International Civil Aviation Organization

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Agenda Item 2.3: Update from States and International Organizations

HARNESSING ARTIFICIAL INTELLIGENCE TO ENHANCE AVIATION SAFETY AND EFFICIENCY

(*Presented by the United States)*

SUMMARY

This paper presents the United States (U.S.) Federal Aviation Administration (FAA) approach to harnessing the power of artificial intelligence (AI) for our continuing mission to provide the safest, most efficient aerospace system. The scale, complexity, and dynamism of the modern transportation ecosystem demand a technological and strategic evolution beyond incremental improvements. AI offers a once-in-a-generation opportunity to fundamentally alter the safety paradigm, enabling a monumental shift from a reactive model of accident investigation to a proactive model of incident prevention. In our efforts to employ AI tools and capabilities we are taking a measured and comprehensive approach and prioritizing safe, ethical and reliable AI deployment. As an exemplar, this paper highlights the development of the Aviation Safety Intelligence Platform (ASIP) and modernization of the Aviation Safety Information Analysis and Sharing (ASIAS) system introducing AI capabilities.

1. INTRODUCTION

1.1 The United States (U.S.) Federal Aviation Administration (FAA) is leading an ambitious undertaking involving the integration of Artificial Intelligence (AI) technologies to enhance safety and efficiency across the aviation lifecycle. The recent acceleration in the development of AI provides new opportunities to leverage the technology to support a safe aviation system, while posing new issues if not appropriately qualified and used. The introduction of such novel concepts and technologies necessitates a robust framework for deployment.

1.2 AI represents a foundational technological shift. It is not merely a collection of discrete software tools but a new paradigm for decision-making and operations, akin to the transformative impact of the internet or the Global Positioning System (GPS). The core power of AI lies in its ability to fuse and process immense and diverse datasets, recognize complex patterns invisible to human analysts, and generate predictive judgments at a scale and speed that is otherwise unattainable. This capability allows for a more effective and efficient use of available data to further enhance the proactive and predictive focus of safety management, where risks are anticipated, failures are predicted, and disruptions are mitigated before they escalate.

1.3 In 2007, the FAA and the U.S. aviation industry launched a collaborative safety data collection, analysis and information sharing initiative known as the Aviation Safety Information Analysis and Sharing (ASIAS) program. This program advanced aviation safety by leveraging

voluntary safety data from across the aviation industry to identify emerging risks and help evaluate the effectiveness of deployed mitigations. As the program pioneered new analytical technologies and methodologies, ASIAS implemented those capabilities to support safety teams (such as the Commercial Aviation Safety Team (CAST)). Today, over 200 operators as ASIAS members provide their data for use in ASIAS safety analysis. The program has been credited with dramatically improving the safety of commercial flight in the United States.

1.4 The ASIAS program set us on a transition from reactive to proactive safety management but with the introduction of Safety Management, new entrants and increased complexity of aviation operations and the airspace; we face heightened expectations for safety, and the amount of safety data has increased exponentially. The FAA, in collaboration with industry stakeholders set a course to modernize ASIAS and with the advent of AI and machine learning (AI/ML) it was clear that this revolutionary technology is the answer to enabling safety intelligence. This modernization culminated in the deployment of ASIAS 3.0 and the parallel development of the Aviation Safety Intelligence Platform (ASIP) as an internal safety management platform. Built together on a shared AI/ML infrastructure, they function as two sides of the same coin: complementary environments on a common platform designed to deliver timely, trusted, and actionable enterprise safety intelligence. While ASIP supports internal FAA safety management, ASIAS 3.0 supports collaborative FAA-industry safety analysis. Together, they create a unified, prognostic capability across the National Airspace System (NAS)

1.5 ASIAS revolutionized aviation safety by providing a platform for aggregating flight operations quality assurance (FOQA) data and voluntary safety reporting data from operators in a protected environment. This level of data integration allowed for more holistic analysis to identify emerging safety issues and collaboratively develop safety enhancements or mitigations. As the amount of safety data increased exponentially, because of more advanced aircraft systems and airspace technologies leading to more data parameters and complex operations, and the inclusion of general aviation and helicopter operators, the limitations of data analytics technology were apparent. Vast amounts of safety data from across diverse communities and operations needed to be fused, and the lack of contextual data limited the power of data analysis and actionable safety information. The lack of scalability to support new entrants and the speed at which data was onboarded and analysed was not keeping pace with the advancements in the aviation system.

1.6 FAA Flight Plan 2026 set us on a course to create an integrated, one SMS to unify safety management across the FAA in alignment with ICAO Annex 19. In addition to establishing the Office of Aviation Safety Management, this resulted in the development of the ASIP, an integrated tool employing AI/ML to produce safety intelligence. As the internal prognostic layer for ASIAS 3.0, ASIP uses advanced data fusion and system modelling to catch risks early. It also introduces Large Language Models through "Ask ASIP"—a natural-language assistant that helps analysts query data. Together, these tools automatically surface hidden relationships and precursor conditions before incidents occur. We are also focused on expanding from a proactive to a prognostic approach to enterprise safety management allowing us to monitor safety barriers in the system so that we can remain ahead of incidents or accidents. This requires a safety II approach which translates to even greater amount of safety data to include operations with safe outcomes and modelling high-risk categories to compare operational data and identify anomalies.

2. DISCUSSION

2.1 As the FAA continues to modernize its approach in pursuit of the mission and adapts to emerging technology, AI is a strategic enabler in providing the safest and most efficient aerospace system, while posing new issues if not appropriately qualified and used. A central theme of the FAA AI strategy is to assure the safety of the technology and introduce it for safety. With respect to AI in safety management we want to learn from the vast sea of operational data that precedes an event and

uneventful operational data may still present a wealth of safety information for a more predictive posture. This is commonly known as Safety II approach or learning from what went right to enhance safety.

2.2 Historically, safety improvements have often been driven by forensic analysis of past incidents. AI enables a transition to a predictive approach by identifying leading indicators of risk. Machine learning and natural language processing (NLP) algorithms can be deployed to analyse millions of unstructured and semi-structured documents, such as voluntary safety reports, confidential close-call narratives, and maintenance logs. These systems can detect subtle patterns, recurring themes, and correlations that are impossible for human analysts to find at scale, flagging latent risks before they manifest as incidents. This capability provides a constant stream of data-driven intelligence that directly enhances the Safety Risk Management (SRM) and Safety Assurance (SA) components of a Safety Management System (SMS). By identifying emerging safety issues regulators and service providers can proactively develop policy, guidance and training for new technologies like advanced air mobility, ensuring safety is built-in from the start.

2.3 For regulators and service providers considering deployment of AI systems it is highly recommended that you approach it from a use-case perspective. A mature and forward-looking element of the FAA safety strategy is the recognition that as AI is deployed to enhance safety, the AI systems themselves become safety-critical components. Therefore, it is important that to identify and mitigate the associated risks to ensure AI deployment is transparent, fair, safe, ethical, secure, and reliable.

2.4 To build a successful and trustworthy enterprise AI program a well-documented strategic roadmap is crucial to align the implementation of AI across the enterprise. Some key areas to consider are:

2.4.1 Strategic Foundation – Define a clear strategic vision for what you want to achieve with the implementation of AI. This vision should be grounded in a cohesive, enterprise-wide capability, deliberately aimed at augmenting human potential and integrating people, process and data to achieve core mission outcomes. A robust AI strategy helps guarantee that every AI investment is justifiable, measurable, and aligned with the safety mission.

2.4.2 Technical Engine (Data, Infrastructure, Engineering) – Trustworthy data is arguably the most critical element for effective and sustainable implementation of an enterprise AI program. Safety data must be high-quality, relevant, and well-governed. The technical engine which uses this data is the "how" that makes the "what" of the AI strategy possible in a responsible way, delivering robust, enterprise-grade AI solutions that can be trusted with mission-critical tasks, such as preventing runway incursions.

2.4.3 Enabling Capabilities (Workforce) –An organization's AI capability is only as good as the people who build, manage, govern, and use it. We should aim to build an AI-ready culture that extends beyond a small cadre of technical specialists to empower the entire organization. This involves fostering broad-based AI literacy for all employees, creating clear career paths for AI professionals, and cultivating a culture of continuous learning and responsibility that embraces AI as a tool to augment human capabilities and enhance mission delivery.

2.4.4 Oversight and Accountability – These are critical to ensure that our strategy is guided by a commitment to safety and public trust. The strategic roadmap should consider authoritative bodies (like an AI Governance Board), policies (AI Trust and Accountability Plan), and processes (AI Use Case Inventory and lifecycle management) that translate high-level principles of fairness, accountability, and transparency into enforceable, day-to-day practice.

2.5 The FAA is applying this approach and has made a significant investment in enhancing safety management by deploying ASIP alongside a modernized ASIAS 3.0 with AI/ML capabilities on

a common platform to generate timely and actionable enterprise safety intelligence. This unified framework flags anomalies and detects safety patterns at scale. This helps analysts research critical issues like runway incursions, loss of control, and near midair collisions. Rather than making automated safety decisions, these advanced tools serve as support for safety experts., rather than automated safety determinations. The anticipated enhanced benefits include the following with basic functionality (Table 1) maintained:

2.5.1 Rapid ingestion, processing, and fusion of datasets collected from across the aviation lifecycle.

2.5.2 Collaborative identification of hazards, analysis, and sharing of safety intelligence through an integrated, access-controlled platform.

2.5.3 ASIAS stakeholder access to ASIP data and fused ASIAS datasets; ASIAS stakeholder access to AI and advanced analytical capabilities.

2.5.4 ASIAS stakeholders' ability to integrate and fuse operator SMS data with ASIP data and produce self-service metrics for benchmarking.

2.6 The launch of ASIP and ASIAS 3.0 modernization promote greater collaboration between U.S. industry stakeholders and FAA while ensuring the foundational principles remain intact: voluntary reporting culture; data used solely for advancement of safety; data is deidentified; data analytics transparency. This shared platform offers a clear path for deeper safety collaboration. Users can start by viewing basic metrics and progress to analysing data within secure enclaves. The goal is to build a full, trusted data-sharing partnership with the aviation industry. These enhanced data analytics platforms support a broader range of data sources, use advanced data fusion, apply risk modelling to produce safety metrics and monitor key performance indicators for predictive analytics. This modernization will provide a more comprehensive safety picture and improve our ability to identify and analyse potential hazards. When monitoring precursor data or key performance indicators the system will leverage risk models and performance thresholds to identify when barriers or mitigation controls fail or may be close to failing and this will assist the analysts in being able to predict precursor events.

2.7 Our goal is to foster greater collaboration across the aviation safety community. These advanced analytic tools provide resources to facilitate information sharing and cooperation among stakeholders, government agencies, and international organizations.

Table 1. Basic Functionality

Focus Area	Scope
Collect	Collect, ingest, and manage activities related to the processing and preparation of existing FAA, public source, and stakeholder data. Evaluate emerging data sources for future use.
Analytics Capabilities	Develop algorithms and techniques to detect safety-relevant anomalies using a risk-based analytical framework and methods. Develop new analytic capabilities or tailor commercially available ones that can support analysts in the identification of emerging aviation safety risks.
Analysis	Conduct analysis to support the identification and assessment of safety-related vulnerabilities, completion of studies, and the development of metrics for monitoring known safety issues. Monitor implemented safety enhancement and vulnerability discovery processes and trend/anomaly detection.

Focus Area	Scope
Collaborate	Support collaboration between the FAA and stakeholders through processes and capabilities that provide insight into analytical results and data in accordance with required de-identification protocols and similar protections.
Connect	Perform outreach, onboarding, and governance activities to facilitate and enhance the safety missions for flight operators, the FAA and specific FAA organizations, aircraft manufacturing and maintenance industry stakeholders, international organizations, and others.

3. ACTION BY THE MEETING

3.1 The Meeting is invited to:

a) review this information paper and the FAA welcomes any feedback or interest in further knowledge sharing.
b) encourage a Positive Reporting Culture: By demonstrating the value of voluntary reports in identifying hazards and mitigating risks, organizations can foster a stronger safety culture where employees feel empowered to report safety concerns without fear of blame. This aligns with an emphasis on collaboration and learning.
c) consider the advancements in AI and their application in safety management functions and collaborate on a common framework to test, validate, and verify the safety of AI to ensure that it is applied responsibly.

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