Safety Enhancement SE 211.3 (R&D) ASA – Research – Training for Attention Management	
Safety Enhancement Action:	Aviation community (government, industry, and academia) performs research to develop and assess training methods and realistic scenarios that can address the attention-related human performance limitations observed in the airplane state awareness (ASA) event data, including channelized attention, confirmation bias, startle/surprise, with accompanying performance measures.
Implementers: (Select all that apply)	☒ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT) ☒ Research Organization ☐ Labor Organization ☒ Manufacturer ☒ Regulator ☐ Other (specify)
Statement of Work:	A CAST study of 18 loss-of-control events accidents and incidents showed that issues with flight crew attention were involved in 16 of the 18 events. The aviation community (government, industry, and academia) should conduct research on methods for understanding the phenomena of flight crew channelized attention, confirmation bias, startle/surprise, and diverted attention. 1. Research and training organizations develop methods to detect and measure attention-related human performance limitations. 2. Research organizations should work with industry partners (air carriers, manufacturers, and commercial training providers) to develop methods and guidelines for creating training scenarios that induce attention-related human performance limitations and develop and assess potential mitigations to these issues in the training environment.
Total Financial Resources:	**Total: $3.5M** Output 1: $1.0M Output 2: $2.5M
Relation to Current Aviation Community Initiatives:	• National Aeronautics and Space Administration (NASA) Aviation Safety Program • Title 14, Code of Federal Regulations (14 CFR) 25.771 (a) and (c), *Pilot compartment* • 14 CFR 25.1301, *Function and installation – intended function of installed systems* • 14 CFR 25.1302, *Installed systems and equipment for use by the flightcrew* • 14 CFR 25.1309 (a) and (c), *Equipment, systems and installations*, amendment 25–123 • 14 CFR 25.1322, *Flightcrew alerting*, amendment 25–131 • 14 CFR 25.1329, *Flight guidance system – Autopilot, flight director and autothrust*

Performance Goal Indicators:	The goal is to provide design and training recommendations to reduce the occurrence and enable recovery from attention issues, and receive feedback from training providers that training is effective.
Key Milestones:	<table><tr><th></th><th>Flow time (mo)</th><th>Start Date</th><th>End Date</th></tr><tr><td>Output 1:</td><td>57</td><td>12/31/2013</td><td>9/30/2018</td></tr><tr><td>Output 2:</td><td>57</td><td>12/31/2013</td><td>9/30/2018</td></tr><tr><td>Completion:</td><td>57</td><td>12/31/2013</td><td>9/30/2018</td></tr></table>
Potential Obstacles:	1. Reliable presentation of scenarios which induce attention-related human performance limitations. 2. Development of cost-effective, operationally practical measures.
Detailed Implementation Plan Notes:	None
CICTT Code:	Loss of Control–Inflight (LOC–I)
Output 1:	
Description:	Research and training organizations develop methods to detect and measure attention-related human performance limitations.
Lead Organization:	National Aeronautics and Space Administration (NASA)
Human Resources:	Air carriers Airbus Bombardier, Inc. Embraer Federal Aviation Administration (FAA) Flight Standards Service (AFS) The Boeing Company
Implementers: (Select all that apply)	☒ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT) ☒ Research Organization ☐ Labor Organization ☒ Manufacturer ☒ Regulator ☐ Other (specify)
Actions:	1. NASA will coordinate with FAA AFS and manufacturer research organizations to develop methods to detect and measure attention-related human performance limitations in pilots and validate those methods in simulator, taking into account— a) Prototype technologies for detection and mitigation of issues (e.g., visual, neurological, and electro/psycho-physiological measures); and

	b) Ability to detect human performance limitations noted in the airplane state awareness (ASA) event data, including channelized attention, confirmation bias, startle/surprise, and diverted attention. 2. Air carriers will provide research organizations with access to operational expertise that can help improve effectiveness and feasibility of detection methods. 3. Research organizations will provide final reports to JIMDAT and CAST for review and reference. 4. JIMDAT will track research results against the risk reduction performance of ASA safety enhancements (SE) and make recommendations to CAST for future technology implementations.
Financial Resources:	Total: $1.0M (4.0 Full Time Equivalent (FTE))
Itemized Resources:	R&D Org: 4.0 FTE to perform study (2.0 FTE per year for 2 years) NOTES: • For labor, 1 FTE was assumed to = $250K. • Rough Order of Magnitude (ROM) estimates provided for CAST prioritization and assessment—actual resources to be informed by historical research and development (R&D) cost data from similar programs through each organization's normal research planning process • "R&D Org" resources indicate general labor support required to perform the research. Specific organization support will be determined through normal organizational R&D planning efforts using guidance from a CAST R&D forum to discuss development of and execution of R&D plans by member organizations.
Output Notes:	This is a research detailed implementation plan (DIP).
Time Line:	• 6 months from CAST initiation of R&D plan for NASA to convene a CAST R&D forum • 45 months after R&D forum for research organizations to complete studies and document reports
Target Completion Date:	9/30/2018 (extended from 3/31/2018). Completed and closed 10/04/2018 based on completed NASA research. JIMDAT will review reports and recommend appropriate follow-on actions.
Output 2:	
Description:	Research organizations should work with industry partners (air carriers, manufacturers, and commercial training providers) to develop methods and guidelines for creating training scenarios that induce the attention-related human performance limitations observed in the airplane state awareness (ASA) event data set and assess whether these methods can be used to support training in the airline operational environment.
Lead Organization:	National Aeronautics and Space Administration (NASA)
Human Resources:	Air carriers Federal Aviation Administration (FAA) Flight Standards Service (AFS)

	Manufacturers' research organizations	
Implementers: (Select all that apply)	☒ Air Carrier ☐ Industry Association ☐ Commercial Aviation Safety Team (CAST) ☐ Joint Implementation Measurement and Data Analysis Team (JIMDAT)	☒ Research Organization ☐ Labor Organization ☒ Manufacturer ☒ Regulator ☐ Other (specify)
Actions:	1. NASA will coordinate with FAA AFS, manufacturer research organizations, and air carriers to develop methods for creating realistic, high-workload scenarios that can incite human performance limitations, including channelized attention, confirmation bias, startle/surprise, and diverted attention. These methods should employ use of the technologies developed in Output 1 for measuring human attention issues. 2. Air carrier training organizations, in conjunction with research organizations, will use these methods to develop scenarios and training-based mitigations, including but not limited to— a) Improved instrument-scanning behaviors in both nominal and off-nominal conditions, with emphasis on scan patterns for glass cockpits; b) Recognition of channelized or diverted attention in one flight crew member by the other flight crew member, and appropriate methods of intervention and correction; c) Self-diagnosis methods for flight crew members to recognize and recover from channelized attention, confirmation bias, startle/surprise, and diverted attention; and d) Reinforcement of proper airline procedures regarding recognition of and response to flightdeck alerts. 3. Air carriers and research organizations assess effectiveness of these scenarios and mitigations and report results to JIMDAT and CAST for review and reference. 4. JIMDAT will track research results against the risk reduction performance of ASA safety enhancements (SE) and make recommendations to CAST for future safety enhancement implementation.	
Financial Resources:	Total:	$2.5M (10.0 Full Time Equivalent (FTE))
Itemized Resources:	R&D Orgs: Air carriers: FAA AFS: NOTES: • For labor, 1 FTE was assumed to = $250K	8.0 FTE to perform study (2.0 FTE per year for 4 years) 1.5 FTE to support study (flight crew member and training organization support of simulator sessions) 0.5 FTE to support study

	• Rough Order of Magnitude (ROM) estimates provided for CAST prioritization and assessment—actual resources to be informed by historical research and development (R&D) cost data from similar programs through each organization's normal research planning process • "R&D Org" resources indicate general labor support required to perform the research. Specific organization support will be determined through normal organizational R&D planning efforts using guidance from a CAST R&D forum to discuss development of and execution of R&D plans by member organizations.
Output Notes:	This is a research detailed implementation plan (DIP). At the conclusion of the research, JIMDAT should assess the results against the objectives of Outputs 1 and 2 and make recommendations to CAST. If approved by CAST, the following actions are expected to inform future CAST SEs for training of attention-related scenarios: • Air carriers and training organizations implement realistic, high-workload training scenarios and training-based mitigations based on methods from Output 2. • Air carriers incorporate appropriate measures to monitor human performance during scenarios (in consideration of Output 1) to support conveying effective training feedback to flight crews. • Air carriers and training organizations revise training syllabuses as needed to accommodate new scenarios and mitigations.
Time Line:	• 6 months from CAST initiation of R&D plan for NASA to convene a CAST R&D forum • 51 months after R&D forum for research organizations to complete studies and document reports
Target Completion Date:	9/30/2018 (extended from original date of 12/31/2017). Completed and closed 10/04/2018 based on completed NASA research. JIMDAT will review reports and recommend appropriate follow-on actions.

Reference Material	
Supporting CAST Intervention Strategies	NOTE: *This section lists applicable CAST Intervention Strategies (IS) used to develop the actions in this detailed implementation plan (DIP). These ISs are listed to provide traceability and supporting rationale for the recommended actions. IS recommendations may be wholly or only partly represented in the DIP, based on a final determination of feasible actions during DIP development.* IS 208—Research should be conducted to understand and counteract the phenomenon of flight crew overload (e.g., why flight crews ignore ground proximity warning system (GPWS) warnings). IS 385—Because flight crews sometimes disregard flightdeck warnings, which require immediate action, research should be conducted to understand these phenomena and develop appropriate solutions. IS 572—Research should be conducted to improve understanding of how/why pilots misprioritize or become fixated upon concerns and tasks, and to develop strategies to counteract this effect. IS 1008—To help ensure sufficient airplane attitude and energy state awareness, the aviation industry should conduct research to understand effective instrument-scanning behaviors in both nominal and off-nominal conditions and then develop scan patterns for glass cockpits to ensure information transfer. IS 1027—To support future design of flightdecks for more effective crew management of tasks, the aviation industry should conduct research on how flightdeck displays can be arranged, customized, etc., to better divide the pilot flying and pilot monitoring tasks and workload. IS 1222–R—To mitigate effects of flight crew channelized attention and confirmation bias, the aviation industry should perform research and development of systems that can detect these conditions and alert the crew (e.g., cockpit video cameras capable of gaze tracking and determining normal and non-normal visual behavior, flight management and autoflight systems capable of tracking anomalous mode selections or control inputs).