Federal Aviation Administration

AVS Research, Engineering and Development

AVS RE&D Portfolio:

BLI - System Safety Management/ Terminal Area Safety (A11H)

Research Plan: 2022- 2027

January 26, 2022

Part 1: BLI Definition and Scope

Program Area: System Safety Management & Terminal Area Safety (A11H)

FAA Domain: Aviation Performance and Planning

BLI Scope: System Safety Management/ Terminal Area Safety

The System Safety Management (SSM) program is designed to improve safety by developing data collection methods, advancing data and risk analysis techniques, and creating prototypes for risk-based decision-making capabilities to identify and analyze emerging safety issues in a collaborative nature with aviation stakeholders.

As the overwhelming majority of aircraft accidents occur in the takeoff, approach, and landing phases of flight, the Terminal Area Safety (TAS) program aims to improve aircraft safety in those flight phases. Research projects develop both training and technology solutions to mitigate key causes of fatal accidents such as loss of control, runway excursions, runway overruns, and controlled flight into terrain. The domain of applications includes the commercial jet fleet, general aviation, and rotorcraft communities.

Part 2: Service/Office Research Requirements and Research Gap Analysis

1.0 Operational Capability: Enhance the safety of the NAS by advancing safety analysis methods, developing analysis tools, improving data collection capabilities, expanding the understanding of safety gaps, and enhancing safety oversight capabilities.

Definition:

Develop analysis tools, methods, and integrated modeling techniques for enhanced safety analysis capabilities to support innovative procedures to separate aircraft during all phases of flight and ground operations. Support the FAA initiative to increase throughput while maintaining a target level of safety by analyzing quality data with state-of-the-art tools.

Primary S/O: AFS
Secondary S/O: AIR

S/O Priority: 2

Outcome:

Increase NAS capacity, efficiency, and enhance the FAA safety management system. Updates may include Title 14 Code of Federal Regulations, Advisory Circulars and FAA policies.

Research Gap Analysis

Research Questions	Contribution	Research Output
1.1 Could an effective collision risk analysis/modeling tool incorporating artificial intelligence/machine learning be developed for safer NAS operations? **(NEW - A11H.SSM.32)**	50%	Review existing literatures, research, and data sources and document the outcomes. Enhance CRM methodologies for the NAS by incorporating advanced AI/ML analytical techniques. Prototype, document, and implement final tool.
1.2 Can aircraft response and pilot survey data collected in aircraft simulators be combined to develop a quantitative wake turbulence risk metric for all aircraft types and all phases of flight? **(NEW – A11H.SSM.34)**	50%	Report that validates metrics and quantify risks related to wake turbulence in all phases of flight. Additionally, the data will inform FAA regulations, policy, and guidance materials.

2.0 Operational Capability: Measure system-wide safety performance, identify emerging risks, locate system hot-spots, study effectiveness of safety measures and mitigations, and anticipate the effect system changes on safety.

Definition:

Develop predictive analytic tools, models, and methods to monitor system safety performance and reveal when, where, and why the level of risk elevates. Integrate and enhance safety modeling and analysis capabilities through a transparent and appropriate exchange of information and data within the FAA and among air transportation system participants.

Primary S/O: AVP
Secondary S/O:

S/O Priority: 1

Outcome:

Models and analytical tools will monitor precursors and barriers; results will reflect the logical flow of precursors and the system arrangement of barriers; and outputs will rank hazards and express relative risk across the entire air transportation system so that FAA can apply resources where most needed and most effective.

Research Gap Analysis

Research Questions	Contribution	Research Output
2.1 How can we improve upon safety risk data extraction from narrative descriptions of incidents/accidents and assess system-wide rate of occurrence for the key events described? **(FY23 - A11H.SSM.25)**	~~40%~~ **NOTE: Strikethrough contribution indicates that the research project was not entered for funding in FY24.**	Develop an improved system-wide risk analysis, safety monitoring, and decision support tool that acts as a "common safety ruler" across organizations.
2.2 How can the various safety culture measures developed or in development for unique domains and participants of the air transportation system be aggregated to reflect the overall US Aviation safety culture? **(NEW - A11H.SSM.33)**	~~20%~~ 100% **NOTE: Contribution shown in red indicates the updated contribution based on research projects not**	Evaluate the accuracy and reliability of instruments to measure the safety culture of dissimilar participants in the air transportation system and develop methods for aggregating multiple safety culture measurements into an accurately and reliably system-wide safety culture measure.

	entered for funding in FY24.	
2.3 What is the current level of safety performance of the NAS and its functional domains, and what measures of safety performance do executive need to support decision making on system changes, safety initiatives, and policy? **(NEW)**	~~10%~~	Evaluate what measures, obtainable through safety risk modelling, executives need to best 1) understand the current safety performance of the NAS and its functional domains, and 2) anticipate the effects on safety performance of planned system changes.
2.4 To be more predictive, how can FAA enhance its safety risk models to detect emerging risk before the risk is realized? **(NEW)**	~~10%~~	Develop techniques for assessing and reporting 1) uncertainty in event likelihoods, 2) confidence in hazard models, and 3) accuracy of domain safety baselines for incorporation into the Integrated Safety Assessment Model and other system-wide safety risk assessment tools.
2.5 How can we improve the current state of data repositories and knowledge sharing among FAA information domains and overcome challenges caused by data systems that were either never designed to coordinate/integrate or those capabilities have become obsolete? **(NEW)**	~~20%~~	Develop an approach/process to reduce or eliminate data silos, including isolated data systems, disparate data sources, and limited formalized processes for information sharing, along with improving protocols for accessing protected information. Research and best practice reviews will be conducted to formulate case studies and Use Cases that demonstrate proofs of concept from proven government agency, private sector and industry models.

3.0 Operational Capability: Manage risk through advanced safety analytics and modeling techniques for operational hazards.

Definition:

We could reduce the risk of certain hazards by better understanding them, enhancing data analytics, and safety modelling capabilities. This operational capability advances data collection and sharing methods, hazard identification and risk analysis techniques, and the development of risk profiles and associated acceptable levels of risk for hazards that are not well understood.

Primary S/O: AOV
Secondary S/O: AVP, AIR

S/O Priority: 1

Outcome:

Forensic and diagnostic tools will reveal the root causes of hazardous events not well understood today and enable improved safety through changes to policy, techniques, training, and equipment.

Research Gap Analysis

Research Questions	Contribution	Research Output
3.1 Can we reduce the helicopter fatal accident rate by developing analysis tools, metrics, and capabilities used by industry and government safety teams? **(A11H.SSM.9)**	20%	Develop data analysis techniques, tools, and metrics representing the helicopter community and create standardized data formats and prototype event replay capabilities.
3.2 Can we develop a runway operations safety monitoring tool and sector risk profile for airport surface safety for AOV and AVS partners' risk-based oversight missions? **(A11H.SSM.26)**	20%	Develop a sector risk profile prototype incrementally and present final tool with user guidance and supporting documentation.
3.3 How to develop a sector risk profile for Aeronautical Information Services (AIS) for AOV and AVS partners' risk-based oversight missions? **(A11H.SSM.30)**	20%	Develop a sector risk profile prototype incrementally and present final tool with user guidance and supporting documentation
3.4 How can new tools, methods, and data mining techniques for identifying wake encounter flight risk be used to develop wake risk mitigations that enhance/maintain the NAS system level flight safety of current and future ATC Separation Assurance procedures and associated supporting automation systems? **(NEW -A11H.SSM.36)**	20%	Provide statistical and predictive modeling for wake encounter risk mitigations. Assess developed tools capabilities in providing statistical wake information to support FAA SMS for ATC separation.

3.5 In an instrument that measures Safety Culture/Ethos in General Aviation, what is necessary to uncover weaknesses in GA safety culture and what additional information is necessary to develop mitigations of discovered weaknesses actionable by safety organizations and the FAA? **(NEW -A11H.SSM.35)**	20%	Expand upon existing instruments that measure GA Safety Ethos in terms such as safety attitudes, risk perception, safety citizenship, safety reporting, and safety practice to evaluate the instrument's reliability, accuracy and effectiveness in identifying safety culture problems (and their causes).

4.0 Operational Capability: Improve operational safety in the terminal area environment through technology development, procedures and training.

Definition:

Evaluate the potential solutions and procedural changes to improve pilot performance, reduce incidents and accidents through new technologies, innovative procedures, and pilot training. Address and mitigate the causal factors of accidents in the commercial, general aviation, and rotorcraft communities. Assess the impact of improved operational capabilities on pilot performance and ability to manage threats.

Primary S/O: AFS
Secondary S/O: AIR

S/O Priority: 1

Outcome:

Reduce the following accident classifications, in terminal area flight phases, by 15% by 2028: major accidents, fatal accidents, minor accidents, aircraft incidents, and terminal area accidents. Inform and update applicable regulatory and guidance material.

Research Gap Analysis

Research Questions	Contribution	Research Output
4.1 How do we assess new operational concepts and performance criteria for the use of helicopter enhanced vision systems in all-weather conditions and missions during critical phases of flight to achieve higher levels of safety? **(A11H.TAS.5)**	~~19%~~ 24% **NOTE: Contribution shown in red indicates the updated contribution based on research projects not entered for funding in FY24.**	Develop interoperability considerations, guidance material, and conduct operational evaluations of Vision Systems Technologies. Generate visual performance criteria (i.e. visual references, sensor/display field of view, and flight symbology/sensor performance criteria) required of pilots for visual segments of helicopter instrument approaches.
4.2 Can we improve the fidelity of helicopter simulation mathematical physics models to provide an	~~12%~~	Identify conditions of interest and develop improved

immersive training environment in low-risk, low-cost, high-fidelity, and technologically advanced safe operational training devices? **(A11H.TAS.10)**	18%	mathematical/physics-based flight dynamics simulator models.
4.3 How do we determine requirements for furthering immersive flight simulation in the terminal area through the use of (1) simulated air traffic control using artificial intelligence, and (2) virtual reality goggles? **(A11H.TAS.11)**	~~29%~~ 33%	Modify 14 CFR Part 60.
4.4 How can flight simulator scenarios be created to show pilots the dangerous errors that can arise from the cognitive biases? **(A11H.TAS.12)**	~~11%~~ 15%	Generate reports on prioritized biases that should be trained and on validated scenarios for training biases.
4.5 What are human factors considerations for simultaneous parallel approaches and non-VNAV capable aircraft? **(WAS – A11G.HF.17 – OC 8.1)**	~~10%~~ **NOTE: Strikethrough contribution indicates that the research project was not entered for funding in FY24.**	Technical Report
4.6 What are human factors considerations for simultaneous parallel approaches and navigation source transition issue? **(WAS – A11G.HF.17 – OC 8.2)**	~~10%~~	Technical Report
4.7 What are the performance criteria and infrastructure requirements needed to define an IFR Heliport/Vertiport that will allow helicopters, tiltrotors, and eVTOL aircraft to achieve higher levels of safety and efficiency support approval of instrument approaches and departures to and from a	~~9%~~ 10%	Examine and document performance criteria (Helicopter/eVTOL Viewing Angle, Lighting, Signage/Markings, Weather Equipment, Ground Infrastructure, etc.) and infrastructure requirements to be included in FAR 91.175, Aeronautical Information Manual, Advisory Circular on Heliport Design, and the US Standard for Terminal Procedures to define an IFR

helicopter/vertical flight landing area? **(New – A11H.TAS.13)**		Heliport/Vertiport and support approval of helicopter instrument approaches and departures to and from a landing area.

Part 3: RE&D Management Team Programming

BLI Planning 3 Year Funding Profile (FY22-24) as of 01/28/2022

YEAR	Appropriation or Formulation Contract Funding ($)	INITIAL BLI TEAM PLANNING CONTRACT FUNDING – AFN BLI Target minus the Hold Back ($)	AVS-1 APPROVED CONTRACT FUNDING ($)
FY22 formulation or appropriation (if known)	**$4,786,742**		
FY23 formulation	**$6,794,745**		
FY24 AFN funding allocation target		**$4,140,096**	**$5,714,096**

BLI Plan 5 Year Outlook (FY22-27)

Complete (C)	In Progress (IP)	Programmed (P)	Need (N)

Research Activities	FY22	FY23	FY24	FY25	FY26	FY27
Operational Capability 1.0: Enhance the safety of the NAS by advancing safety analysis methods, developing analysis tools, improving data collection capabilities, expanding the understanding of safety gaps, and enhancing safety oversight capabilities.						
1.1 Could an effective collision risk analysis/modeling tool incorporating artificial intelligence/machine learning be developed for safer NAS operations? (NEW - A11H.SSM.32)	P	P	IP	N	N	C
1.2 Can aircraft response and pilot survey data collected in aircraft simulators be combined to develop a quantitative wake turbulence risk metric for all aircraft types and all phases of flight? (NEW – A11H.SSM.34)			N	N	N	N
Research Activities	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**
Operational Capability 2.0: Measure system-wide safety performance, identify emerging risks, locate system hot-spots, study effectiveness of safety measures and mitigations, and anticipate the effect system changes on safety.						
2.1 How can we improve upon safety risk data extraction from narrative descriptions of incidents/accidents and assess system-wide rate of occurrence for the key events described? (FY23 -A11H.SSM.25)	IP	IP	C	C	C	C
2.2 How can the various safety culture measures developed or in development for unique domains and participants of the air transportation system be aggregated to reflect the overall US Aviation safety culture? (NEW - A11H.SSM.33)			P	C	C	C
2.3 What is the current level of safety performance of the NAS and its functional domains, and what measures of safety performance do executive need to support decision making on system changes, safety initiatives, and policy? **(NEW)**			N	N	N	N

2.4 To be more predictive, how can FAA enhance its safety risk models to detect emerging risk before the risk is realized? **(NEW)**			N	N	N	N
2.5 How can we improve the current state of data repositories and knowledge sharing among FAA information domains and overcome challenges caused by data systems that were either never designed to coordinate/integrate or those capabilities have become obsolete? **(NEW)**			N	N	N	N
Research Activities	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**
Operational Capability 3.0: Manage risk through advanced safety analytics and modeling techniques for operational hazards.						
3.1 Can we reduce the helicopter fatal accident rate by developing analysis tools, metrics, and capabilities used by industry and government safety teams? (A11H.SSM.9)	P	IP	IP	IP	IP	C
3.2 Can we develop a runway operations safety monitoring tool and sector risk profile for airport surface safety for AOV and AVS partners' risk-based oversight missions? (A11H.SSM.26)	IP	IP	IP	IP	C	C
3.3 How to develop a sector risk profile for Aeronautical Information Services (AIS) for AOV and AVS partners' risk-based oversight missions? (A11H.SSM.30)	P	IP	IP	C	C	C
3.4 How can new tools, methods, and data mining techniques for identifying wake encounter flight risk be used to develop wake risk mitigations that enhance/maintain the NAS system level flight safety of current and future ATC Separation Assurance procedures and associated supporting automation systems? (NEW -A11H.SSM.36)			N	N	N	N
3.5 In an instrument that measures Safety Culture/Ethos in General Aviation, what is necessary to uncover weaknesses in GA safety culture and what additional information is necessary to develop mitigations of discovered weaknesses actionable by safety organizations and the FAA? (NEW - A11H.SSM.35)			N	N	N	N
Research Activities	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**
Operational Capability 4.0: Improve operational safety in the terminal area environment through technology development, procedures and training.						
4.1 How do we assess new operational concepts and performance criteria for the use of helicopter enhanced vision systems in all-weather conditions and missions during critical phases of flight to achieve higher levels of safety? (A11H.TAS.5)	N	P	IP	IP	IP	C
4.2 Can we improve the fidelity of helicopter simulation mathematical physics models to provide an immersive training environment in low-risk, low-cost, high-fidelity, and technologically advanced safe operational training devices? (A11H.TAS.10)	N	P	IP	IP	IP	C
4.3 How do we determine requirements for furthering immersive flight simulation in the terminal area through the	N	P	IP	IP	IP	C

use of (1) simulated air traffic control using artificial intelligence, and (2) virtual reality goggles? (A11H.TAS.11)						
4.4 How can flight simulator scenarios be created to show pilots the dangerous errors that can arise from the cognitive biases? (A11H.TAS.12)	N	P	IP	IP	IP	C
4.5 What are human factors considerations for simultaneous parallel approaches and non-VNAV capable aircraft? **(WAS – A11G.HF.17 – OC 8.1)**		P	N	N	N	N
4.6 What are human factors considerations for simultaneous parallel approaches and navigation source transition issue? **(WAS – A11G.HF.17 – OC 8.2)**		P	N	N	N	N
4.7 What are the performance criteria and infrastructure requirements needed to define an IFR Heliport/Vertiport that will allow helicopters, tiltrotors, and eVTOL aircraft to achieve higher levels of safety and efficiency support approval of instrument approaches and departures to and from a helicopter/vertical flight landing area? (NEW – A11H.TAS.13)			N	N	N	N

Part 4: BLI Team Members

Participants Name	Role	Routing Symbol
Doug Rodzon	BLI Chair	AFS - 430
John Mixon	REDMT Voting Member	AOV -150
Scott LeMay	REDMT Voting Member	AVP - 200
Rany Azzi	REDMT Non-Voting	AFS-430A
Hailey Abaee	S/O Management Team	AFS-430A
Jeff Schroeder (TAS)	CSTA – Flight Simulation	AVS
Kathy Abbott (TAS)	CSTA - HF	AVS
Colleen Donovan (TAS)	STS - HF	AVS
Edward Johnson (SSM)	CSTA – Wake Turbulence	AVS
Frank Wondolowski (SSM)	Sponsor SME	AOV-150
Shane Bertish (SSM)	Sponsor SME	AVP-210
John Walberg (SSM)	Sponsor SME	AVP-230
Laura Bachurski (SSM)	Sponsor SME	AVP-220
Hong Jiang (SSM)	Sponsor SME	AFS-430B
Edwin Miller (TAS)	Sponsor SME	AFS-800
Mike Webb (TAS)	Sponsor SME	AFS-420
Vasu Kolli (SSM)	Performer SME	ANG-E272
Huasheng Li (SSM)	Performer SME	ANG-E272
Cliff Johnson (SSM & TAS)	Performer SME	ANG-E272
Angela Campbell (TAS)	Performer SME	ANG-E272