U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., SW.
Washington, DC 20591

March 31, 2020

The Honorable Richard Shelby
Chairman, Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

As requested by House Report 115-750 and Senate Report 115-268 accompanying the
Consolidated Appropriations Act, 2019 (Public Law 116-6), the Federal Aviation Administration
is pleased to provide the enclosed report on accelerating Aviation Safety Information Analysis
and Sharing (ASIAS) program capabilities.

The House Report and the Senate Report request the FAA to "accelerate the ASIAS capabilities,
including Fusion, next generation of ASIAS architecture, and expanding General Aviation safety
elements," and provide a status report to Congress.

We have sent identical letters to Senator Leahy, Chairwoman Lowey, and
Congresswoman Granger.

Sincerely,

Steve Dickson
Administrator

Enclosure

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., SW.
Washington, DC 20591

March 31, 2020

The Honorable Nita M. Lowey
Chairwoman, Committee on Appropriations
House of Representatives
Washington, DC 20515

Dear Madam Chair:

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Sincerely,

Steve Dickson
Administrator

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March 31, 2020

The Honorable Patrick Leahy
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Vice Chairman Leahy:

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Administration**

Office of the Administrator

800 Independence Ave., SW.
Washington, DC 20591

March 31, 2020

The Honorable Kay Granger
Committee on Appropriations
House of Representatives
Washington, DC 20515

Dear Congresswoman Granger:

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Enclosure

Report to Congress:
Report on the Status of Aviation Safety
Information Analysis and Sharing (ASIAS)
Capability Acceleration

Consolidated Appropriations Act, 2019
Public Law 116-6
House Report 115-750
Senate Report 115-268

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Introduction

On February 15, 2019, President Trump signed into law the Consolidated Appropriations Act of 2019 (Public Law 116-6).[1] House Report 115-750 and Senate Report 115-268 accompanying that Act request the Federal Aviation Administration (FAA) to provide a report on the Aviation Safety Information Analysis and Sharing (ASIAS) program. The House Report, using substantially similar text as the Senate Report, states as follows:

> *Aviation Safety Information Analysis and Sharing – The Committee commends the FAA for the collaborative government-industry Aviation Safety Information Analysis and Sharing (ASIAS) whose mission is to proactively discover and mitigate emerging safety issues, before they result in an incident or accident. The Committee appreciates this collaborative initiative that has resulted in the implementation of safety enhancements that have improved our nation's aviation safety. The Committee directs the FAA to accelerate the ASIAS capabilities, including Fusion, next generation of ASIAS architecture, and expanding General Aviation safety elements. Within 180 days of the enactment of this legislation, the FAA shall provide a report to Congress on the status of ASIAS capability acceleration.*

Overview

In 2007, the FAA and the aviation industry launched a collaborative safety analysis and data sharing initiative known as the Aviation Safety Information Analysis and Sharing (ASIAS) program. This program was intended to advance aviation safety by leveraging safety data from across the aviation industry to identify emerging risks and help evaluate the effectiveness of deployed mitigations.

The development of the ASIAS program faced considerable challenges and began with only a few carriers, manufacturers, and government and labor representatives. Working in coordination with MITRE/Center for Advanced Aviation System Development (CAASD), the group started by establishing governance protocols, data transformation processes, de-identification requirements, and system architecture development. MITRE/CAASD fulfilled the role of the "trusted third party" to help facilitate the sharing of proprietary data and to ensure associated protections for the data. Data protection and de-identification protocols had to be established before participants were willing to share sensitive data.

As a Federally Funded Research and Development Center, MITRE/CAASD provided a neutral site where the data could be protected from disclosure. In this capacity, MITRE/CAASD could act as a system integrator to develop an information sharing technology platform capable of processing a multitude of data sources with a suite of analytical tools designed to support the analysis of data by government/industry safety teams. At that time, analytical tools were not typically designed to operate on the large volumes of data that ASIAS would receive.

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[1] https://www.congress.gov/bill/116th-congress/house-joint-resolution/31?s=7&r=1

As the program pioneered new analytical technologies and methodologies, ASIAS has implemented those capabilities to support safety teams (such as the Commercial Aviation Safety Team (CAST)). The ASIAS next generation architecture is now in advanced planning stages, with initial operational capabilities to follow starting in calendar year 2021, after deployment of the system. The FAA is focused on program planning efforts in order to accelerate ASIAS capabilities, including data-fusion analytics (the merging of multiple data sources for more granular analysis), the implementation of a new ASIAS architecture platform (designed to process increased volumes and varieties of data), and advancements in general aviation (GA) safety efforts (to address critical issues in this segment of the aviation community). These areas will be addressed in detail later in this report.

ASIAS continues to evolve and has matured to the point that it now incorporates voluntarily provided safety data from operators representing a vast majority of U.S. air carrier operations in the National Airspace System (NAS). The data available in ASIAS has expanded considerably over time, and ASIAS continues to pioneer advanced analytical capabilities to provide safety teams with enhanced insight into these operations.

ASIAS data repositories include FAA data (e.g., surveillance radar data and navigational information), airline operator proprietary safety data (i.e., digital flight data and safety reports), publicly available safety data, manufacturer information, and other data from operations in the NAS. This data has been an invaluable source of information for safety teams to monitor known safety risks, evaluate the effectiveness of deployed safety mitigations, and identify emerging hazards.

Today, ASIAS has active data-sharing agreements with, and participation from, 45 commercial carriers, including all major U.S. domestic airline carriers. ASIAS also includes participation from corporate and business operators with 98 participating aviation companies, as well as labor associations, flight training entities, government agencies, manufacturers such as Boeing and Airbus, and trade associations including the General Aviation Manufacturers Association. General aviation and flight training operators alone have contributed over one million flight hours of digital flight data. The following chart displays the breadth of the ASIAS community.

ASIAS Stakeholders As of 30 September 2019

*Newest Stakeholder

Commercial Air Carriers (45)

ABX Air	ExpressJet	PSA Airlines
Air Canada	FedEx Express	Republic Airline
Air Transport Intl.	Frontier Airlines	Silver Airways
Air Wisconsin Airlines	GoJet Airlines	SkyLease Cargo
Alaska Airlines	Hawaiian Airlines	SkyWest Airlines
Allegiant Air	Horizon Air	Southern Air
Aloha Air Cargo	JetBlue Airways	Southwest Airlines
American Airlines	Kalitta Air	Spirit Airlines
Atlas Air/Polar Air Cargo	Mesa Airlines	Sun Country Airlines
CommutAir	Miami Air Intl.	Swift Air
Compass Airlines	Mountain Air Cargo	Trans States Airlines
Delta Air Lines	National Airlines	United Airlines
Empire Airlines	Northern Air Cargo	United Parcel Service
Endeavor Air	Omni Air Intl.	USA Jet Airlines
Envoy Air	Piedmont Airlines	Via Airlines

General Aviation Operators (98)

Abbott Laboratories	Gulfstream Aerospace Flight Operations	Pacific Gas & Electric Co.
ACI Jet	Hanover Foods Flight Ops	Priester Aviation
Aero Charter	Jet Aviation	Qualcomm, Inc.
Airshare	Jet Edge International	Raytheon EAO
Albertsons*	Jet Linx	REVA
Best Jets International	JetSuite	SevenBar Aviation
Blue Ridge Jet	JetSuiteX	Solairus Aviation
Bombardier Flight Operations	Johnson & Johnson	Smithfield Foods Flight Department
Boston Scientific	Kroger Aviation	Stryker Corporation
Cape Air	LECO Corporation	Talon Air
Cook Canyon Ranch Aviation	Luck Companies	Textron Aviation
Costco Wholesale	Mayo Aviation	UTFlight
Eli Lilly	Meridian Air Charter	Valero Travel Services
Embraer Executive Jets	N724DB, LLC	Venture Jets
Enterprise Holdings	NetJets	Vulcan, Inc.
Fair Wind Air Charter	Northeastern Aviation Corp.	Wing Aviation Charter Services
Flexjet	Northern Jet	XOJET
Flight Options	OnFlight, Inc.	44 Additional Operators
Gama Aviation Signature		

Industry

A4A—Airlines for America	IPA—Independent Pilots Association
AIA—Aerospace Industries Association	NACA—National Air Carrier Association
Airbus	NAFA—National Aircraft Finance Association
ALPA—Air Line Pilots Association	NATCA—National Air Traffic Controllers Association
APA—Allied Pilots Association	NAV CANADA
Boeing	RAA—Regional Airline Association
CAPA—Coalition of Airline Pilots Associations	SAPA—SkyWest Airlines Pilot Association
IBT—International Brotherhood of Teamsters	SWAPA—Southwest Airlines Pilots Association

Industry

ACSF—Air Charter Safety Foundation	Gulfstream Aerospace
Embraer	NBAA—National Business Aviation Association
GAMA—General Aviation Manufacturers Association	NJASAP—NetJets Association of Shared Aircraft Pilots
	Textron Aviation

Maintenance, Repair & Overhaul

AAR Aircraft Services	HAECO Americas

Flight Training

Southern Utah University	1 Additional Stakeholder
University of North Dakota	

Government

AMC—Air Mobility Command	NASA—National Aeronautics & Space Admin.	Naval Air Force Atlantic
FAA—Federal Aviation Admin.		USAF Safety Center

ASIAS Stakeholder Organizations

ASIAS is engaging with the Unmanned Aircraft System (UAS), rotorcraft, and military aviation communities as these communities advance their data collection efforts. Starting with fewer than one million digital flight records (also known as Flight Operational Quality Assurance or FOQA) in 2007, ASIAS now accesses over 31 million digital flight records contributed by commercial air carriers, and 500,000 safety reports submitted by pilots, air traffic controllers, and others. In the corporate/business aviation community, flight data contributions have increased from less than 500 flight records in 2010 to over 140,000 at the time of this report.

ASIAS data collection and analysis is based on the guiding principles noted below, which foster trust with participating entities:

- ASIAS information is used solely for the identification, monitoring, and mitigation of systemic safety issues;
- Submitted data is not used punitively;
- ASIAS stakeholders voluntarily submit safety-sensitive data;
- Data are de-identified to preserve anonymity;
- Roles and responsibilities of ASIAS stakeholders are developed collaboratively; and
- ASIAS data use is transparent to all stakeholders and supporting organizations.

The ASIAS Executive Board (AEB), which includes representatives from the FAA and industry, provides oversight of the program, approving policy and authorizing studies. The AEB

authorizes the use of ASIAS data to identify, characterize, and monitor systemic safety issues through root cause analysis, and supports the development of risk mitigation strategies. The ASIAS program works closely with CAST and the General Aviation Joint Steering Committee (GAJSC) to monitor known risks for the respective communities, evaluate the effectiveness of deployed mitigations, and detect emerging risks.

The ASIAS Commercial Issue Analysis Team and General Aviation Issue Analysis Team are composed of members of stakeholder organizations that represent the respective aviation communities. Each Issue Analysis Team (IAT) executes activities as directed by the AEB, and develops proposals on priorities and process changes for the program. The IAT puts systemic safety issues in context for review by the AEB, which may authorize expanded in-depth analysis or disseminate the information to ASIAS stakeholder organizations and other safety groups for risk analyses.

ASIAS has established metrics that enable CAST to monitor and evaluate the effectiveness of deployed safety mitigations. These metrics support recent efforts by CAST to evolve beyond its "historic" approach of examining past accident data, now adopting a proactive methodology that focuses on detecting risk and implementing mitigation strategies before accidents or serious incidents occur. ASIAS also incorporates de-identified GA flight operations data that supports GAJSC efforts to identify risks and evaluate the effectiveness of deployed solutions. ASIAS and GAJSC conduct outreach with the GA community to demonstrate the benefits of sharing safety data with ASIAS in a protected, non-punitive manner.

Data from ASIAS has enabled the aviation community to transition away from a forensic and investigative approach to safety, toward a more prognostic and diagnostic methodology by leveraging voluntary safety reporting programs, which enable the proactive identification and mitigation of risks before they lead to significant events.

The ASIAS process begins with the intake of disparate data sources, which are used to gain insight on safety issues through a variety of perspectives and safety products:

- **Metrics** monitor safety trends, detect safety issues, and assess the effectiveness of implemented safety enhancements.
- **Quick-look Studies** allow initial investigation of emerging safety issues.
- **Vulnerability Discovery** probes for new aviation hazards and changes in threat levels.
- **Directed Studies** are undertaken to dive deeply into systemic issues and gain insights into underlying contributing factors.
- **Benchmarks** allow airlines to compare their operations against an aggregate de-identified norm.

ASIAS works closely with government and industry safety teams to inform safety mitigation efforts.

CAST and #ASIAS help aircraft operators identify and mitigate hazards before they occur," according to Secretary of Transportation Elaine Chao on Twitter. "The result has been a remarkable safety record that is the gold standard worldwide.[2]

When a potential safety issue is identified, ASIAS working groups evaluate the risk and determine if further analysis is warranted. For systemic issues with potential widespread effects across the NAS, ASIAS provides analysis for the development of safety mitigation strategies by safety teams such as CAST and GAJSC. Once these safety enhancements are deployed, ASIAS works in partnership with the teams to monitor the effectiveness of the mitigations.

Michael Quiello, Vice President, Corporate Safety for United Airlines and industry co-chair for CAST, noted that: "The adoption of these [safety enhancements] represents the first approval…by the CAST to mitigate systemic risk without a previous fatal accident—demonstrating the evolution of safety analysis from a reactive, forensic activity toward a more proactive analysis."[3]

With a large data repository and analytical tools to proactively analyze, identify, and monitor data for potential safety risks, ASIAS is a flagship program of aviation safety. Aviation Week recognized the combined efforts of ASIAS and CAST with a Laureate Award in 2018 for Commercial Safety. ASIAS has enabled the aviation community to transition from a forensic approach in managing safety to a more prognostic and diagnostic approach.

According to Captain Al Madar, Managing Director, Corporate Safety, American Airlines: "ASIAS has been a game changer that applies leading-edge data analytics to aviation safety data to identify, understand, and mitigate aviation risk."[4]

Capabilities

The following sections provide a description of ASIAS capabilities, including Fusion, the next generation of ASIAS architecture, and general aviation safety elements, as well as the status of efforts to accelerate them.

Fusion

ASIAS de-identifies airline and company proprietary data submitted in accordance with ASIAS sharing agreements. These governance protocols ensure a level of protection for participants and protect against disclosure of a specific flight crew or entity. Adherence to these protocols has helped to foster a culture of trust within the ASIAS program and across stakeholder organizations. As trust was developed, ASIAS was able to advance data analysis methodologies through more automated capabilities and fuse together data streams to provide a 360-degree

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[2] *The FAA @FAANews · Sec. Elaine Chao: "CAST and #ASIAS help aircraft operators identify and mitigate hazards before they occur. The result has been a remarkable safety record that is the gold standard worldwide." Learn more at bit.ly/2MHEBNv. #FAAturns60 (August 2018).*

[3] *A Decade of Safety through Collaboration, ASIAS | 2007-2017 (2017).*

[4] *A Decade of Safety through Collaboration, ASIAS | 2007-2017 (2017).*

perspective of safety issues. Data-fusion analytics (or "Fusion") bypasses the limits associated with analyzing data in separate "silos" of information, provides insight from multiple fused data sources, and enables analysts to better understand the context of safety events.

By merging multi-source data, we can improve our understanding of safety issues and generate aggregated, de-identified safety results for enhanced analysis. Without the Fusion capability, ASIAS safety analysts were not able to align and measure the influence of specific unique factors associated with a flight. With Fusion data analysis, ASIAS analysts have an enhanced ability to determine the causal factors and trends associated with aviation hazards and to corroborate the findings across multiple information sources.

An important element of Fusion is the Threaded Track Flight Story. This capability integrates surveillance radar data sources across the route of flight (capturing the departure, enroute, and arrival portions of a flight) into a single, synthetic "threaded track" to provide optimal representation of an aircraft's flight trajectory from beginning to end. The fusion of airline digital flight data and text-based safety reports into a foundation of Threaded Track is a key element of the ASIAS Fusion capability.

Fusion merges Threaded Track surveillance radar data, digital FOQA data, Aviation Safety Action Program (ASAP) reports, Air Traffic Safety Action Program (ATSAP) reports, Air Traffic Mandatory Occurrence Reports (MORs), and other data sources to develop an integrated flight story. Descriptions of data sources include:
- Threaded Track – Offers an integrated collection of surveillance radar data;
- FOQA data – The collection and analysis of flight operational data to provide greater insight into the operations environment;
- ASAP - Encourages voluntary reporting of safety issues and events;
- ATSAP - System for air traffic controllers and others to voluntarily identify and report safety and operational concerns;
- MOR - An occurrence involving air traffic services that mandates the collection of associated safety-related data and conditions; and
- Other relevant data such as air traffic control voice data and weather information.

These sources are fused, as depicted in the figure below, to provide a complete 360-degree perspective of available information at each stage of a flight and to identify factors to address systemic safety issues in the NAS.
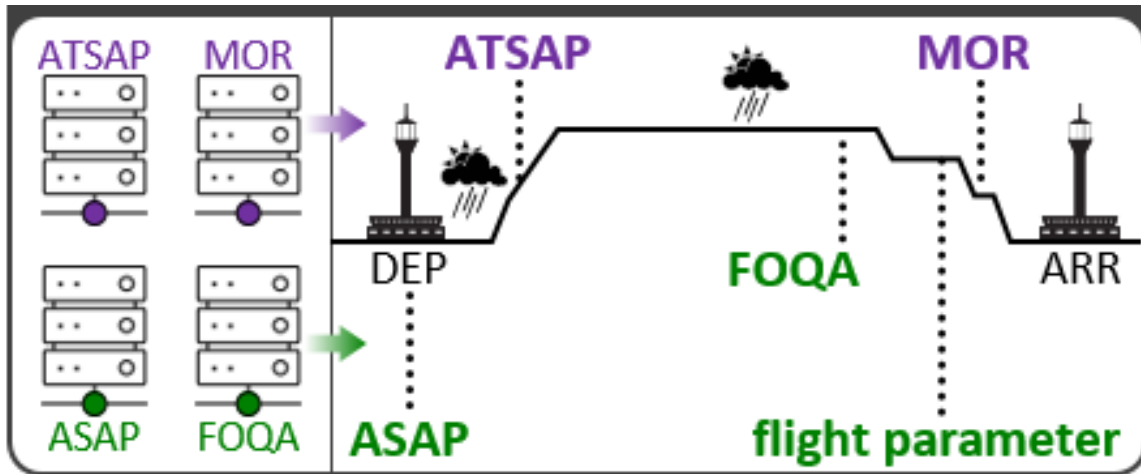
ASIAS Fusion

Air Traffic Safety Action Program (ATSAP)
Mandatory Occurrence Report (MOR)
Aviation Safety Action Program (ASAP)
Flight Operational Quality Assurance (FOQA)

ASIAS ensures that identifying information unique to an individual flight (such as aircraft tail number) is removed as part of the data intake process. Special Fusion data-handling and processing techniques have been established to ensure that the data remains de-identified when used for studies by safety teams and analysts, and cannot be associated with a specific entity. As part of these procedures, flight-specific information is encrypted and removed prior to the data being fused with safety reports, digital flight data, or other sources.

Incorporation of these features and development of the Fusion capability has progressed through multiple stages:

- **Fusion Demonstration Project** - The first stage, the Fusion Demonstration Project, was completed in September 2015 and focused on developing a capability to enable the fusing of ASAP and FOQA data while stripping identifying data fields. The objective was to demonstrate that utilizing fused sources could provide additional insight beyond the "silos" of information originally used for ASIAS analysis.
- **Fusion Operational Prototype** - In 2017, ASIAS completed the Fusion Operational Prototype, which built upon insights gained from the Fusion Demonstration Project and focused on creating automated technology processes for data intake and fusion. This project also focused on increasing airline industry participation and developing preliminary Fusion-based metrics to address specific aviation risks. Technical efforts and growth of participation during this stage made Fusion technology available for ASIAS analysis through manually merging the surveillance radar data, digital flight data, safety reports, and other data as needed.

- **Fusion Automation/Production** - These efforts provide the foundation for the Fusion production capability during the automated Fusion production stage. The ASIAS 2.0 architecture is currently in advanced planning stages, with initial capabilities scheduled to become operational starting in calendar year 2021. During this phase, the creation of Fusion data goes beyond current manual Fusion efforts to provide a dynamic architecture capable of the automated merging of multiple data sources. This platform architecture will be discussed in a following section.

ASIAS analysts are starting to leverage Fusion to support directed studies, and it will be used to develop integrated metrics to identify and monitor risks and help evaluate the effectiveness of deployed mitigations. Fusion will enhance safety analysis capabilities for the community and offer insight into safety issues at a level that was previously not possible when working with individual data sources. Fusion is a critical enabler for ASIAS development of predictive capabilities. As integrated risk assessment models are developed, the Fusion environment will enable the community to evaluate potential changes in the NAS and proactively mitigate and monitor risks as changes are introduced into the system.

ASIAS is looking ahead to incorporate the use of artificial intelligence (AI) technologies. Machine learning is an area where ASIAS can accelerate safety analysis using the Fusion capability. Through approaches such as topic modeling, ASIAS can utilize machine learning algorithms on Fusion data to automatically extract information from safety reports submitted by pilots, air traffic controllers, and others, classify the reports into known safety events (e.g., go-arounds or altitude deviations), and assist with understanding of key issues.

The ASIAS program will also leverage advances in the FAA's Systems Safety Management Transformation (SSMT) program. SSMT is a stakeholder-driven effort to support the development and implementation of integrated safety management systems. The SSMT program incorporates risk models into the Integrated Safety Assessment Model (ISAM) platform, and enables analysis ranging from the NAS to a single operator, region, or function. Additional components of SSMT, including the Airport Surface Anomaly Investigation Capability (ASAIC) and the Safety Investigation for Analysis and Reporting (SITAR), provide identification of, data about, and replay of detected safety events for surface and enroute operations, respectively.

These tools will leverage Fusion to incorporate the best available operational data from the system and provide a baseline for safety risk assessments. Determining the impact on safety for a set of circumstances allows stakeholders to work from a common baseline and allows direct comparisons between assessments. System-wide models, such as those in ISAM, can use Fusion to characterize system behavior and evaluate scenarios in various locations and phases of flight by considering interactions among each element. For proposed system changes, these models can help predict the impact to safety risk and inform risk assessments for situations in which no historical precedent exists.

The aggregation and merging of data from multiple sources in ASIAS enables comprehensive analysis that provides a more complete understanding of contributing factors, beyond single data sources and single root causes. The Fusion capability is a critical component that will drive ASIAS' vulnerability discovery efforts, the processes to uncover previously unknown aviation risks or accident precursor events, in order to vet and prioritize safety issues.

Next Generation of ASIAS Architecture

ASIAS is developing the next generation information technology platform architecture to advance its development of predictive capabilities. Known as ASIAS 2.0, the system will be sustainable, secure, agile, and scalable to support ASIAS current and future data processing, analyses, and stakeholder requirements. This system will be a critical component enabling ASIAS to address the increasing volume, variety, and velocity of data to be collected and analyzed, and to address associated data management challenges.

ASIAS 2.0 will replace the current ASIAS capability (ASIAS 1.0), originally designed in 2007 to support a distributed technology architecture. During the program's infancy, participating airlines would not agree to provide data unless their sensitive, proprietary flight data was maintained on servers located at their own data centers. This created inefficiency in the application of analytical tools and system performance. As ASIAS gained trust with the industry, airlines agreed to transition to a centralized architecture model. Advancements in cloud-based technologies and associated security applications have enabled the community to start the transition to ASIAS 2.0.

As Fusion data (including surveillance radar data, digital flight data, safety reports, and weather information) in ASIAS are currently merged through a manual and laborious process, the ASIAS 2.0 architecture will automate this process as a sustainable and enduring capability moving forward. The new architecture will provide a unified analytic environment and provide access to fused data for analysis in a more efficient manner. The ASIAS 2.0 platform architecture will support the traceability of findings developed through various types of ASIAS studies, metrics, and analyses, and enable ASIAS to store and analyze new types of data sources.

ASIAS 2.0 will be able to ingest, process, assimilate, and utilize increasing amounts of aviation data from multiple sources. For example, ASIAS currently maintains over 31 million digital flight records, more than 500,000 text-based safety reports, and more than 1,000,000 recreational general aviation flight hours, with data collection requirements continuing to expand.

The FAA is currently conducting design reviews for implementation of the ASIAS 2.0 architecture and is also evaluating ways to accelerate the development of advanced analytical capabilities. Pending results of the design reviews, the FAA plans to purchase components of the new platform, with initial operational capabilities to follow starting in calendar year 2021. Upon full capability of the ASIAS 2.0 platform, ASIAS analysts will be able to perform enhanced hazard vulnerability analysis, safety studies, and research efforts. The ASIAS 2.0 environment will also enable developers to accelerate the development of the new data mining tools and leverage advanced technologies, such as artificial intelligence and machine learning.

The ASIAS program plan was adjusted to facilitate the development of ASIAS 2.0 architecture and allocate required resources to purchase the necessary equipment. The ASIAS 2.0 architecture, leveraging Fusion data, advanced metrics, and new methodologies and analytical models (such as SSMT), will accelerate ASIAS capabilities in the following areas:

- Improved Data Receipt and Processing of FOQA, ASAP, ATSAP, mandatory occurrence reports, surveillance radar data, weather information, and other data as appropriate;
- Fusion Analysis Capabilities to support aviation studies utilizing airline proprietary data and other data;
- Business Intelligence Metrics and Processing Efforts aligned with the construction and quality review of ASIAS workbooks;
- Enhanced Portal and Collaboration Engagement to support ASIAS information sharing, collaboration, and knowledge management processes;
- Maintainability and Security Requirements related to testing, configuration management, and system monitoring functions; and
- Architecture Scalability for activities related to system configurations, sizing, and hardware/software administration.

Specific activities associated with development and deployment of the ASIAS architecture include:

- **Data Processing**: The new ASIAS architecture will have a dynamic data processing platform that is uniform, extendable, and driven by metadata with a capability to adapt and add new data workflows. The platform will ensure data lineage, with a capability to monitor, identify, and address data issues in a timely manner. The ASIAS 2.0 platform will have built-in data management rules and incorporate multi-tiered levels for data resilience and to ensure uniform processing across data sources.

- **Security**: The ASIAS 2.0 architecture will be an accredited production system following federal guidelines and applying best practices outlined in the National Institute of Standards and Technology (NIST) Special Publication 800-37, Risk Management Framework. Software changes for the platform will be tested and applied as appropriate, and security vulnerability scans of the system will be conducted on a regular schedule. System and application audits will be routinely consolidated and reviewed.

- **Stakeholder Access**: Once data are matured through processing levels, the new platform will enable capabilities that can support improved information sharing with the aviation community. The architecture will have a uniform data product publishing platform able to develop safety products, such as business intelligence workbooks, from an integrated database on a regular schedule. The publishing platform will be able to

securely transfer data to the ASIAS portal for review by ASIAS stakeholders, with portal software to manage access control.

- **Transition**: Development plans will enable ASIAS to support current/ongoing analyses while developing the new platform to address future needs. ASIAS is developing a flexible platform that facilitates big data storage and processing, multi-dimensional data fusion, and partner analytical access for collaboration. As elements of the next generation ASIAS architecture are developed and moved to a production environment, components of the legacy ASIAS architecture will be incrementally deprecated.

The design, development, and implementation of the ASIAS 2.0 architecture is a critical aspect of accelerating new and advanced analytical capabilities. Government and industry safety teams like CAST and GAJSC are working with ASIAS to help guide the development of these capabilities.

Expansion of General Aviation Safety Elements

The United States has the largest and most diverse GA community in the world, with more than 220,000 active aircraft including amateur-built aircraft, rotorcraft, and highly sophisticated turbojets. ASIAS provides safety analysis on key issues relevant to the GA community. The ASIAS GA community is growing rapidly and consists of participants from corporate and business flight departments and the broader GA community, including representatives from flight training entities and recreational flying segments. GA corporate and business membership in ASIAS has grown to 98 operators who contribute digital flight data and/or safety reports. The growth of GA participation in ASIAS has been accelerated through focused outreach efforts by current ASIAS stakeholders, as corporate and business aviation operators and flight training entities promote the safety benefits of participation. This outreach occurs during industry conferences, regional safety meetings, and through one-on-one encounters with potential members, as well as through print and web-based safety articles.

ASIAS works with GAJSC, a government and industry collaboration focused on improving GA safety in the United States. The GAJSC safety team uses the same data-driven methodology as CAST to analyze safety data and develop interventions to mitigate the root causes of GA accidents. GAJSC met its goal to reduce the GA fatal accident rate by 10 percent from fiscal year 2009 to fiscal year 2018. GAJSC has adopted a new goal to further reduce the fatal accident rate by 10 percent by fiscal year 2028.

ASIAS has developed metrics for use by the corporate and business aviation community to monitor aviation risks via a dashboard accessible on the ASIAS portal. These metrics use digital flight data, surveillance radar data, text-based safety reports, and other information to address risks associated with unstable approaches, loss-of-control incidents, aircraft traffic and terrain proximity events, as well as other issues.

Additional ASIAS dashboard metrics were developed to accelerate ASIAS capabilities supporting corporate and business aviation operators and address safety issues such as flight control

checks not performed according to manufacturer guidance, airport-related safety metrics, and additional measurements related to unstable approaches.

ASIAS continues to engage the recreational GA community. In collaboration with GAJSC, the FAA established the ASIAS Project Demonstration for General Aviation, also known as the GA Demo Project, in 2014. This initiative was a foundational effort to demonstrate the capabilities of ASIAS for the broader GA community by using voluntary data contributions from pilots in the area surrounding Phoenix, Arizona.

The GA Demo Project Team demonstrated the capabilities of ASIAS by:

- Demonstrating the value of innovative flight data monitoring tools that were previously not widely available for trend analysis and identification of hazards specific to the GA community;
- Introducing flight data management tools and ASIAS to the GA community through workshops, attendance at "fly-in" events, and other outreach efforts to increase awareness of the benefits of ASIAS participation; and
- Performing studies in which ASIAS analysts mined available data and reported findings specific to the Phoenix area to GA associations and operators in the region. Through these studies, the analysts identified potential precursors of risks specific to GA.

Using an open exchange of information, member organizations and the FAA reviewed the data and offered feedback for further areas of investigation. In addition, member organizations provided presentations and other information that added local context to identified issues.

ASIAS also developed and deployed the National General Aviation Flight Information Database (NGAFID), an open-source portal created to enable pilots and operators to analyze their own data, identify potential risks, and to share flight operations data with ASIAS. NGAFID accommodates a variety of data formats commonly found on flight data recording devices and avionics suites, and consists of multiple elements: a database, analytic tools, a flight playback capability, and a user portal to review results of the analytics. The database currently holds more than 500,000 flights representing more than 1,000,000 flight hours.

The majority of NGAFID data is collected from flight schools, university training fleets, and some individual pilots and operators, but NGAFID is accessible for use by all GA pilots. For those not possessing higher-level avionics and flight data collection capabilities, ASIAS developed the General Aviation Airborne Recording Device (GAARD). GAARD is an application that uses a mobile device (iOS or Android phone or tablet), a GPS receiver, and (optionally) an Attitude and Heading Reference System, to collect and store flight data. GAARD can record basic flight data such as position, airspeed, acceleration, and aircraft attitude, and this information can be uploaded to the NGAFID for further analysis. ASIAS is also working to facilitate the use of data recorded by electronic flight bag applications on mobile devices.

Recent ASIAS development efforts for NGAFID include the following analytical tools:

- Enhanced Unstable Approach Tool / Self-Defined Glide Path: Operations conducted at GA airfields often lack an established visual landing aid to provide glideslope guidance information for pilots during final approach to landing. To support analysis in these situations, this NGAFID tool uses an algorithm that enables users to reference the approach path for an individual flight event based on the pilot's selected start-of-descent-point and glideslope profile.
- Turn-to-Final Tool: Loss-of-control flight events are a significant issue for GA operators and can occur when an aircraft stalls during the approach phase of flight as the pilot maneuvers for landing in the airport traffic pattern. This tool provides analysis to help pilots determine if flight paths resulted in an over/undershooting turn-to-final, conditions which can serve as precursors to loss-of-control, aircraft stalls, and fatal accidents. This analysis may enable the pilot to avoid similar risks in the future.

Future ASIAS development efforts for NGAFID include implementing a tool that will analyze the risk of loss-of-control during all phases of a flight. This capability will allow the pilot to identify situations of elevated risk, consider precursors, and mitigate those factors.

ASIAS is also accelerating capabilities for the GA community through technical upgrades to the NGAFID, such as implementing improved data ingestion processes that allow users to download files more efficiently and to identify errors within the data.

The Digital Copilot system was developed by ASIAS to assist GA pilots and improve safety. Digital Copilot is a set of software algorithms that acts as a cognitive assistant to reduce the solo pilot's workload by using a simple and intuitive hybrid speech/touch-based interface. This technology can infer the pilot's intent based on the flight context to determine when certain information is required and to provide the information to the pilot at the appropriate time. For example, Digital Copilot can provide assistance by offering radio frequencies when needed, monitoring for and alerting pilots to weather situations at the destination airport, or warning pilots when they deviate from safe operations. Digital Copilot was recognized by Research and Development (R&D) Magazine as an "R&D 100" Award Finalist for 2017.

ASIAS is working to accelerate advanced safety analysis for the GA community through enhancements to the NGAFID, Digital Copilot, and in other areas, including the development of safety metrics for rotorcraft operators. Working with the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS) and others, ASIAS is moving forward with initial efforts to collect rotorcraft flight data and analyze community hazards. ASIAS will continue to engage with the United States Helicopter Safety Team (USHST) to identify critical safety issues for analysis and safety mitigation options. Outcomes of this engagement with USHST may include the development of helicopter metrics that address loss-of-control and unstable approaches or other issues related to fatal accidents, which would bring new insight and expand data-driven analytical methods into the helicopter community.

In addition, ASIAS is directing initial research to accelerate the collection of UAS data by working with the Alliance for System Safety of UAS through Research Excellence (ASSURE). In

this effort, three universities are collaborating to identify benefits, specifications, and data formats to collect and aggregate flight data from UAS operators.

ASIAS continues to advance efforts to reach the large diversity of the GA community in order to analyze and share safety information, and to encourage data sharing with ASIAS in an effort to improve safety. This will include further engagement with corporate and business operators, continuation of efforts with training entities and private pilots through enhancements to NGAFID, and expansion to new communities such as rotorcraft.

ASIAS will expand outreach efforts to engage broader GA participation and to demonstrate the value of flight data analysis. This includes working with industry associations, the recreational GA community, and the experimental and amateur built aircraft community. By working together with these entities, ASIAS can help pilots to identify and mitigate safety hazards.

Summary and Way Ahead

This report provides a description of the current status and efforts to accelerate ASIAS Fusion data-analytics, the ASIAS 2.0 platform architecture, and the ASIAS General Aviation program. Working closely with the aviation industry and pending future funding allocations, ASIAS is planning to adopt new artificial intelligence capabilities including machine learning, predictive analysis, advanced data mining, and other methods to leverage state-of-the art advances in technology.

Future advances will build upon the ASIAS 2.0 architecture and Fusion technology to provide increased access to data and analytical tools, improving the agility of the program and encouraging innovation. Pending approval by ASIAS stakeholders and executive leadership, ASIAS can develop governance protocols and technical capabilities that share aviation safety information more broadly. With proper protections in place, this sharing initiative could go beyond safety teams (such as CAST, GAJSC, USHST, and the Unmanned Aircraft Safety Team) and ASIAS stakeholder organizations (airlines, corporate/business operators, labor associations), by enabling controlled access to analytic cell structures for university researchers, international aviation organizations, and other entities with compelling contributions for aviation safety.

Moving forward, ASIAS will collect, analyze, and monitor key sources of data, using expanded volumes and varieties of data with advanced analytic tools. ASIAS program management will pursue opportunities to expand information access and collaboration initiatives with new safety partners, and to enhance connections throughout the aviation community.

Along those lines, ASIAS is working to accelerate program capabilities by building upon current collaborative efforts with global entities (i.e., the European Union Aviation Safety Agency/Data4Safety) and U.S. government agencies (i.e., the National Aeronautics and Space Administration) to leverage existing safety resources. This will also entail continued sharing of program protocols and approaches with domestic agencies (such as the National Highway

Traffic Safety Administration and the Pipeline and Hazardous Materials Safety Administration) to guide development of similar data-sharing initiatives in other transportation domains.

Current programmatic statutes and challenges will continue to be considerations for ASIAS, and the program is presently in a transitional period: conducting a full range of analyses and studies; developing and deploying the new ASIAS 2.0 architecture; and building a long-term strategy to support future aviation industry and community safety requirements. To succeed during this period, ASIAS leadership is working to increase the quality of safety analysis products by utilizing Fusion-based analysis and new general aviation analysis capabilities, and to reduce the timeframe required for analysis by investing in the ASIAS 2.0 architecture platform.

In addition, ASIAS must minimize the cost of delivering aviation safety analysis products. ASIAS must define long-term program requirements based on industry inputs, update ASIAS program plan activities accordingly, and manage the programmatic risk. That said, due to the unique nature of this government/industry safety initiative, establishing strict objectives and long-range schedules may limit the program's ability to adapt to immediate/emerging vulnerabilities in the NAS. In order to lead aviation safety analysis efforts in the United States and in the global community, ASIAS must address the challenges of working through extended Federal budget planning processes while maintaining the flexibility to incorporate new advances in safety technology and methodologies.