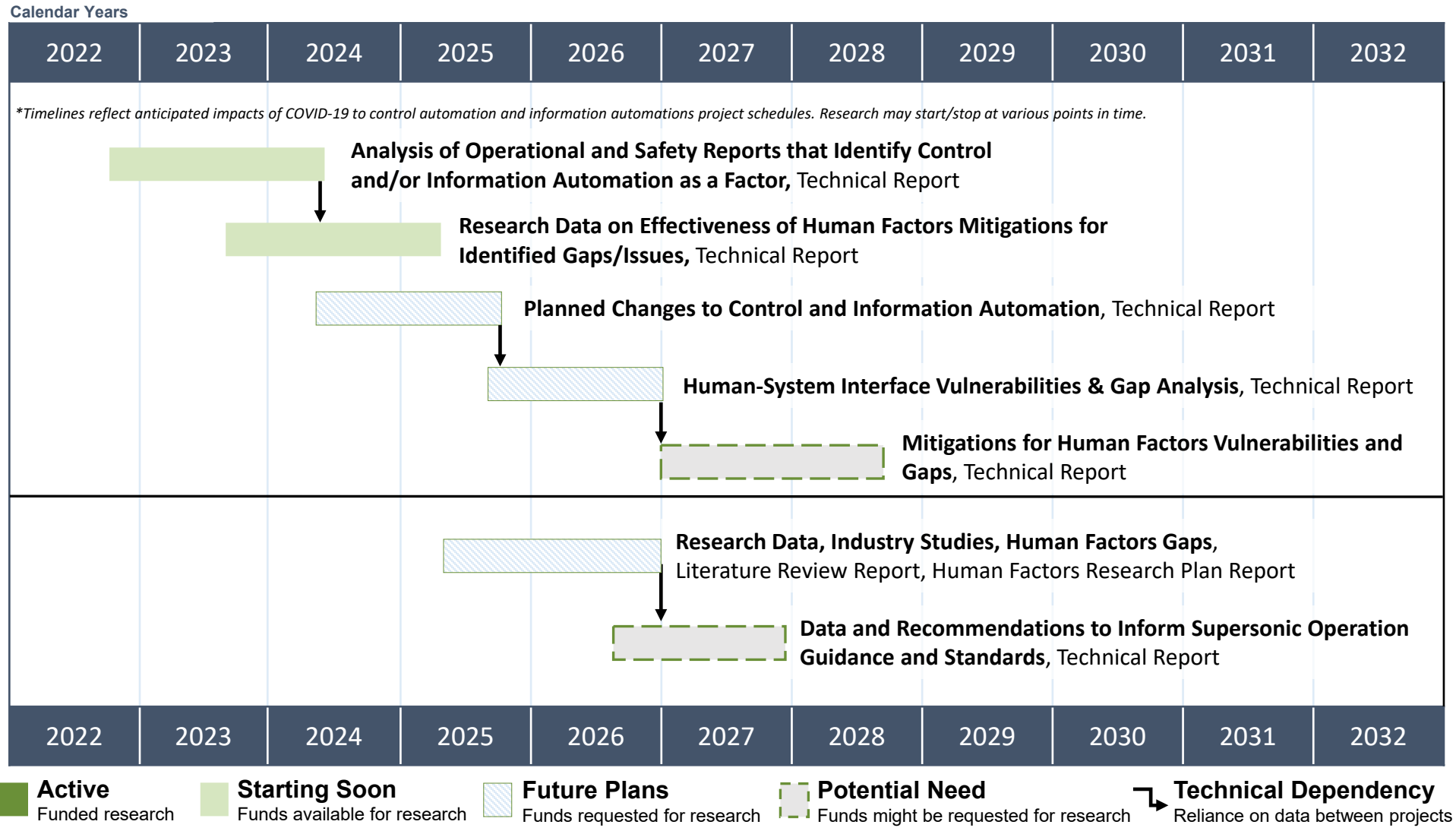
Control Automation and Information Automation

Research Question: What human factors issues and data are associated with automation, including control automation and information automation?
ACSAA related research

Supersonic Aircraft

Research Question: Can we enable supersonic flight operations at an equivalent level of safety as transport category operations, and if so, how?
ACSAA related research



OC 9: Integrating Human Factors into Aircraft Certification & Flight Standards Methods & Processes

FY2022 Research and Potential Project Plans

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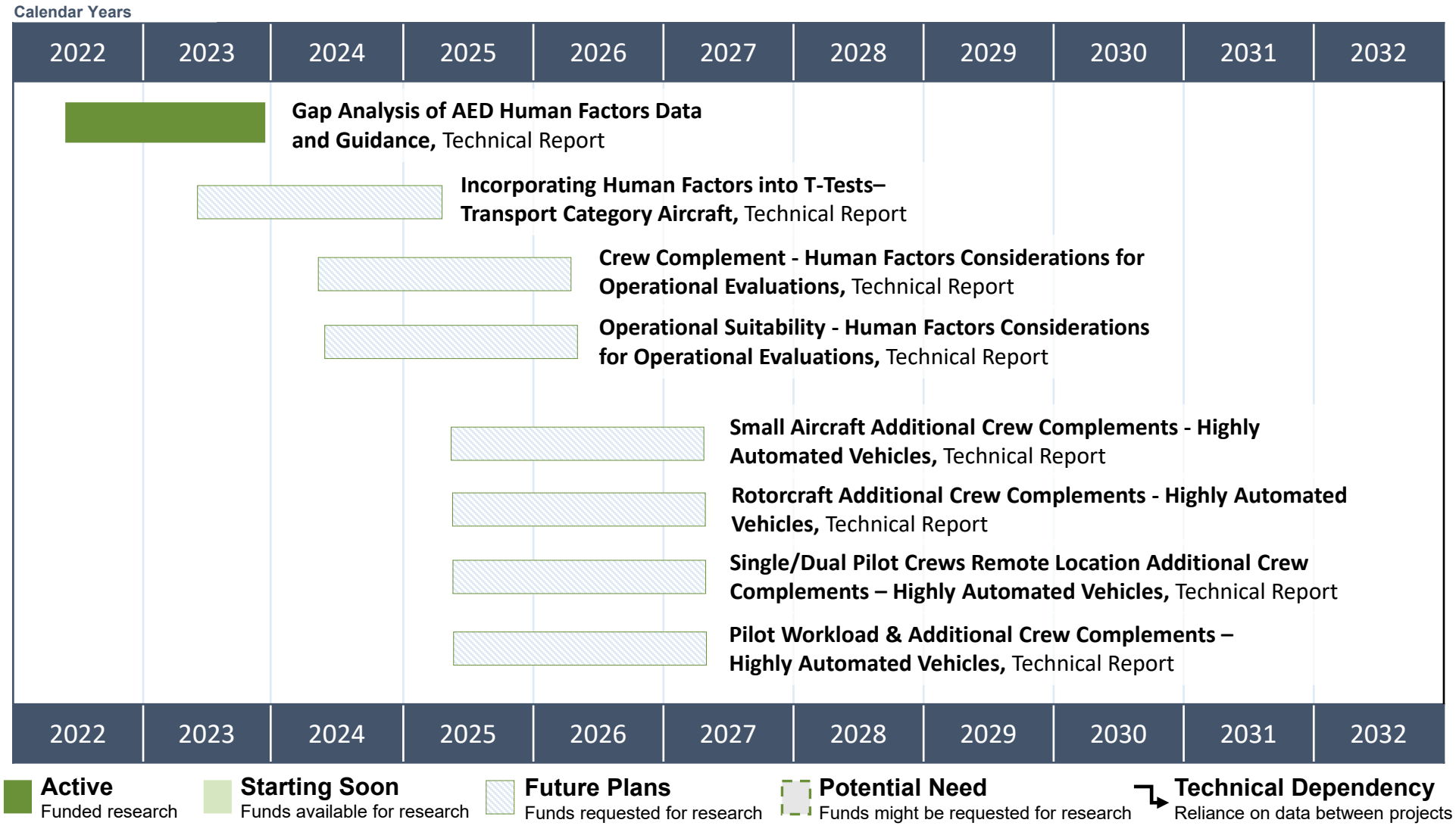
Integration of Human Factors into the Aircraft Evaluation Division (AED) Processes and Criteria

Research Question: What human factors data, processes, and procedures can support operational suitability evaluations and in the Flight Standardization Board (FSB) process?

***ACSAA related research**



OC 9: Integrating Human Factors into Aircraft Certification & Flight Standards Methods & Processes

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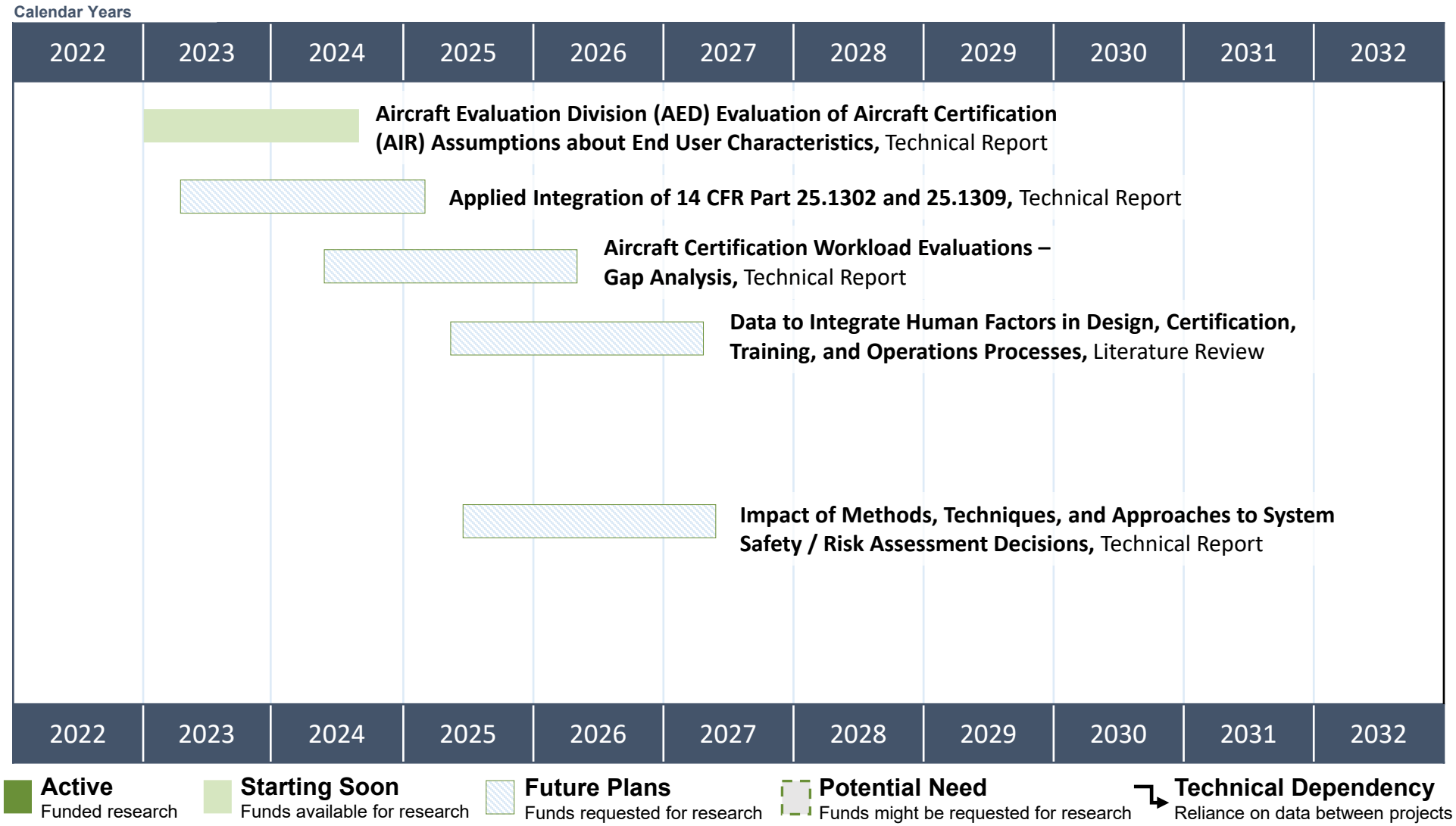
Design, Certification, Training, and Operations

Research Question: What human factors data, processes, and procedures can support Aircraft Certification in human factors evaluations of aircraft design and certification?
ACSAA related research

Research Question: What human factors methods, techniques, and approaches are available to integrate human error considerations into system safety assessments, and what factors need to be considered when using these new methods in an aircraft certification application / context?
ACSAA related research



OC 10: Pilot Physiological State Monitoring Technologies and Mitigations

FY2022 Research and Potential Project Plans

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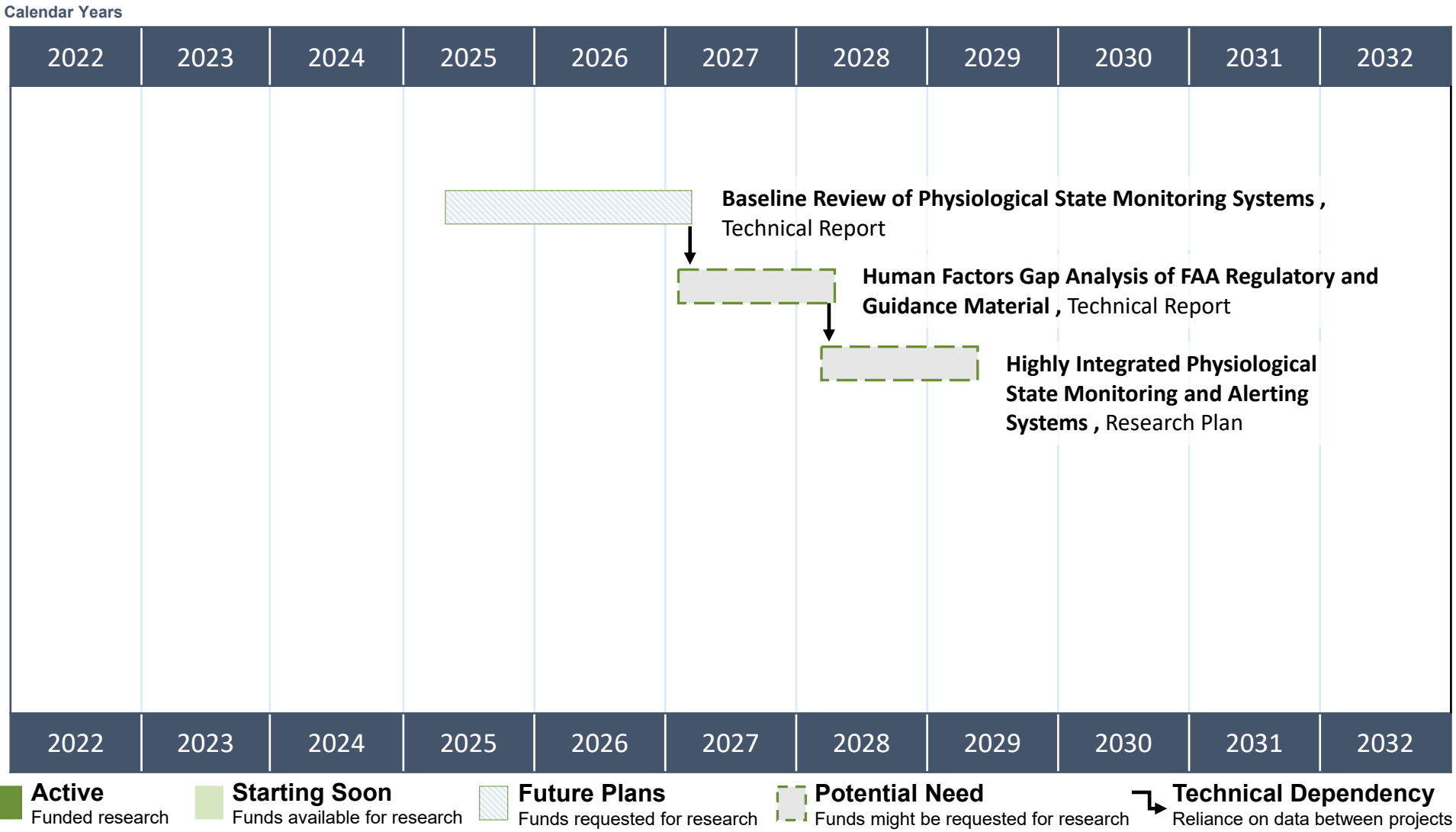
Design and Operational Evaluation Considerations

Research Question: What is the state of the art for pilot physiological state monitoring technologies and mitigations?

Research Question: What are the minimum standards/requirements for pilot physiological state monitoring and mitigations?



Other Research Topics Not Assigned to an OC

FY2022 Research and Potential Project Plans

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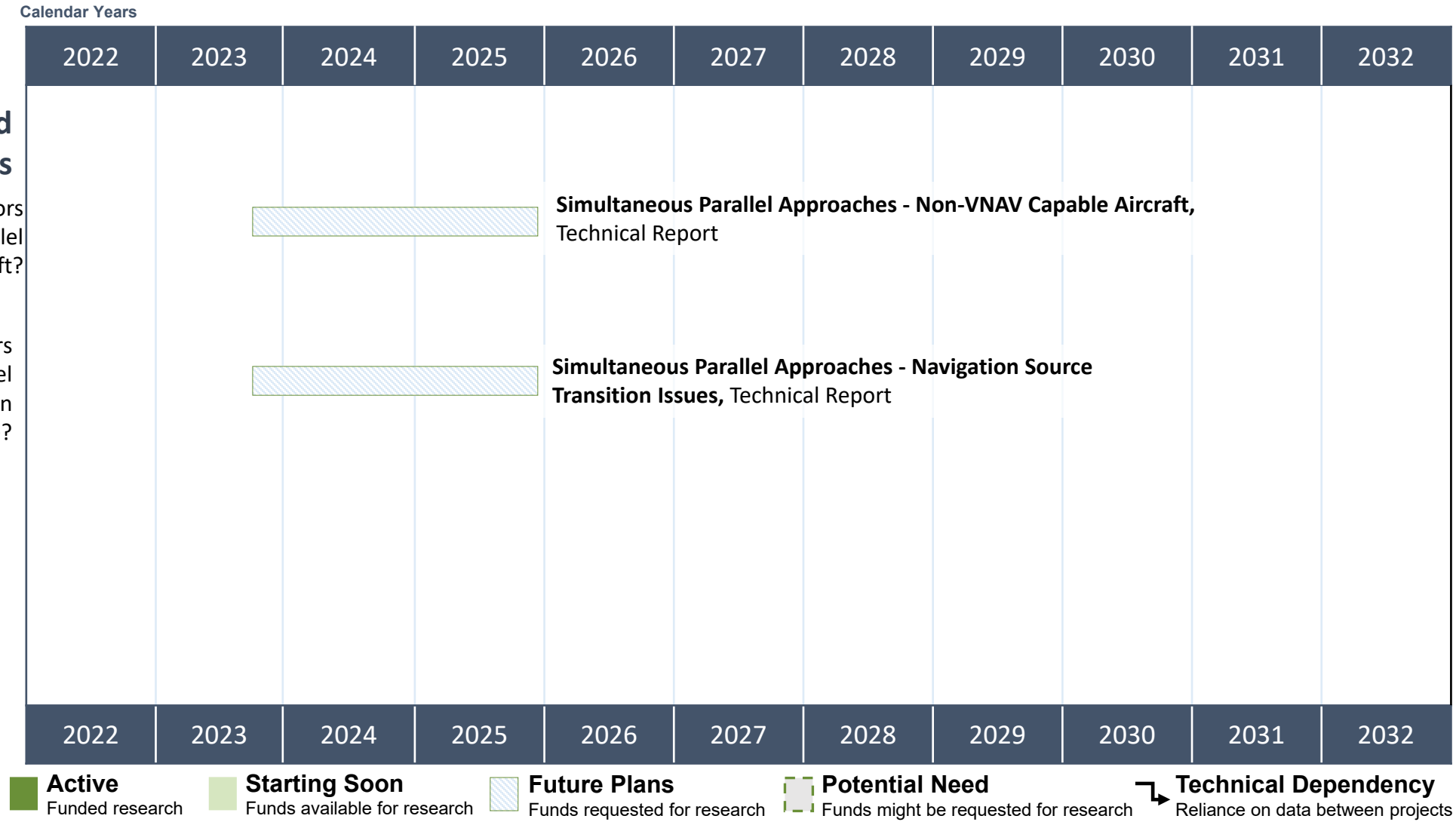

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