U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON SPACE AND AERONAUTICS

HEARING CHARTER

NASA's Aeronautics R&D Program: Status and Issues

Thursday, May 1, 2008
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

Purpose

On Thursday, May 1, 2008 at 10:00 a.m., the House Committee on Science and Technology's Subcommittee on Space and Aeronautics will hold a hearing to review NASA's current Aeronautics R&D Program, examine what needs to be done to make it as relevant as possible to the Nation's needs, and in particular to examine R&D challenges related to safety and environmental impacts.

Witnesses

Witnesses scheduled to testify at the hearing include the following:

Dr. Jaiwon Shin
Associate Administrator
Aeronautics Research Mission Directorate
National Aeronautics and Space Administration

Carl J. Meade
Co-Chair
Committee for the Assessment of NASA's
Aeronautics Research Program
National Research Council
National Academies

Preston A. Henne
Senior Vice President
Programs, Engineering and Test
Gulfstream Aerospace Corporation

Dr. Ilan Kroo
Professor
Department of Aeronautics and Astronautics
Stanford University

Potential Issues

The following are some of the potential issues that might be raised at the hearing:

- ***Why is it important for the federal government to invest in aeronautics R&D, and is the current level of investment adequate?***
- ***What needs to be done to ensure that NASA's aeronautics R&D is relevant to the Nation's needs and to maintain U.S. leadership?***
- ***How can NASA's aeronautics R&D activities be more rapidly transitioned to the marketplace and to public sector users?***
- ***How can NASA work most effectively with industry and the universities to carry out a meaningful aeronautics R&D program?***
- ***What are the most important aviation safety issues facing the Nation, and what is NASA's aeronautics R&D program doing to address them?***
- ***What are the most important issues related to aviation's impact on the environment, e.g., noise, emissions, and energy consumption, and what is NASA's aeronautics program doing to address them?***
- ***What are the most important aeronautics R&D issues that will need to be addressed if the Next Generation Air Transportation System (NextGen) initiative is to succeed, and what is NASA's role in addressing them?***
- ***What are the most promising flight regimes for NASA to investigate and what R&D initiatives would offer the most promise for such areas as supersonic flight, V/STOL flight, and so forth?***
- ***What are the most important challenges to be addressed if the Nation is to sustain an efficient, environmentally compatible, and safe aviation system? What should NASA's role be in addressing those***

challenges and is NASA's current aeronautics R&D program able to fill that role?

BACKGROUND

Overview

NASA has long been a major source of the Nation's aeronautical research and development (R&D), R&D that has found application in both civil and military systems. However, funding for NASA's aeronautics program has been in decline for a major portion of the decade, in spite of recent congressional efforts to reverse that negative trend. In addition, beginning in late 2005, NASA began restructuring its aeronautics program to move away from a program that included technology demonstration projects and R&D that led to greater technology maturity towards a program focused on more fundamental research. These changes in NASA's Aeronautics R&D program occur at a time when the Next Generation Air Transportation System initiative known as NextGen is ramping up and increased concerns about aviation's actual and potential impact on the environment are growing.

NextGen is intended to transform the existing air traffic control system to accommodate projected growth in air passenger and cargo rates over the next decade. As part of this modernization, NextGen aims to develop a more efficient and more environmentally friendly national air transportation system, while maintaining safety. The development of NextGen is being overseen by the Joint Planning and Development Office (JPDO), a joint initiative of the Department of Transportation, NASA, Commerce, Defense Homeland Security, and the White House OSTP. FAA has traditionally relied on NASA for a significant portion of the R&D related to air traffic management as well as research to help address substantial noise, emissions, efficiency, performance, and safety challenges that are required to ensure vehicles can support the NextGen vision.

NASA's capabilities are likely to be needed even more in the years ahead as worldwide debate intensifies over how to deal with climate change caused by aviation. Aviation greenhouse gas emissions dominated the discussions last year at the ICAO Assembly in Montreal. And in late 2007, the European Union continued discussions on how to impose its emissions trading system on international aviation. R&D will be needed in several areas to meet the objectives of improving scientific understanding of the

impacts of aviation; accelerating air traffic management improvements and efficiencies to reduce fuel burn; hastening the development of promising environmental improvements in aircraft technology; and exploring alternatives to current greenhouse gas (GHG)-emitting fuels for aviation.

Promising research is already being conducted by NASA in several of these areas, including collaborations with industry for research at the system level on projects such as the X-48B Blended Wing with Boeing, Geared Turbo Fan with Pratt & Whitney, and sonic boom suppression technologies with Gulfstream Aerospace. However, the declining funding for Aeronautics R&D in NASA's budgets provides a worrisome backdrop that calls into question the agency's ability to meet the expectations of federal and private sector partners. The assessment of NASA's Aeronautics Research Program just completed by a Committee established by the National Research Council (NRC) reinforces concern over NASA's ability to successfully conduct a comprehensive aeronautics R&D program under the budgets given to NASA's aeronautics program.

Projecting what the air transportation system will look like and anticipating how to deal with increased demand, the integration of new aircraft technology in the National Airspace System, safety issues, and aviation's effect on the environment will require a responsive aeronautics R&D program at NASA. However, NASA's Aeronautics Research Program will be severely challenged in attempting to address those issues under current budgetary trends.

Fiscal Year 2009 Budget Request

NASA's FY 09 budget provides $446.5 million for the Aeronautics Research Program under the direction of Aeronautics Research Mission Directorate (ARMD). It should be noted that NASA's FY 2009 budget has been restructured pursuant to the Consolidated Appropriation Act, 2008, and is now presented in seven accounts. In addition, the budget estimates presented in the FY 2009 request are in direct program dollars rather than in the full cost dollars used in previous Presidential budget requests. From a direct cost perspective[1], the proposed FY 09 budget for Aeronautics

[1] As part of the budget restructuring, NASA shifted from a full-cost budget, in which each project budget included overhead costs, to a direct cost budget. All overhead budget estimates are now consolidated into the

Research is a decrease of $65.2 million from that appropriated in FY 08. This continues a multi-year trend of declines in the budget requests for NASA's aeronautics programs.

The Aeronautics Research Program budget funds:

- Fundamental Aeronautics. The FY 09 request for Fundamental Aeronautics is $235.4 million, a decrease of $34.5 million from the $269.9 million enacted in FY 08. Long-term research conducted by the Fundamental Aeronautics Program will be used to provide feasible solutions to the performance and environmental challenges of future air vehicles. Research efforts in revolutionary configurations, lighter and stiffer materials, improved propulsion systems, and advanced concepts for high-lift and drag reduction all target the efficiency and environmental compatibility of future air vehicles. NASA's FY 09 budget request says that space exploration activities will benefit from fundamental technology advances that can impact the agency's future ability to both access space and survive the planetary entry, descent, and landing phase of missions to other planetary surfaces.

- Airspace Systems. The FY 09 request for Airspace Systems is $74.6 million, a decrease of $25.5 million from the $100.1 million enacted in FY 08. The Airspace Systems Program is intended to address the air traffic management research needs of NextGen in collaboration with the member agencies of the JPDO. NASA is working with the JPDO as well as other government, industry, and academic partners to enable the formation, development, integration, and demonstration of revolutionary concepts, capabilities, and technologies intended to allow significant increases in capacity, efficiency, and flexibility of the National Airspace System.

Cross Agency Support budget line. NASA has stated that maintaining a full cost budget with seven appropriations accounts would be overly complex and inefficient. The direct cost budget shows program budget estimates that are based entirely on program content. Individual project managers continue to operate in a full-cost environment, including management of overhead costs.

- Aviation Safety. The FY 09 request for Aviation Safety is $62.6 million, a decrease of $3.9 million from the $66.5 million enacted in FY 08. The program builds on NASA's unique safety-related research capabilities to improve aircraft safety for current and future aircraft, and to overcome aircraft safety technological barriers that would otherwise constrain the full realization of NextGen. To that end, NASA says that it is focusing its Aviation Safety Program on developing cutting-edge technologies to improve the intrinsic safety attributes of current and future aircraft that will operate in NextGen. For example, NASA's work on an Integrated Intelligent Flight Deck will include research into a forward looking sense-and avoid concept aimed at detecting hazardous icing conditions with ground-based and on-board sensing technologies, a potentially significant safety capability for the flying public. Furthermore, the Aviation Safety Program supports NASA's human and robotic exploration missions by advancing knowledge, tools, and technologies in areas relevant to operations in harsh environments.

- Aeronautics Test Program. The FY 09 request for the Aeronautics Test Program is $73.9 million, a decrease of $1.2 million from the $75.1 million enacted in FY 08. Prior to 2005, NASA's management approach for major test facilities was for each NASA Research Center to be fully responsible for their Center's facilities. NASA believed that this approach limited the potential ability to pursue Agency-wide approaches and hampered interaction. In 2006, the Aeronautics Test Program was developed to establish corporate management of NASA's aeronautics ground test facilities. This was done, NASA says in its FY 09 budget request, to *optimize utilization of the Agency's wind tunnel and air breathing propulsion test facility assets for efficiency and cost effectiveness; to sustain and improve NASA's core capability of wind tunnel and air breathing propulsion testing; and to ensure a minimum core capability is maintained*.

NASA's out-year projections for the Aeronautics Research in the President's FY 09 budget request show only minor changes in projected funding levels through 2013. As a point of comparison, NASA Aeronautics funding was about $1.85 billion (2006 dollars) in 1994—the current budget request is thus only about 24% of that level.

$ in millions					
FY 2008 Enacted	FY2009 Request	FY 2010	FY2011	FY2012	FY2013
511.7	446.5	447.5	452.4	456.7	467.7

Congressional Direction to Develop a National Aeronautics R&D Policy and Plan

In the 2005 NASA Authorization Act, Congress reaffirmed the national commitment to aeronautics research made in the National Aeronautics and Space Act of 1958 and went on to state that *"Aeronautics research and development remains a core mission of NASA. NASA is the lead agency for civil aeronautics research."* The Act also directed that the government of the United States "*promote aeronautics research and development that will expand the capacity, ensure the safety, and increase the efficiency of the Nation's air transportation system, promote the security of the Nation, protect the environment, and retain the leadership of the United States in global aviation*". The Act also directed the development of a national policy to guide the aeronautics research and development programs of the United States through 2020. The policy was to include national goals for aeronautics research and development and describe the role and responsibilities of each Federal agency that will carry out the policy.

In addition, the Act specified that the national aeronautics research and development policy describe for NASA (a) the priority areas of research for aeronautics through fiscal year 2011; (b) the basis on which and the process by which priorities for ensuing fiscal years will be selected; (c) the facilities and personnel needed to carry out the aeronautics program through fiscal year 2011; and (d) the budget assumptions on which the policy is based.

In developing the national aeronautics research and development policy, the Act specified consideration of several issues, namely:

- The extent to which NASA should focus on long term, high-risk research or more incremental research, and the expected impact of that decision on the United States economy, and the ability to achieve environmental and other public goals related to aeronautics.
- The extent to which NASA should address military and commercial needs.

- How NASA will coordinate its aeronautics program with other Federal agencies.
- The extent to which NASA will conduct research in-house, fund university research, and collaborate on industry research, and the expected impact of that mix of funding on the supply of United States workers for the aeronautics industry.

In response to the congressional direction, the Bush Administration released its National Aeronautics Research and Development Policy, along with its accompanying Executive Order 13419. That policy established principles and objectives to drive federal aeronautics R&D activities and guidelines that delineate agency roles and responsibilities in (a) stable and long-term foundational research; (b) advanced aircraft systems development; (c) air transportation management systems; and (d) national research, development, test and evaluation infrastructure. The Policy also called for an infrastructure plan for managing critical Federal research, development, test and evaluation (RDT&E) assets.

The National Aeronautics R&D Policy laid out seven key principles to guide the conduct of the Nation's aeronautics R&D activities through 2020. These principles (with two exceptions discussed later) served as the framework for the R&D Plan issued in December 2007:

- Mobility through the air is vital to economic stability, growth, and security as a Nation.
- Aviation is vital to national security and homeland defense.
- Aviation safety is paramount.
- Security of and within the aeronautics enterprise must be maintained.
- The United States should continue to possess, rely on, and develop its world-class aeronautics workforce.
- Assuring energy availability and efficiency is central to the growth of the aeronautics enterprise.
- The environment must be protected while sustaining growth in air transportation

For each principle addressed in the plan, the state of the art of related technologies and systems was provided as well as a set of fundamental challenges and associated high-priority R&D goals and supporting

objectives for each goal. Objectives are phased over three time periods: near term (<5 years), mid term (5–10 years), and far term (>10 years). Two principles in the Policy are being addressed in different efforts. Specifically, Aviation security R&D efforts are coordinated through the National Strategy for Aviation Security and its supporting plans. Aerospace workforce issues are being explored by the Aerospace Revitalization Task Force led by the Department of Labor.

The infrastructure plan called for in the 2005 Authorization Act has yet to be completed. The R&D Plan issued in December 2007 outlined future steps in developing the RDT&E infrastructure plan that will focus on the critical RDT&E assets and capabilities necessary to support the aeronautics R&D goals and objectives laid forth in this Plan. The RDT&E infrastructure includes experimental facilities and computational resources, as well as the cyber-infrastructure that serves to connect the two. The supplemental infrastructure plan will also address an approach for constructing, maintaining, modifying, or terminating assets based on the needs of the broad user community.

Establishing Research Priorities: NRC's Decadal Survey of Civil Aeronautics

In 2005, NASA contracted with the NRC to develop a consensus document representing the external (industry and academia) community's views about what NASA's aeronautics research priorities ought to be. The Decadal Survey of Civil Aeronautics was the first decadal survey ever produced for NASA's aeronautics program. Eighty-five aeronautics experts from academia, industry, and federal laboratories met and worked over a one year period to develop a consensus document. The report laid out five key areas for research: aerodynamics and aeroacoustics; propulsion and power; materials and structures; dynamics, navigation and control, and avionics; and intelligent and autonomous systems, operations and decision-making, human integrated systems, networking and communications. Overall, the Decadal Survey laid out a prioritized list of 51 challenges to address and recommended that NASA use them as the foundation for its aeronautics program over the next decade.

The report was the subject of hearings before the House Committee on Science and Technology's Subcommittee on Space and Aeronautics in July and September of 2006. At the first of those hearings, then Subcommittee

Chairman Ken Calvert raised concern over instability in NASA's aeronautics R&D program, saying that *"NASA's aeronautics program has, in recent years, been prone to changes in leadership and program goals and strategies"*. At that same hearing, then Ranking Democratic Member Mark Udall called for investing in aeronautics R&D, thereby leading to such important efforts as enhancing the capability of America's air transportation system and enabling more environmentally compatible aircraft with significantly lower noise emissions and energy consumption relative to aircraft currently in service. He also warned that *"if we don't reverse this budgetary decline that NASA's aeronautics program is undergoing, we are not going to have the robust and vital R&D program we need and the [NRC] report envisions."*

NRC's Assessment of NASA's Aeronautics Research Program

The 2005 NASA Authorization Act directed the NASA Administrator to enter into an arrangement with the NRC for an assessment of the Nation's future requirements for fundamental aeronautics research and whether the Nation will have a skilled research workforce and research facilities commensurate with those requirements. The assessment was to include an identification of any projected gaps, and recommendations for what steps should be taken by the Federal Government to eliminate those gaps.

The Committee for the Assessment of NASA's Aeronautics Research Program found that *"even though the NASA aeronautics program has the technical ability to address each of the highest-priority R&T challenges from the Decadal Survey individually (through in-house research and/or partnerships with external research organizations), ARMD would require a substantial budget increase to address all of the challenges in a thorough and comprehensive manner."*

The Committee recommended that NASA:

- Ensure that "*its research program substantively advances the state of the art and makes a significant difference in a time frame of interest to users of the research results by (1) making a concerted effort to identify the potential users of ongoing research and how that research relates to those needs and (2) prioritizing potential research opportunities according to an accepted set of metrics. In addition,*

absent a substantial increase in funding and/or a substantial reduction in other constraints that NASA faces in conducting aeronautics research (such as facilities, workforce composition, and federal policies), NASA, in consultation with the aeronautics research community and others as appropriate, should redefine the scope and priorities within the aeronautics research program to be consistent with available resources and the priorities identified in (2), above (even if all 51 highest-priority R&T challenges from the Decadal Survey of Civil Aeronautics are not addressed simultaneously). This would improve the value of the research that the aeronautics program is able to perform, and it would make resources available to facilitate the development of new core competencies and unique capabilities that may be essential to the nation and to the NASA aeronautics program of the future."

- Bridge "*the gap between research and application—and thereby increase the likelihood that this research will be of value to the intended users."* Furthermore, the Committee recommended that NASA, for "*technology intended to enhance the competitiveness of U.S. industry, establish a more direct link between NASA and U.S. industry to provide for technology transfer in a way that does not necessarily include the immediate, public dissemination of results to potential foreign competitors."*
- Develop *"a vision describing the role of its research staff as well as a comprehensive, centralized strategic plan for workforce integration and implementation specific to ARMD. The plan should be based on an ARMD-wide survey of staffing requirements by skill level, coupled with an availability analysis of NASA civil servants available to support the NASA aeronautics program. The plan should identify specific gaps and the time frame in which they should be addressed NASA should reduce the impact of facility shortcomings by continuing to assess facilities and mothball or decommission facilities of lesser importance so that the most important facilities can be properly sustained"*.

The Challenge of Sustaining an Efficient, Environmentally Compatible, and Safe Aviation System in the Face of Increasing Demand

As evidenced by frequent reports of flight delays around the country, the Nation's air transportation system is reaching saturation. The number of passengers using the system has been climbing steadily. In 2006, passengers exceeded 750 million; it is likely that between 2012 and 2015, the number of passengers could reach one billion each year. At that point, the air transportation system will be reaching its limits. Some models project that the number of passengers could double or even triple by the year 2025.

In the U.S., the major effort to develop a new air transportation system falls under the aegis of NextGen. The vision for NextGen is a system that is based on satellite navigation and control, digital non-voice communication and advanced networking. Furthermore, NextGen envisions shifting of decision making from the ground to the cockpit. Flight crews will have increased control over their flight trajectories and ground controllers will become traffic flow managers. The air transportation system of the future will likely need to accommodate new flight regimes such as supersonic flight and the emergence of scheduled vertical and short take-off and landing (V/STOL) airline operations. Recent aircraft groundings for inspection of wiring bundles remind us that aviation safety issues associated with existing aircraft will also continue to need to be addressed.

There has long been a recognition of the need for R&D to minimize the adverse impacts on the environment, namely in the areas of aircraft noise around airports, energy consumption, and engine emissions. This is particularly important in light of the expected growth in air travel projected in the next decade. Some progress has been achieved in noise reduction for conventional fixed wing aircraft. FAA cites a decrease from 7 million to half a million people exposed to significant aircraft noise in the past thirty years, this despite a significant number of passenger emplanements. Such a reduction was made possible through the evolution of aircraft powerplants, from the use of turbojets to more efficient and quieter generations of turbofans which have benefited from NASA R&D. However, noise remains a significant issue, particularly around the Nation's busiest airports and more needs to be done. Noise also has been a significant challenge for civil V/STOL aircraft.

Airlines and other users of the Nation's air transportation system are particularly sensitive to the cost of fuel, and R&D to increase aircraft energy efficiency has been a significant focus of NASA's aeronautics R&D program at various times. Yet technical or operational measures to promote energy efficiency have to be considered in the context of the overall aviation system. As a result, air transportation is particularly sensitive to requirements that may impact on fuel efficiency. For example, higher fuel consumption is oftentimes the result of having to design aircraft capable of meeting airport noise restrictions. For that reason, there is high interest in future powerplants that are both quiet *and* fuel efficient. NASA's Ultra-Efficient Engine Technology (UEET) program was a government-industry cooperative effort to develop improved engine technologies. NASA's Space Act Agreement with Pratt & Whitney on the Geared Turbo Fan is a more recent illustration of NASA's work on this challenging problem.

Concerns about climate change and the impact of the aviation sector on global warming have spurred a variety of efforts to cut aviation emissions in the U.S. and overseas. Studies have determined that airlines contribute worldwide up to 3 percent of greenhouse gas emissions. Governmental and private sector organizations have implemented efforts to reduce aviation-related emissions. In the U.S., the focus has been on continued development of NextGen and R&D on engines. While there is increasing understanding of the impact of carbon dioxide, the impacts from other emissions are less well known. The goal is to identify the harmful emissions, accurately measure their impact, and design appropriate technologies or procedures to mitigate or eliminate their effects. In Europe, the response has been more aggressive. To cut aviation emissions, the European Union (EU) has embarked on an emission trading scheme for its airline industry. This trading scheme may include U.S. airlines serving Europe and has generated controversy. U.S. airlines are reported to have said that forced participation in the European Union's carbon trading plan violates international treaties. The Air Transport Association, the trade group for U.S. carriers, is reported to have called the European's focus on aviation emissions "out of proportion" and has noted the U.S. industry's success with market driven approaches such as buying more fuel-efficient aircraft, reducing the weight of their planes, and investigating alternative fuels.

In October 2007, the International Civil Aviation Organization (ICAO), the United Nations body responsible for regulating the aviation industry, rejected airline participation in Europe's Climate Emissions Trading System.

Instead, ICAO created a group of senior government officials to recommend what action the body should take on climate change. Calling for an "aggressive" plan of action from the new group, ICAO is reported to have said that the options to be considered include voluntary measures, technological advances in both aircraft and ground-based equipment, more efficient operational measures, improvements in air traffic management, positive economic incentives, and market-based measures to achieve reductions in emission of greenhouse gases.

The European Union is also focusing its aeronautics R&D on environmental effects. Under the aegis of its Seventh Framework Programme, the EU's main instrument for funding research over the period 2007 to 2013, the Union will be conducting research on developing technologies to reduce the environmental impact of aviation with the aim of halving the amount of carbon dioxide emitted by air transport, cutting specific emissions of nitrogen oxides by 80% and halving perceived noise. The research will address green engine technologies, alternative fuels, novel aircraft/ engine configurations, intelligent low-weight structures, improved aerodynamic efficiency, airport operations and air traffic management as well as manufacturing and recycling processes. The "Clean Sky" Joint Technology Initiative will bring together European R&D stakeholders to develop 'green' air vehicle design, engines and systems aimed at minimizing the environmental impact of future air transport systems. This initiative establishes a Europe-wide partnership between industry, universities and research centers, with a total public/private funding of €1.6 billion.

Last year, to better understand governmental, industry, and international efforts to reduce aviation-related emissions, the House Science and Technology Committee and the House Transportation and Infrastructure Committee asked the Government Accountability Office to survey those various initiatives, their potential to reduce emissions, and the competitive impact on U.S. airlines. The Committees are awaiting GAO's report.

Analyzing Safety Trends—NAOMS and ASIAS

Last September, in a letter denying a press request under the Freedom of Information Act for the data generated through a survey of airline pilots about safety incidents conducted under the National Aviation Operations Monitoring Service (NAOMS), a NASA official indicated that the data would not be released because it is "*sensitive and safety-related, [and] could*

materially affect the public confidence in, and the commercial welfare of, the air carriers and general aviation companies whose pilots participated in the survey."—a position subsequently reversed by the NASA Administrator. The survey was intended to be a forward-looking tool to identify emerging aviation safety problems. Instead, NASA had decided to stop the NAOMS project – despite the fact that the project had enjoyed unusual success in gathering responses from pilots.

NASA subsequently posted redacted responses collected from surveys of general aviation pilots and airline carrier pilots between April 2001 and December 2004 and a portion of the actual or raw survey responses collected to "*show the breadth and scope of the pilot community surveyed and the types of aircraft flown.*" In February of this year, five Members of the Committee asked the Government Accountability Office to use the unredacted set of data collected by the NAOMS project to provide the Committee with an appropriate level of analysis of the data and verification of the survey methodology. The Committee is awaiting the results of GAO's analysis.

The value of having another tool to enhance safety, such as NAOMS, was demonstrated last week. It was reported that the Department of Transportation's Inspector General found that managers at a Texas facility had reclassified errors by controllers as mistakes by pilots. The errors included instances in which controllers allowed aircraft to get too close to one another and others in which pilots were given improper or late instructions. FAA officials noted that none of the errors resulted in crashes but provided no further details. While the report was not released, the FAA Acting Administrator characterized the report as "disturbing". The availability of corroborative data from another source, such as NAOMS, might have provided FAA with an earlier indication that the reclassifications were not warranted.

NASA currently is working with FAA and the Commercial Aviation Safety Team (a cooperative government-industry initiative) on the development of the Aviation Safety Information Analysis and Sharing (ASIAS) system. ASIAS is intended for use by the aviation community to automatically integrate and analyze large sources of operational flight data in order to detect and mitigate system-wide anomalies or dangerous trends before an accident occurs. If ASIAS works as planned, Government and industry stakeholders will be able to query operational data to automatically identify

systemic risks, evaluate identified risks, and formulate and monitor the effectiveness of safety interventions targeted at identified risks. However, achieving such capabilities will not be easy. In addition to the challenge of developing and delivering new algorithms to automatically detect and identify vulnerabilities, NASA and its partners will need to develop new methods to automatically integrate and process large sources of disparate data.