Federal Aviation Administration

National Aviation Research Plan 2006

An Investment in Aviation's Future

April 2006

Contents

executive summary

Executive Summary

Aviation is a vital national resource for the United States. It provides opportunities for business, jobs, economic development, law enforcement, emergency response, and personal travel and leisure. It attracts investment to local communities and opens up new domestic and international markets and supply chains. As a result, the United States must have an aviation system that is second to none – a system that can respond quickly to its changing and expanding transportation needs. This can only be achieved through the introduction of new technologies and procedures, innovative policies, and advanced management practices. Research and development (R&D) is central to this process and enables the United States to be the world leader in aviation.

The Federal Aviation Administration (FAA) is committed to sustaining America's global leadership in aviation through the conduct and use of world-class, cutting-edge research, engineering, and development. To do this, the FAA R&D program needs to be flexible, balanced, and dynamic. It needs to respond to the critical near-term needs of the aviation system as defined in the FAA *Flight Plan*, while simultaneously providing a solid foundation for the next generation air transportation system, now being defined by the Joint Planning and Development Office. This plan will enable the FAA to capitalize on scarce federal R&D investments and achieve the national vision for a transformed aviation system.

The *National Aviation Research Plan* (NARP) is the single, integrated, and performance-based plan for the FAA R&D. The plan ensures that R&D is goal-driven, world-class, collaborative, innovative, and customer-focused. The FAA R&D program supports the development of the next generation air transportation system. This long-term focus will have to be balanced with the research needed to address the day-to-day safety and capacity problems of the national aerospace system. To achieve this balance, the FAA has defined ten crosscutting R&D goals to focus and integrate its program.

The ten R&D goals are not meant to be operational goals for the FAA. They are meant to challenge the R&D community to think long-term and achieve future breakthroughs. The best way for R&D to help transform the system is to aim for the ideal performance; otherwise, it will tend to focus on incremental improvements to current capabilities that may not achieve the long-term goals and objectives for the next generation system. The ten goal areas, with milestones for the years 2010 and 2015, will help focus and integrate the R&D programs and enable us to measure our progress toward accomplishing both the near- and long-term goals and objectives.

2007 Funding Highlights:

The FAA plans to invest $130,000,000, in current year dollars, in Research, Engineering and Development (R,E&D) and $78,700,000 for R&D-related Facilities and Equipment (F&E) programs.

The FAA also plans to invest $10,000,000 for Airport Cooperative Research. The FAA requests $17,870,000 for the Airports Technology Research program making the total Airport Improvement Program R&D request $27,870,000 in 2007.

2005 Research Highlights:

Air Quality Standards. The FAA released a new version of the Emissions Dispersion Modeling System that improves the estimation of particulate matter mass emissions from aircraft engines. The modeling system can now be used to demonstrate compliance with national ambient air quality standards for airport emission sources.

Aircraft Certification Job Aid. The FAA upgraded the computer-based, decision-support tool to provide an integrated database of regulatory information and human factors considerations for aircraft design and certification. The tool provides a single source of requirements to integrate safety and capacity considerations, streamline and improve processes, and reduce cycle-times. The FAA estimates that this will save $3 million per year for FAA and $6 million per year for industry.

Micro-scale Combustion Calorimeter. The FAA received a patent on a flammability tester that determines the fire resistance of a material using small samples and licensed two companies to manufacture and sell the tester. The FAA is already receiving royalties. The calorimeter provides a quick and less expensive way to test new materials that will enable us to develop a fireproof cabin.

Nondestructive Inspection Methods for Composite Aircraft Structures. The FAA developed a prototype, air-coupled, ultrasonic system that works on composite structures, since current ultrasonic inspection techniques for metal fuselages are not effective on composites. The FAA successfully demonstrated the first, non-contacting, non-contaminating, air-coupled, ultrasonic inspection tool in the field. This will enable quick assessment of composite damage and of structural soundness after repair. The FAA initiated efforts to license the technology and transfer it to the commercial sector.

Pavement Tests for Heavy Vehicles. The FAA completed tests on three different types of pavement and confirmed that the quality of the pavement base has a specific, quantifiable effect on the durability of the pavement after cracks form. The FAA will use this data to update the thickness design standard for concrete pavements, which is required to support the next generation of heavy transport civil aircraft.

Preface

Title 49 of the U.S. Code section 44501(c) requires the Administrator of the Federal Aviation Administration (FAA) to submit the *National Aviation Research Plan (NARP)* to the Congress annually with the President's budget. The plan includes both applied research and development as defined by the Office of Management and Budget Circular A-11 and is funded in four appropriations accounts: Research, Engineering and Development; Facilities and Equipment; Airport Improvement Program; and, Operations.

The *NARP* is evolving. The *2005 NARP* showed the relationship between the goals and objectives of the five-year FAA *Flight Plan*[1] and the Joint Planning and Development Office (JPDO) *Next Generation Air Transportation System Integrated Plan* for the year 2025.[2] It identified how the research and development (R&D) programs supported these plans. The focus of the *NARP* was on the *Flight Plan*, since the JPDO work was in its initial planning phase.

The *2006 NARP* shows how the FAA R&D programs work together to contribute to both the near- and long-term goals and objectives of the system with a master schedule focused on 2010 and 2015 milestones in ten R&D goal areas. The R&D goals are not meant to be operational goals for the FAA. They are meant to challenge the R&D community to think long-term and achieve breakthroughs in the future. As the system evolves, there will also be a need for ongoing research to address new issues that are likely to emerge.

In the future, the *NARP* will show how the FAA R&D programs are achieving the R&D milestones. This will enable the FAA to address the near-term challenges facing the air transportation system and provide a foundation for the next generation system in its areas of responsibility of increasing safety and providing greater capacity.

Chapter 1 of this year's *NARP* provides an overview of the national aviation system mission, vision, and long- and near-term goals and objectives that help the FAA define its R&D needs for the next twenty years. It describes the mission, vision, values, and goals for the R&D program. Chapter 2 provides a master schedule that shows how the FAA R&D programs relate to the ten R&D goals. Chapter 3 provides information on the FAA R&D sponsors, programs, budget, partnerships, and evaluation. The appendices, provided in a separate volume, contain detailed information on: FAA R&D program descriptions; partnership activities; reviews by the Research, Engineering and Development Advisory Committee; and acronyms and abbreviations, respectively.

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1 Federal Aviation Administration, *Flight Plan 2006-2010,* November 2005, http://www.faa.gov/aboutfaa/RevisedStrategicPlan/RevisedPlan.pdf

2 Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan,* December 2004, www.jpdo.aero.


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chapter one

chapter one
National Aviation System

Aviation is a vital national resource for the United States because of its strategic, economic, and social importance. It provides opportunities for business, jobs, economic development, law enforcement, emergency response, and personal travel and leisure. It attracts investment to local communities and opens new domestic and international markets and supply chains.

To realize these benefits, the United States must have an aviation system that can respond to its rapidly changing and expanding transportation needs. Increased mobility, higher productivity, and greater efficiency are possible through the introduction of new technologies and procedures, innovative policies, and advanced management practices. Collaborative, needs-driven research and development (R&D) is central to this process. R&D enables the United States to be a world leader in its ability to move more people and goods by air safely, securely, quickly, affordably, efficiently, and in an environmentally sound manner.

mission & vision

Mission & Vision

1.1 Mission

The nation's aviation system, or air transportation system, provides a service: it moves anyone and anything (e.g., people, goods, aerospace vehicles) through the atmosphere between points on the earth's surface and between the Earth and space. It does this for a wide range of users (e.g., passengers, shippers, general aviation) and purposes (e.g., leisure and business travel, law enforcement, defense, emergency response, surveillance, research).

The system is global, operates day and night, in peacetime and wartime, and in all but the most severe weather conditions. It accommodates many types of aerospace vehicles, airport/airfield configurations, launch and re-entry sites, and a wide variety of military, civil, and commercial operations. The system consists of three major elements: aerospace vehicles (e.g., commercial and military aircraft, general aviation, space launch and re-entry vehicles, rotorcraft, gliders, hot air balloons); infrastructure (e.g., airports and airfields, air traffic management system, space launch and re-entry sites); and people (e.g., aircrews, air traffic controllers, security screeners, ground personnel). The role and interactions of all of these elements determine the nature and performance of the system, so we need to consider all elements in designing, developing, and operating the system.

The air transportation system is designed, developed, maintained, and operated through the efforts of various federal, state, and local government organizations; industry; labor unions; academia; and other domestic and international organizations. The public also plays a key role in paying taxes and user fees that are ultimately used by the government to: regulate the aviation industry; develop, maintain and operate the air traffic management system; and provide airport security and other public aviation services.

1.2 Vision

In November 2003, Secretary of Transportation Norman Mineta defined a vision to transform the nation's air transportation system into a dramatically more capable system to ensure that America maintains its leadership in global aviation. That vision, created by the Departments of Defense (DOD), Transportation (DOT), Homeland Security (DHS), and Commerce (DOC); Federal Aviation Administration (FAA); National Aeronautics and Space Administration (NASA); and the Office of Science and Technology Policy (OSTP), is "A transformed aviation system that allows all communities to participate in the global market place, provides services tailored to individual customer needs, and accommodates seamless civil and military operations."[1]

To realize this vision, the air transportation system must accommodate an increasing number and variety of aerospace vehicles (e.g., unmanned aircraft systems), a broader range of air and space operations (e.g., point-to-point, space launch and re-entry), and a variety of business models (e.g., air taxis, regional jets). It will do this across all airspace, at all airports and launch and re-entry sites, and in all weather conditions, while simultaneously improving system performance and ensuring safety and security.

1 Letter to the President from Secretary of Transportation Norman Y. Mineta, "America at the Forefront of Aviation: Enhancing Economic Growth," November 25, 2003.

The basic challenge posed by this vision is to:

- Increase significantly the capacity of the national aviation system, and
- Decrease the time it takes to move people and goods from their origin to destination,

while simultaneously:

- Decreasing the number of fatalities and injuries due to aerospace operations;
- Eliminating the threat from terrorists and other hostile actions;
- Reducing the environmental impact of aerospace;
- Decreasing the cost of system operations; and,
- Improving the quality of air travel.

To achieve the vision, the Secretary of Transportation established a set of long-term national goals to transform the current aviation system over the next 20 years into a Next Generation Air Transportation System (NGATS) that will contribute substantially to continued economic prosperity, national security, and a higher standard of living for all Americans in the 21st century. These national goals are:

- Enhancing economic growth and creating jobs;
- Expanding system flexibility and delivering capacity to accommodate future demand;
- Tailoring services to customer needs;
- Integrating capabilities to ensure our national defense;
- Promoting aviation safety and environmental stewardship; and,
- Retaining U.S. leadership and economic competitiveness in global aviation.

long-term

Long–term

1.3 Long–term

In 2003, Congress created a multi-agency Joint Planning and Development Office (JPDO),[2] which reports to a Senior Policy Committee (chaired by the Secretary of Transportation) through the FAA Administrator, to oversee planning related to the next generation air transportation system. The JPDO includes representatives from the DOD, DOT, DHS, DOC, FAA, NASA, and OSTP. Working together with industry and academia, the JPDO has established long-term system goals and performance characteristics for the system in its *Next Generation Air Transportation System (NGATS) Integrated Plan*.[3]

- **Retain U.S. leadership in global aviation**
  - Retain our role as the world leader in aviation
  - Reduce costs for air transportation
  - Enable services tailored to traveler and shipper needs
  - Encourage performance-based, harmonized global standards for U.S. products and services to keep new and existing markets open
- **Expand capacity**
  - Satisfy future growth in demand (up to 3 times current levels) and operational diversity
  - Reduce transit time and increase predictability (domestic curb-to-curb transit time cut by 30 percent)
  - Minimize the impact of weather and other disruptions (95 percent on time)
- **Ensure safety**
  - Maintain aviation's record as the safest mode of transportation
  - Improve the level of safety of the U.S. air transportation system
  - Increase the safety of worldwide air transportation
- **Protect the environment**
  - Reduce noise, emissions, and fuel consumption
  - Balance aviation's environmental impact with other societal objectives
- **Ensure our national defense**
  - Provide for the common defense, while minimizing civilian constraints
  - Coordinate a national response to threats
  - Ensure global access to civilian airspace
- **Secure the nation**
  - Mitigate new and varied threats
  - Ensure security efficiently serves demand
  - Tailor strategies to threats, balancing costs and privacy issues
  - Ensure traveler and shipper confidence in system security

To achieve these system goals and objectives, the JPDO has identified five principles that will guide the development of NGATS and eight key capabilities that will be needed.[4] As a total-system concept, these capabilities support policy and cultural shifts and contain multiple dependencies. The five guiding principles are: it's about the user; system-wide transformation; proactive approach to safety risk management; global harmonization; and integrated environmental performance. The eight capabilities are:

[2] Vision 100 – Century of Aviation Reauthorization Act, Public Law 108-176, December 12, 2003.

[3] Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan,* December 12, 2004, www.jpdo.aero.

[4] Joint Planning and Development Office, *Next Generation Air Transportation System 2005 Progress Report to the Next Generation Air Transportation System Integrated Plan*.

- **Net-enabled information access.** Give the right information to the right people at the right time. Meet system information needs of all users in the air and on the ground in a secure and useable form and in real time.
- **Performance-based services.** Provide the air transportation system with the ability to transport people and goods to the desired destination on time. Enable multiple service levels to a wide range of users and tailor services to individual needs.
- **Weather assimilated into decision-making.** Provide a "common weather picture" to all pilots, air traffic controllers, and users.
- **Layered, adaptive security.** Create "layers of defense" to detect threats early, provide appropriate intervention using risk-based screening, and respond quickly if a threat materializes.
- **Broad-area precision navigation.** Provide navigation services when and where needed to enable aircraft operations in nearly all conditions.
- **Aircraft trajectory-based operations.** Manage daily operations based on aircraft trajectories, adjusting the airspace structure to meet user needs and DOD and DHS requirements.
- **Equivalent visual operations.** Provide critical information needed to navigate without visual reference and maintain safe distances from other aircraft during non-visual conditions.
- **Super-density operations.** Enable peak throughput performance at even the busiest airports.

The NGATS goals, objectives, guiding principles, and key capabilities will help define the R&D that the government, industry, and academia need to perform to achieve the desired NGATS operational capability in the 2025 timeframe. In 2005, the Senior Policy Committee endorsed six leveraging opportunities for the fiscal year (FY) 2007 budget submission. These include: align environmental R&D; synchronize weather R&D; define required total system performance; initiate dynamic airspace research; jump start cooperative surveillance; and jump start network enabled information sharing.[5] In FY 2006, the JPDO will develop agency guidance for the FY 2008 budget to further align agency R&D budgets with NGATS.

[5] Joint Planning and Development Office, *Next Generation Air Transportation System 2005 Progress Report to the Next Generation Air Transportation System Integrated Plan.*

near-term

Near-term

1.4 Near-term

The FAA is committed to supporting the long-term NGATS vision, but it also has the day-to-day responsibility to ensure the safe and efficient operation of the current aviation system. The near-term priorities of the FAA are driven by the goals and objectives in its five-year strategic plan -- *Flight Plan 2006-2010* – and an *Enterprise Architecture,* which will define the system architecture and transition strategy to NGATS. See figure 1.1.

The *Flight Plan 2006-2010*[6] describes the Agency's near-term performance goals and objectives.

- **Increased Safety** – Achieve the lowest possible accident rate and constantly improve safety.
  - Reduce the commercial airline fatal accident rate
  - Reduce the number of fatal accidents in general aviation
  - Reduce the risk of runway incursions
  - Ensure the safety of commercial space launches
  - Enhance the safety of FAA's air traffic systems

- **Greater Capacity** – Work with local governments and airspace users to provide capacity in the United States airspace system that meets projected demand in an environmentally sound manner.
  - Increase capacity to meet projected demand
  - Increase or improve aviation capacity in the eight major metropolitan areas and corridors that most affect total system delay
  - Increase on-time performance of scheduled carriers
  - Address environmental issues associated with capacity enhancements

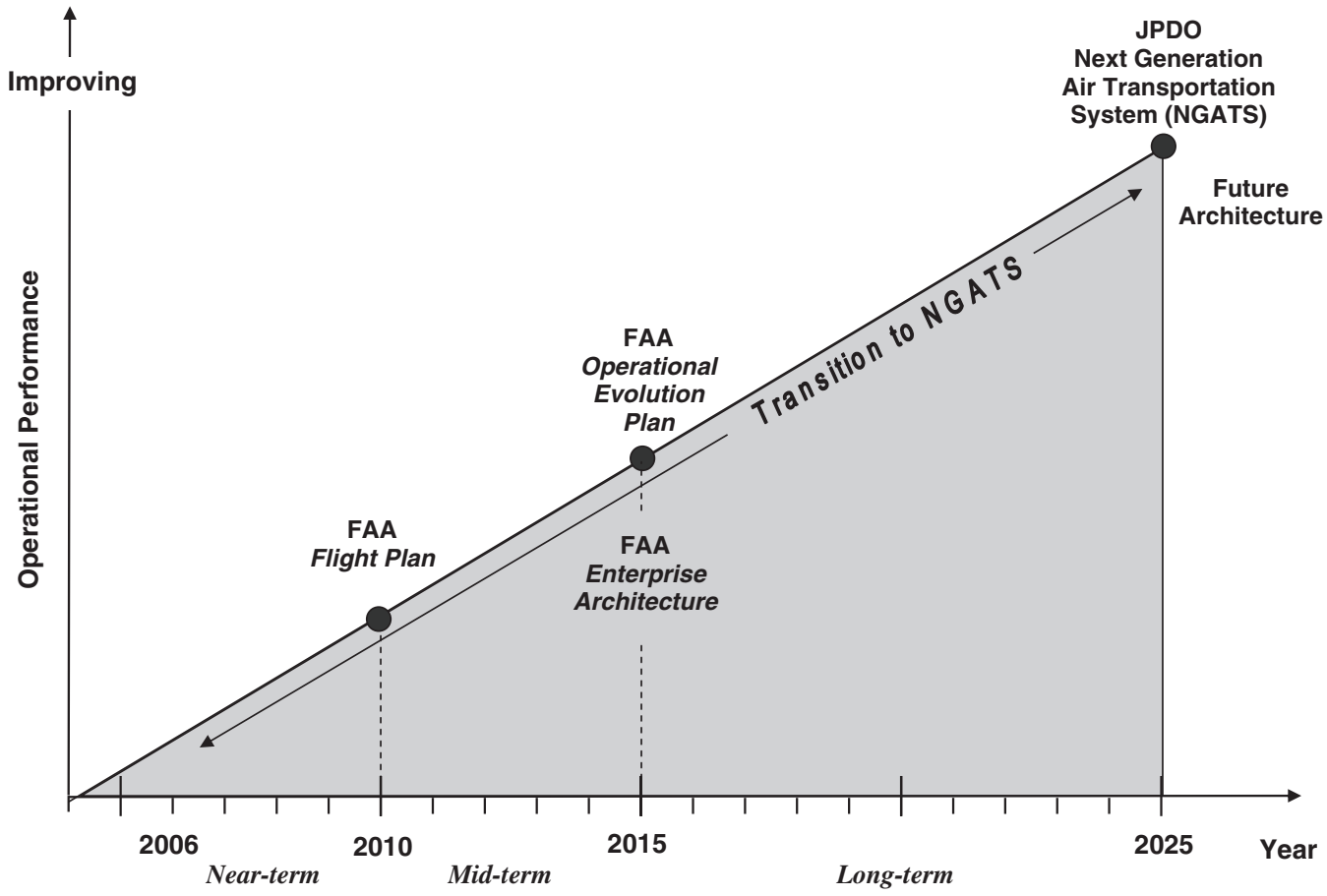
- **International Leadership** – Increase the safety and capacity of the global civil aerospace system in an environmentally sound manner.
  - Promote improved safety and regulatory oversight in cooperation with bilateral, regional, and multilateral aviation partners
  - Promote seamless operations around the globe in cooperation with bilateral, regional, and multilateral aviation partners

- **Organizational Excellence** – Ensure the success of the FAA's mission through stronger leadership, a better trained workforce, enhanced cost-control measures, and improved decision making based on reliable data.
  - Make the organization more effective with stronger leadership, increased commitment of individual workers to fulfill organization-wide goals, and a better prepared, better trained, safer, diverse workforce
  - Improve financial management while delivering quality customer service
  - Make decisions based on reliable data to improve our overall performance and customer satisfaction

The FAA *Enterprise Architecture* (EA) will represent the mid-term strategic plan of the FAA in terms of the desired future architecture and the transition strategy to arrive at that desired future. It will provide the operational and technical framework for all capital assets of the FAA and will serve as the agency's basic investment plan. It will serve as an initial element of the NGATS architecture, currently being developed by the JPDO. Since one of the main goals of the FAA EA is to ensure that its roadmap is aligned with the goals of NGATS, the FAA is working to ensure that the transition roadmaps and resulting architectures are aligned.

[6] Federal Aviation Administration, *Flight Plan 2006-2010,* November 2005, http://www.faa.gov/aboutfaa/RevisedStrategicPlan/RevisedPlan.pdf.

Figure 1.1 - FAA Integrated Planning



research & develo

Research & Development

1.5 Research and Development

The FAA uses R&D to achieve its near- and long-term goals and objectives. In the past, the R&D program has been driven by the near-term operational needs of the aviation system. As a result, a large share of the agency's R&D has focused on specific near-term safety and capacity issues. In the future, the R&D program needs to be more balanced between these near-term operational needs and the long-term, strategic, government-wide NGATS requirements being defined by the JPDO. The R&D program will need to be more flexible, balanced, and dynamic to respond simultaneously to the critical near-term needs of the system while providing a solid foundation for the next generation system.

Mission

The mission of the FAA R&D is to, "Conduct, coordinate, and support domestic and international R&D of aviation-related products and services that will ensure a safe, efficient, and environmentally compatible global air transportation system." It supports a range of research activities from materials and human factors to the development of new products, services, and procedures.

Vision and Values

The FAA has defined five R&D organizational values that will enable it to better manage its programs and achieve its long-term vision to, "Provide the best air transportation system through the conduct of world-class, cutting edge research, engineering and development."

- **Goal Driven.** Achieve the mission. The FAA will use R&D as a primary enabler to accomplish its goals and objectives.
- **World Class.** Be the best. The FAA will deliver world-class R&D results that are high quality and relevant, and improve the performance of the aviation system.
- **Collaborative.** Work together. The FAA will partner with other federal departments and agencies, industry, and academia to capitalize on national R&D capabilities to transform the air transportation system.
- **Innovative.** Turn ideas into reality. The FAA will empower, inspire, and encourage its people to invent new aviation capabilities. It will create new ways of doing business to accelerate the introduction of R&D results into new and better aviation products and services.
- **Customer Focused.** Deliver results. The FAA R&D will deliver quality products and services to the customer quickly and affordably.

By aggressively pursuing these values, the FAA will capitalize on its scarce R&D investments and achieve the national vision of a transformed aviation system.

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R&D Goals

The FAA R&D program supports the development of the next generation air transportation system. This long-term focus will have to be balanced with the research needed to address the day-to-day safety and capacity problems of the national aerospace system. To achieve a better balance between the near- and long-term, the FAA has defined ten crosscutting R&D goals to focus and integrate its program. The R&D goals are aligned with both the near-term *Flight Plan* goals and the key capabilities identified by the JPDO for NGATS. It will not be easy for FAA to achieve these R&D goals by 2025, but they will challenge the R&D community to think long-term and achieve breakthroughs in the future. The way R&D can help transform the system is to aim for the ideal performance; otherwise, it will tend to focus on incremental improvements to current capabilities that may not achieve the NGATS goals.

- **Clean and quiet** – significant reduction of aerospace environmental impact in absolute terms
- **Fast, flexible, and efficient** – a system that moves anyone and anything, anywhere, anytime[7] quickly on schedules that meet customer needs
- **High quality teams and individuals** – best qualified and trained workforce in the world
- **Human-centered design** – aerospace systems adapt to, compensate for, and augment the performance of the human
- **Human protection** – no fatalities, injuries, and adverse health impacts on the human due to aerospace operations
- **Safe aerospace vehicles** – no accidents and incidents due to aerospace vehicle design, structure, and subsystems
- **Separation assurance** – no accidents and incidents due to aerospace vehicle operations in the air and on the ground
- **Situational awareness** – common, accurate, and real-time information on aerospace operations, events, crisis, obstacles, and weather
- **System knowledge** – thorough understanding of how the aerospace system operates, the impact of change on system performance and risk, and how the system impacts the nation
- **World leadership** – globally recognized leader in aerospace technology, systems, and operations

[7] *Anyone, Anything, Anywhere, Anytime,* Final Report of the Commission on the Future of the United States Aerospace Industry, November 2002.

Table 1.1 R&D Goals Support the *Flight Plan* and *NGATS Integrated Plan*

Flight Plan Goals	FAA R&D Goals
Increase Safety	Human-centered design Human protection Safe aerospace vehicle Separation assurance System knowledge
Greater Capacity	Clean and quiet Fast, flexible, and efficient Situational awareness
International Leadership	World leadership
Organizational Excellence	Highly qualified teams and individuals
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	NGATS Key Capabilities	*NGATS Integrated Plan* Goals
	Performance-based services Weather assimilated into decision-making	Ensure Safety
	Aircraft trajectory-based operations Broad-area precision navigation Equivalent visual operations Net-enabled information access Performance-based services Super-density operations Weather assimilated into decision-making	Expand Capacity Protect the Environment
	Performance-based services	Ensure Safety Retain U.S. Leadership in Global Aviation
	Performance-based services	Retain U.S. Leadership in Global Aviation
	Layered adaptive security Net-enabled information access	Ensure our National Defense Secure the Nation

chapter two

chapter two
R&D Master Schedule

The Federal Aviation Administration (FAA) has developed a master schedule to help align, plan, and evaluate its research and development (R&D) activities to support both the near-term operational needs of the *Flight Plan* and the long-term research needs of the next generation air transportation system (NGATS). The schedule is built around the ten cross-cutting R&D goals defined in Chapter 1 and supports the four FAA *Flight Plan* goals of increased safety, greater capacity, international leadership, and organizational excellence.

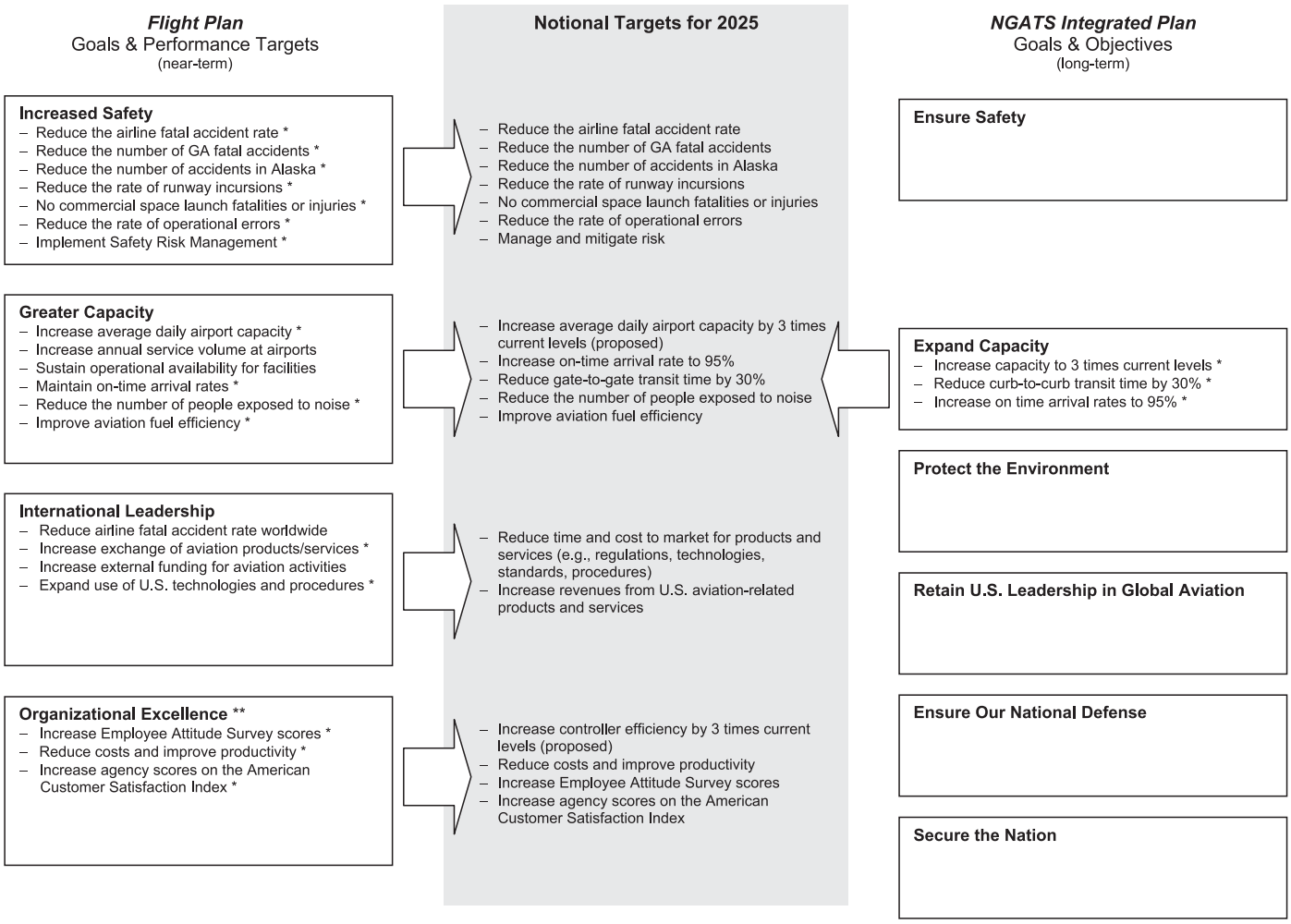
- Clean and quiet
- Fast, flexible, and efficient
- High quality teams and individuals
- Human-centered design
- Human protection
- Safe aerospace vehicles
- Separation assurance
- Situational awareness
- System knowledge
- World leadership

The R&D goals are not meant to be operational goals for the FAA. They are meant to challenge the R&D community to think long-term and achieve breakthroughs in the future. The best way for R&D to help transform the system is to aim for the ideal performance; otherwise, it will tend to focus on incremental improvements to current capabilities that may not achieve the long-term goals and objectives of the system.

notional targets

Notional Targets

Figure 2.1 - Notional Targets



Notes:
* These performance target areas were used to formulate the NARP R&D goals and milestones
** Organizational Excellence includes additional performance target areas that are not listed here

To achieve a balance between the near- and long-term, it was necessary to define notional performance targets for the nation's air transportation system for the year 2025. The notional targets were defined by first applying the *NGATS Integrated Plan*[1] objectives for the year 2025 to the *Flight Plan* performance measures for capacity. The capacity targets then drove the targets for safety and organizational excellence. See Figure 2.1.

For example, reduction in the rate of aerospace-related fatalities and significant injuries under safety is based on the NGATS target for 2025 to, "Satisfy future growth in demand (up to 3 times current levels) and operational diversity." The intent is to maintain an acceptable level of safety given a three fold increase in capacity. Likewise, the three times increase in air traffic controller efficiency and effectiveness under organizational excellence assumes that we will use the same number of controllers as today even with a three fold increase in capacity.

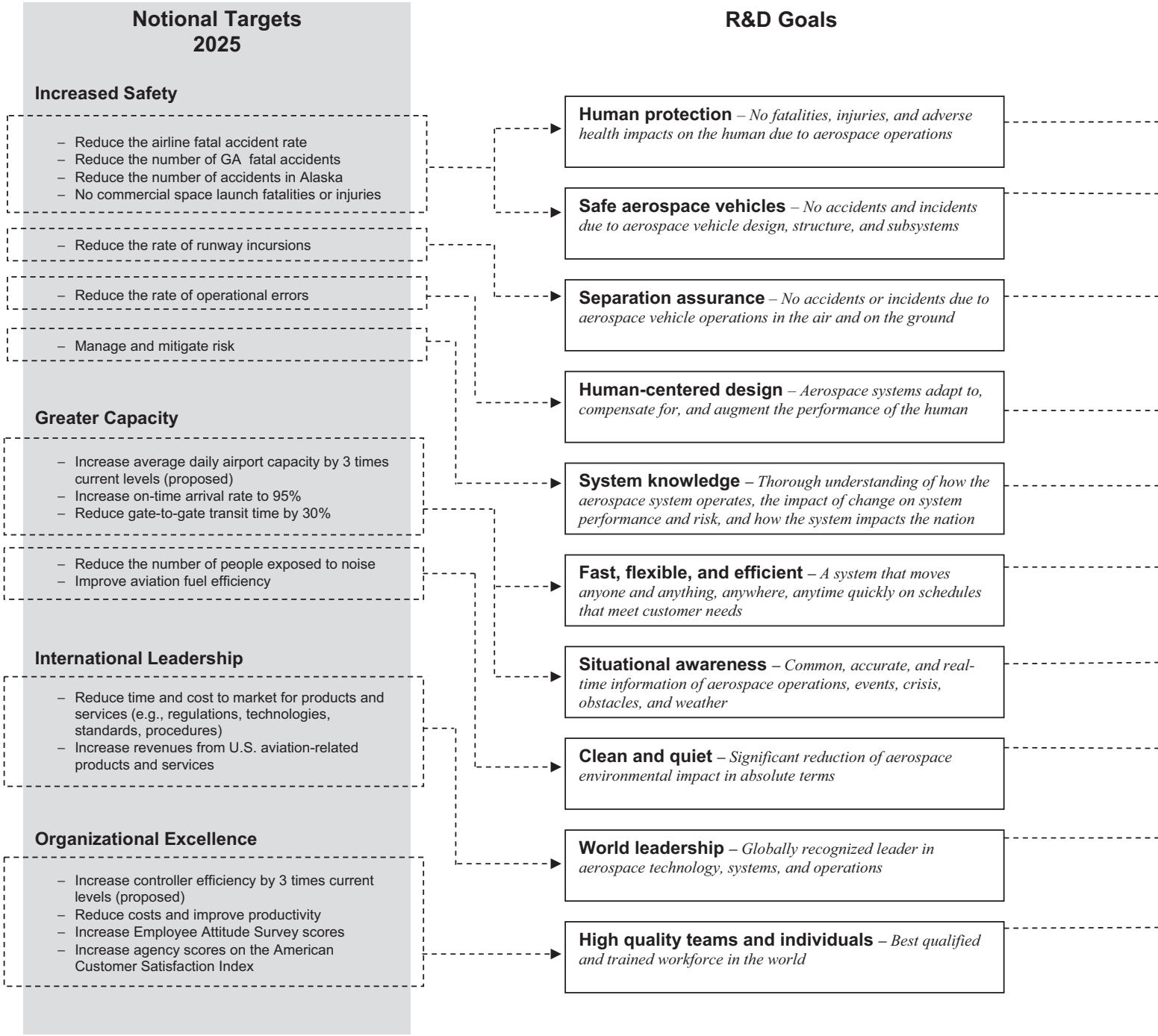
Figure 2.2 (on page 16) shows how the ten R&D goals directly support the notional performance targets for the year 2025. The R&D goals support achievement of other targets as well. For example, the main focus of the R&D goal for "System knowledge" is to understand how the aerospace system operates and the impact of change, improving our ability to manage and mitigate risk. Understanding these factors, however, also contributes to other *Flight Plan* goals and targets, such as our ability to achieve greater capacity, promote international leadership, and reduce costs and improve productivity.

Each R&D goal has a milestone for the year 2015. Achieving the milestones will demonstrate that it is possible to reach the notional targets. The milestones also provide a link between the R&D program and the goals and objectives of the *Flight Plan* and the *NGATS Integrated Plan*.

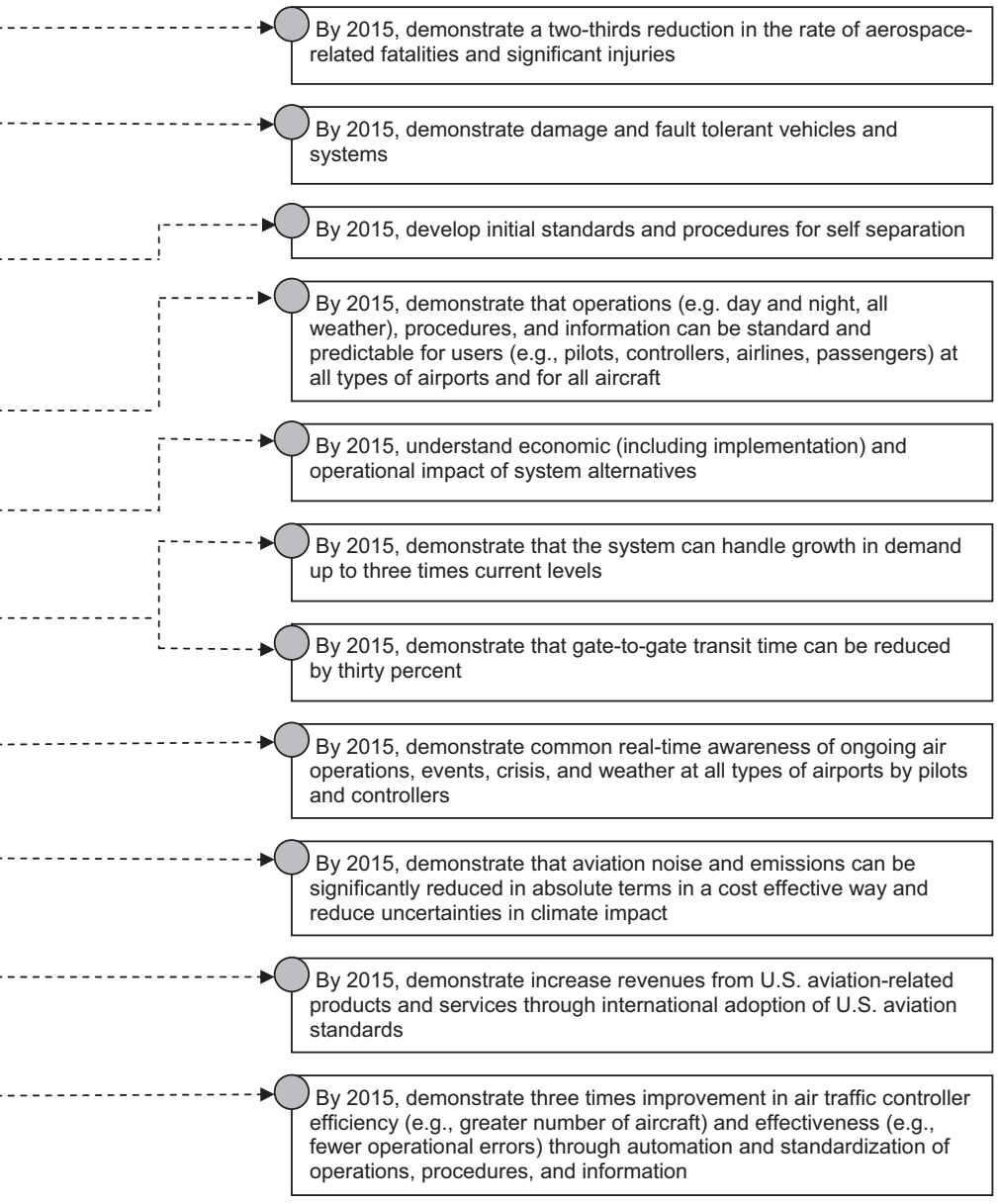
1 Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan*, December 12, 2004, www.jpdo.aero.

goals & milestones

Figure 2.2 - Goals & Milestones



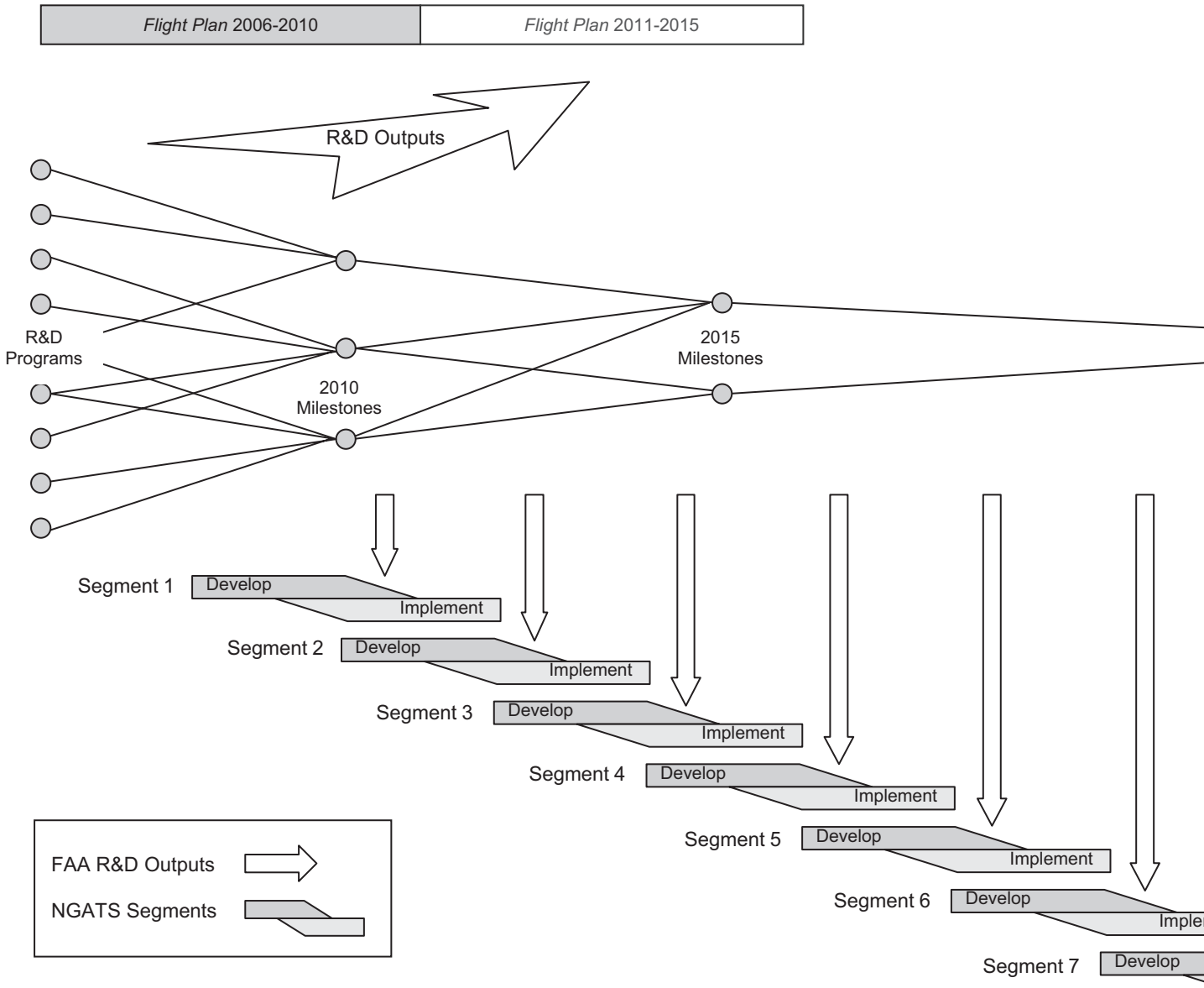
R&D Milestones
2015



concept for maste

Concept for Master Schedule

Figure 2.3 - Concept for Master Schedule



r schedule

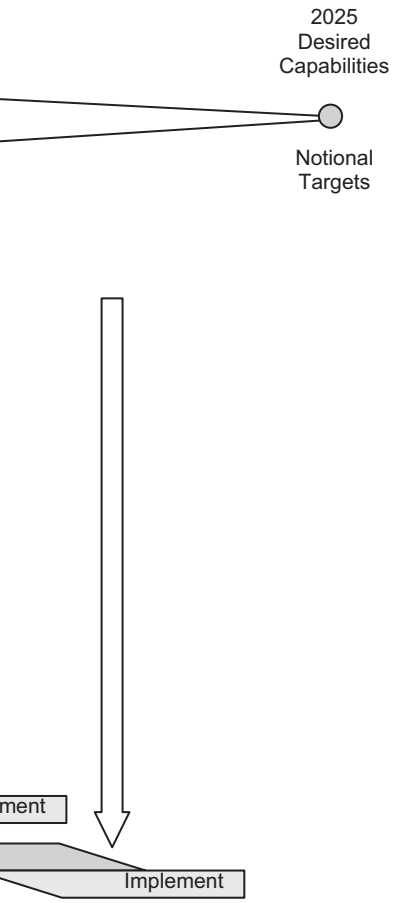


Figure 2.3 provides a notional master schedule. The schedule shows how our R&D programs are working together to achieve the notional performance targets for 2025 and the goals and objectives of both the *Flight Plan* and the *NGATS Integrated Plan*. To achieve the performance targets for the year 2025, we need to focus on the 2015 milestones.

Since it takes years to deploy the results of R&D and to have a major impact on the operational performance of the system, the master schedule identifies milestones for the years 2010 and 2015 in each of the R&D goal areas. The 2010 milestones will help FAA R&D support the development of new regulations, standards, technologies, and procedures needed to achieve *Flight Plan* goals and objectives five to ten years in the future. They will also help FAA measure progress toward the 2015 milestones that will demonstrate key NGATS capability and identify additional research requirements to support NGATS development. As the system evolves, there will be a continuing need for research to address new issues that are likely to emerge.

Table 2.1 (on page 20) shows the mapping of current R&D programs to the ten R&D goals and their 2010 and 2015 milestones. The pages that follow for each goal describe how the programs will achieve the milestones by identifying their major outputs over the next five years. In the future, the NARP will show a closer alignment and grouping of these program outputs in order to achieve the milestones and measure progress toward achieving them.

programs

Programs

Table 2.1 - Programs

	R&D Goal & Description	2010 R&D Milestones	2015 R&D Milestone
1	**Clean and quiet** *Significant reduction of aerospace environmental impact in absolute terms*	By 2010, release new methodologies to quantify and assess the impact of aircraft noise and aviation emissions, and their inter-relationships By 2010, deploy the Aviation Environmental Portfolio Management Tool to provide cost-effective analyses of noise, local air quality, and global emissions mitigation strategies	By 2015, demonstrate that aviation noise and emissions can be significantly reduced in absolute terms in a cost effective way and reduce uncertainties in climate impact
2	**Fast, flexible, and efficient** *A system that moves anyone and anything, anywhere, anytime quickly on schedules that meet customer needs*	By 2010, measure gate-to-gate transit time By 2010, identify ways for the air transportation system to minimize the impact of weather and other disruptions	By 2015, demonstrate that the system can handle growth in demand up to three times current levels By 2015, demonstrate that gate-to-gate transit time can be reduced by thirty percent
3	**High quality teams and individuals** *Best qualified and trained workforce in the world*	By 2010, provide computer-based education and training to improve controller skills (e.g., visual, attention, memory) By 2010, provide real-time, on-line selection, education, and training for all inspectors and maintenance personnel	By 2015, demonstrate three times improvement in air traffic controller efficiency (e.g., greater number of aircraft) and effectiveness (e.g., fewer operational errors) through automation and standardization of operations, procedures, and information
4	**Human-centered design** *Aerospace systems adapt to, compensate for, and augment the performance of the human*	By 2010, complete human factors design and certification information for flight-deck systems	By 2015, demonstrate that operations (e.g., day and night, all weather), procedures, and information can be standard and predictable for users (e.g., pilots, controllers, airlines, passengers) at all types of airports and for all aircraft
5	**Human protection** *No fatalities, injuries, and adverse health impacts on the human due to aerospace operations*	By 2010, develop initial standards for fireproof cabin By 2010, identify cabin environmental threats and demonstrate mitigation strategies	By 2015, demonstrate a two-thirds reduction in the rate of areospace-related fatalities and significant injuries
6	**Safe aerospace vehicles** *No accidents and incidents due to aerospace vehicle design, structure, and subsystems*	By 2010, develop initial standards for unmanned aircraft systems to operate in commercial airspace By 2010, develop initial standards for systems and materials that can monitor, identify, and compensate for faults and failures	By 2015, demonstrate damage and fault tolerant vehicles and systems
7	**Separation assurance** *No accidents and incidents due to aerospace vehicle operations in the air and on the ground*	By 2010, develop initial standards and procedures for pair-wise separation in the air and on the ground, such as to prevent runway incursion By 2010, develop initial standards for handling new large aircraft and unmanned aircraft systems	By 2015, develop initial standards and procedures for self separation
8	**Situational awareness** *Common, accurate, and real-time information of aerospace operations, events, crisis, obstacles, and weather*	By 2010, implement national, high-resolution, convective weather forecast into operations By 2010, Demonstrate Wide- and Local-Area Augmentation Systems standards for general aviation and vertical flight	By 2015, demonstrate common real-time awareness of ongoing air operations, events, crisis, and weather at all types of airports by pilots and controllers
9	**System knowledge** *Thorough understanding of how the aerospace system operates, the impact of change on system performance and risk, and how the system impacts the nation*	By 2010, develop initial specification for a Safety Management System By 2010, understand adaptive flow management concepts and alternatives By 2010, implement national, high-resolution, convective weather forecast into operations	By 2015, understand economic (including implementation) and operational impact of system alternatives
10	**World leadership** *Globally recognized leader in aerospace technology, systems, and operations*	By 2010, measure time and cost to market for R&D products and services By 2010, show that customers (and stakeholders) are satisfied with R&D products and services By 2010, ensure that FAA R&D programs are peer reviewed and judged to be world-class	By 2015, increase revenues from U.S. aviation-related products and services through international adoption of U.S. aviation standards

R&D Programs																															
Advanced Materials/Structural Safety	Aeromedical Research	Aging Aircraft	Airspace Management Laboratory	Airspace Redesign	Aircraft Catastrophic Failure Prevention Research	Airport Cooperative Research	Airport Technology -- Capacity	Airport Technology -- Safety	Air Traffic Control/Airway Facilities Human Factors	Atmospheric Hazards/Digital System Safety	Aviation Safety Risk Analysis	Center for Advanced Aviation System Development (CAASD)	Commercial Space Transportation	Environment and Energy	Fire Research & Safety	Flightdeck/Maintenance/System Integration Human Factors	General Aviation and Vertical Flight Technology (GA & VF)	Joint Planning and Development Office (JPDO)	NAS Requirements	Operations Concept Validation	Propulsion and Fuel Systems	Runway Incursion	Safe Flight 21 -- Alaska Capstone	Safer Skies	System Capacity Planning and Improvement	System Planning and Resource Management	Unmanned Aircraft Systems Research	Wake Turbulence	Weather Program	Wind Profiling and Weather Research - Juneau	William J. Hughes Technical Center Laboratory Facility (WJHTC)
						X				X		X	X	X				X	X		X				X				X		
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clean & quiet

Significant reduction of aerospace environmental impact in absolute terms

2025 Benefit

This R&D goal will result in an aerospace system that has no significant environmental impact on local and global communities in spite of significant increases in air transportation capacity. The FAA will reduce noise and local emissions in absolute terms. It will reduce uncertainties on the impact of aviation particulate matter and hazardous pollutants on the environment and the contribution of aviation to climate change to levels that enable appropriate action. It will significantly and safely reduce the use of hazardous materials from the national aviation system.

R&D Milestones

2010: Release new methodologies to quantify and assess the impact of aircraft noise and aviation emissions, and their inter-relationships

Deploy the Aviation Environmental Portfolio Management Tool to provide cost-effectiveness analyses of noise, local air quality, and global emissions mitigation strategies

2015: Demonstrate that aviation noise and emissions can be significantly reduced in absolute terms in a cost effective way and reduce uncertainties in climate impact

R&D Programs

Airport Cooperative Research – mandated by Congress in Vision 100-Century of Aviation Reauthorization Act to carry out applied research on problems that are shared by airport operating agencies (This program is beginning in 2006 and will include research on the environment.)

Atmospheric Hazards/Digital System Safety – develops and tests technologies to detect frozen contamination, predict anti-icing fluid failure, and ensure safe operations during and after flight in atmospheric icing conditions

2006: Complete report on new test procedures for Type II, III, IV, and non-glycol Type-I fluids for snow

2010: Complete report on equivalent pressure altitude testing, analysis, and scaling of hot-air ice protection systems

Center for Advanced Aviation System Development (CAASD) – develops and tests new technologies, systems, and operational concepts to produce a safer, more efficient air transportation system

2012: Complete development of the Aviation Environmental Portfolio Management Tool that provides the cost/benefit methodology needed to harmonize national aviation policy and environmental policy

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

Environment and Energy – develops computer models and impact criteria for use by civil aviation authorities to assess the impact of aircraft noise and emissions on the environment; provides a science-based understanding of the impact of aviation emissions on local air quality and climate change; develops standards for the certification of new and modified aircraft and engine designs to reduce aircraft noise and engine exhaust emissions as well as technical reports, handbooks, advisory circulars, training courses, and procedures for use by the aviation community and the public

Aircraft Noise

2007: Update and publish Advisory Circular 36-4 on Noise Standards: Aircraft Type and Airworthiness Certification (every 2 years)

2008: Release a new FAA noise standard for helicopters

2008: Create a metric that will assess supersonic aircraft impact

2009: Contribute to a new International Civil Aviation Organization (ICAO) noise standard for subsonic jets and large aircraft

2010: Deploy elements of an Internet-based capability to educate and inform the public about aircraft noise

Engine Emissions

2007: Release simplified engine exhaust emissions certification test procedures

2008: Update and publish Advisory Circular 34-1on Fuel Venting and Exhaust Emissions Requirements for Turbine Engine Powered Aircraft (every 2 years)

2010: Establish methodologies to quantify and assess the impact of particulate matter and hazardous air pollutants policy

2010: Release an assessment of the impacts of aviation on regional air quality, including the effects of climb-cruise oxides of nitrogen (NOx) emissions

2011: Release an assessment of the impact of aviation on climate change with special emphasis on the effects of contrails

2013: Collect direct measurements of hazardous air pollutants and particulate matter from engines to update factors used in modeling tools

Noise and Emissions Analysis

2007: Deploy the first generation of integrated noise and emission prediction and modeling tools

2008: Implement a new continuous-descent approach (CDA) noise and emissions abatement procedure for nighttime operations at selected airports

2010: Deploy an Aviation Environmental Design Tool that quantifies and assesses the inter-relationships among noise and emissions at the local and global levels

2010: Deploy the Aviation Environmental Portfolio Management Tool that will provide cost-effectiveness analyses[1] of noise, local air quality, and global emissions mitigation strategies

2010: Determine feasibility of CDA noise and emissions abatement procedures applicability to airports with greater traffic levels, general mixed fleet, and mixed operations

2011: Deploy noise and emissions exposure models for airspace management activities

2013: Deploy the Aviation Environmental Portfolio Management Tool to provide the cost/benefit methodology needed to harmonize national aviation policy and environmental policy

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system, which should provide a more efficient system to reduce noise, emissions and fuel consumption

NAS Requirements – develops policies, standards, and requirements at the National Airspace System (NAS) level to reduce accidents caused by weather and decrease avoidable weather delays

2007: Evaluate effectiveness of weather information in reducing weather delays which can impact local air quality

Propulsion and Fuel Systems – works with fuel, airframe, and engine manufacturers to test new unleaded fuels

2008: Evaluate ethanol-based piston fuels

2011: Characterize and test unleaded general aviation fuel

System Capacity Planning and Improvement – develops tools, procedures, and technology and collects data to measure and enhance NAS operational performance

Weather Program – develops forecast products for snow and ground icing events; maximizes safe and efficient ground operations by determining appropriate times to apply deicing fluids (thereby avoiding re-application) to aircraft and to determine proper runway clearing process to use and when (this minimizes the need to recapture deicing fluid)

2006: Complete 6-hour winter precipitation forecast product

2009: Complete 12-hour winter precipitation forecast product

[1] Cost-effective analysis determines the alternative with the lowest cost for achieving a given benefit.

clean & quiet
2005 R&D Highlights

Analytical Tools for Noise and Emissions (Environment and Energy)

Completed, with the FAA, National Aeronautical Space Administration (NASA), and Transport Canada-sponsored Partnership for Air Transportation Noise and Emissions Reduction, the initial version of the Environmental Design Space (EDS) tool that generates performance and cost data on source noise and exhaust emissions. EDS is one module of an integrated tool suite that will help government and industry undertake operations and projects that more effectively control aviation noise and emissions and will educate the public about how aviation noise and emissions, in combination, affect local, regional, and global communities.

Emission Modeling for Air Quality Standards (Environment and Energy)

Released a new version of the Emissions Dispersion Modeling System that improves the estimation of particulate matter mass emissions from aircraft engines. The modeling system can now be used to demonstrate compliance with national ambient air quality standards for airport emission sources.

Emissions Profiles (Environment and Energy)

Partnered with NASA and the aviation community to test commercial aircraft under field conditions and develop accurate emissions profiles for their engines. Measured engine emissions with the aircraft stationary on the ground and their engines operating at various power settings. Performed advected emissions measurements near the start of the runway, where aircraft generally begin take-off operations. Evaluated different types of measurement equipment to determine how well they measured various particulate matter characteristics. This could lead to a new standard particulate matter test protocol being developed by the Society of Automotive Engineers.

Low Frequency Noise (Environment and Energy)

Conducted a low frequency noise study at Washington Dulles International Airport with NASA and the Volpe National Transportation System Center to assess "start of take-off roll" source noise. Collected source noise recordings at the houses and runway locations using high-quality microphones, and then labeled acoustic signatures for each of the various types of participating aircraft. Created a database of noise signatures to be used in psychoacoustic testing with human subjects with specific emphasis on their perceptions of low frequency noise.

Particulate Roadmap (Environment and Energy)

Developed with NASA, the Department of Defense (DOD), the Environmental Protection Agency (EPA), engine and aircraft manufacturers, airports, airlines, and other stakeholders a unified R&D and regulatory "Particulate Roadmap" to collect accurate and reliable scientific data on the characteristics of aviation emissions. The roadmap will help researchers understand aircraft particulate matter emissions in relation to other sources and how they affect our health and environment. The resulting long-range action plan will guide aviation technology development.

Quiet Technology Demonstrator 2 (Environment and Energy)

Flight tested new noise reduction technologies developed jointly by the FAA, NASA, and aerospace industry partners using a Boeing 777 to validate their benefits. Tested two improved chevron designs on the engine nacelle and a cover that fits on the landing gear. Tests showed that an advanced chevron shape can reduce jet noise by as much as four decibels during take-off and when flying at cruise altitude. Tested a toboggan-like cover for the aircraft's main landing gear that could reduce landing noise by another three decibels. Results may lead to changes in aircraft configurations and future airplane engine and landing gear designs.

Sonic Boom (Environment and Energy)

Initiated, through the FAA/NASA/Transport Canada-sponsored Partnership for Air Transportation Noise and Emissions Reduction, a project to understand the impact of sonic boom phenomena, assess applicability of existing noise metrics to sonic boom, determine annoyance associated with supersonic jets, and provide guidance for designing supersonic jets that will minimize sonic boom incidents. Surveyed existing sonic boom simulators to compare their ability to duplicate sonic boom sounds and began to use them to assess human perceptions of the simulated sounds. This research will help manufacturers design aircraft that takes into account realistic sonic boom impact.

fast, flexible & efficient

A system that moves anyone and anything, anywhere, anytime[2] quickly on schedules that meet customer needs

2025 Benefit

This R&D goal will enable the air transportation system to move significantly more vehicles, people, and cargo quickly and efficiently from origin to destination on schedules that meet customer needs. The FAA will reduce transit time, improve predictability of on-time service, minimize the impact of weather and other system disruptions, and decrease the cost of flight operations. It will accomplish this without adversely impacting safety, security, and the environment.

R&D Milestones

2010: Measure gate-to-gate transit time

Identify ways for the air transportation system to minimize the impact of weather and other disruptions

2015: Demonstrate that gate-to-gate transit time can be reduced by thirty percent[3]

Demonstrate that the system can handle growth in demand up to three times current levels[4]

R&D Programs

Airspace Management Laboratory - develops data management and simulation tools for the evaluation of airspace design alternatives; develops and manages information management systems to improve the end-to-end integrity of National Airspace System support and post-operational data

Airspace Redesign - investigates and demonstrates new airspace concepts and procedures to increase national aviation system capacity; focuses on the Nation's major metropolitan areas to shorten flight distances, to provide more fuel-efficient routes, and to reduce arrival and departure delays

Airport Cooperative Research – mandated by Congress in Vision 100-Century of Aviation Reauthorization Act to carry out applied research on problems that are shared by airport operating agencies (This program is beginning in 2006.)

Airports Technology Research – Capacity – develops advisory circulars, standards, and guidance material for airport design

2006: Develop advanced design procedures for airport pavements to allow operations of Boeing 777 and Airbus 380 aircraft

2008: Develop design standards for general aviation airports

Air Traffic Control/Airway Facilities Human Factors – develops knowledge and requirements for the design and use of automation-based technologies, tools, and support systems to improve performance of air traffic controllers and airway facilities personnel

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[2] *Anyone, Anything, Anywhere, Anytime,* Final Report of the Commission on the Future of the United States Aerospace Industry, November 2002.

[3] Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan,* December 2004, www.jpdo.aero. Thirty percent is based on the JPDO objective for 2025 to "Reduce transit time and increase predictability (domestic curb-to-curb transit time by 30%)."

[4] Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan,* December 2004, www.jpdo.aero. Three times increase in demand is based on the JPDO objective for 2025 to "Satisfy future growth in demand (up to 3 times current levels) and operational diversity."

Center for Advanced Aviation System Development (CAASD) – develops and tests new technologies, systems, and operational concepts to produce a safer, more efficient air transportation system

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

2006: Analyze vehicle concepts in their operational environments to identify what the safe and most efficient separation standards should be in the air traffic management system

Flightdeck/Maintenance/System Integration Human Factors – develops knowledge, guidance, requirements, and standards for selecting and training pilots, maintenance personnel, and inspectors as well as assessing their performance in relation to the design of displays, controls, flight deck systems, tasks, and procedures

General Aviation and Vertical Flight Technology (GA & VF) – develops standards and procedures that enable simultaneous non-interfering operations between fixed-wing and vertical-flight aircraft

2008: Establish a test bed in the New York terminal area

2010: Demonstrate Wide-Area Augmentation System (WAAS)/Local-Area Augmentation System (LAAS) standards in the New York terminal area

2010: Develop recommendations for WAAS/LAAS national simultaneous non-interfering operations development

2011: Develop helicopter/tilt-rotor criteria for complex approaches

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

Operations Concept Validation – develops and validates new performance requirements and operational concepts for the next generation of decision-support systems for pilots and air traffic controllers to increase capacity, while simultaneously reducing safety risk

2009: Determine how to split en route operations between high and low airspace to increase efficiency and effectiveness

Safe Flight 21 – Alaska Capstone – tests and evaluates, develops procedures, and demonstrates operations with the capstone avionics equipment

2007: Expand use of arrival and departure procedures in Southeast Alaska

System Capacity Planning and Improvement – develops tools, procedures, and technology and collects data to measure and enhance NAS operational performance

2007: Install the Performance Data and Analysis Reporting System at twelve Operational Evolution Plan airports

2008: Model and simulate new large aircraft ground movement

Wake Turbulence – develops knowledge, guidance, standards, and operational procedures for wake avoidance under various weather conditions to increase airport arrival and departure rates

2007: Develop and validate weather dependent wake-avoidance concepts for less than visual flight operations conditions

2007: Develop national modification to the FAA Order 7110.65[5] as it affects closely-spaced parallel runways for less than visual flight conditions

Weather Program – develops new technologies to provide weather observations, warnings, and forecasts that are accurate, accessible, and efficient to minimize the impact of adverse weather events on national airspace operational capacity

2009: Complete development of 6-12 hour freezing precipitation forecasts

2009: Demonstrate winter ceiling and visibility products at New York airports

2010: Complete operational implementation of convectively-induced turbulence product

2010: Implement high-resolution, national convective weather forecast into operation

2015: Develop high-glance-value weather products with longer forecast lead times and increased accuracy and make available electronically to all aviation users

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5 FAA Order 7110.65, "Air Traffic Control," prescribes procedures and phraseology for use by personnel providing air traffic control services.

Automatic Dependent Surveillance –Broadcast (Safe Flight 21)

Completed a data collection effort to develop validation techniques for automatic dependent surveillance – broadcast (ADS-B). Tested a prototype ADS-B ground receiver. Evaluated the business case for ADS-B technology that will lead to a decision for a national ADS-B strategy. ADS-B is a two-way data link system that sends aircraft position, velocity, identification, and other information to equipped aircraft, air-traffic control systems, and airlines. The sharing of this type of situational awareness information among aircraft, air traffic control facilities, and airlines will reduce operation and maintenance costs, increase efficiency and capacity, and improve safety.

Convective Weather (Weather Program)

Demonstrated several new capabilities: a 0-2 hour Echo Tops Forecast product; extending the convective forecast out to 6 hours through the introduction of probabilistic forecasting; and techniques to forecast new growth of thunderstorms, which can greatly disrupt traffic flow and capacity. A demonstration in the Chicago area led to new findings in detecting the surface effects on convection and for the use of satellite data in predicting early storm growth. A second demonstration in the Dallas Fort Worth region tested the capability to have 1-hour automated forecast of storm initiation. These new forecasting capabilities will improve controller situational awareness of weather in terminal and en route airspace, enabling more effective traffic flow planning.

Weather Information on the Internet (Weather Program)

Enhanced, with the National Weather System, the Aviation Digital Data Service, which disseminates weather information to the public 24-hours a day on the Internet (http://adds.aviationweather.gov). The information gives pilots, airline dispatchers, and other users access to up-to-date weather data and products in user-friendly graphical and text formats. Added new functionality to the system's flight path tool, making it easier for users to plan routes to avoid dangerous weather. The service facilitates flight planning and minimizes the time required to change the route of flight when needed. The National Weather Service operates the service.


SARSYS
FRICTIONTESTER

high quality teams & in

Best qualified and trained workforce in the world

2025 Benefit

This R&D goal will enable us to maintain the best qualified and trained aviation workforce (e.g., pilots, aircrews, controllers, inspectors, maintenance personnel, FAA employees) in the world. This will enable our workforce to provide the safest and most efficient air transportation services anywhere. The FAA will select only the best and provide them with the training necessary to excel at their jobs both individually and in teams. It will ensure that they continue to meet the highest medical, technical, and operational requirements.

R&D Milestones

2010: Provide computer-based education and training to improve controller skills (e.g., visual, attention, memory)

Provide real-time, on-line selection, education, and training for all inspectors and maintenance personnel

2015: Demonstrate three times[6] improvement in air traffic controller efficiency (e.g., greater number of aircraft) and effectiveness (e.g., fewer operational errors) through automation and standardization of operations, procedures, and information

6 Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan,* December 2004, www.jpdo.aero. Three times increase in air traffic controller efficiency and effectiveness is based on the JPDO objective for 2025 to "Satisfy future growth in demand (up to 3 times current levels) and operational diversity." It assumes that there will be no increase in the number of controllers.

R&D Programs

Aeromedical Research – supports the FAA regulatory and medical certification processes for safety and health of all aerospace vehicle occupants

2007: Analyze accidents of sport category pilots relative to medical certification requirements

2007: Analyze bioaeronautical data supporting aeromedical certification to reduce in-flight sudden or subtle incapacitation

2007: Establish aircraft cabin and flight deck guidelines to ensure environmental quality in the event of intentional or unintentional introduction of contaminants

dividuals

Air Traffic Control/Airway Facilities Human Factors – develops knowledge, guidance, and standards to assess and improve the performance of controllers and maintainers of the air traffic system

2007: Develop guidance to improve the work flows and communications of the FAA technical operations personnel

2008: Implement on-line data warehouse for FAA Employee Attitude Survey 2008 results and Internet-based reporting capability.

2008: Develop improved methods to place candidates in the air traffic controller workforce by option (i.e., en route, terminal) and measure their performance during training

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

Flightdeck/Maintenance/System Integration Human Factors – develops knowledge, guidance, requirements, and standards for selecting and training pilots, maintenance personnel, and inspectors as well as assessing their performance in relation to the design of displays, controls, flight deck systems, tasks, and procedures

2007: Develop pilot proficiency recommendations for very light jets

2008: Develop training guidelines for flight -deck error management

Assess error patterns of pilots, maintenance personnel, and inspectors and identify precursors to those errors

2010: Complete guidance and educational tools for the general aviation FAA/Industry Training Standards program to integrate new technologies

General Aviation and Vertical Flight Technology (GA & VF) – develops design criteria, technical data, advisory circulars, and training documents related to technology integration in general aviation and vertical flight aircraft

2008: Develop pilot guidance for surveillance options for general aviation

2009: Develop pilot and inspector guidance for synthetic vision displays for general aviation

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

Safe Flight 21 – Alaska Capstone – develops training for pilots that use Capstone avionics equipment

high quality teams & individuals

2005 R&D Highlights

Gene Expression Changes in Response to Mild Alcohol Ingestion (Aeromedical Research)

Demonstrated the effectiveness of micro-array analysis for detecting mild (≤ 0.08 percent) alcohol consumption and identifying genes associated with alcohol consumption. Research will provide genetic knowledge to evaluate aviation accidents in terms of alcohol consumption and impairment.

Opiates in Postmortem Fluids and Tissues (Aeromedical Research)

Developed a simple method to determine the presence and qualities of as many as eight opiate compounds from a single sample. This allows toxicologists to easily and quickly differentiate between codeine use and poppy seed consumption in laboratory tests. Research will protect pilots from false accusation of drug use.

Scientific Information System for Research Studies (Aeromedical Research)

Completed the evaluation of atrial fibrillation (AFIB), a medical condition of importance to aeromedical examiners when evaluating aircrews. Found that the overall safety record of pilots with AFIB is no different than pilots in general. AFIB is the most common form of arrhythmia, a heart condition affecting more than two million people annually. Research will help to identify accident precursors, such as AFIB, thereby enabling more effective and timely introduction of countermeasures.

Advanced Technology for General Aviation Inspection Training (Human Factors)

Developed a prototype computer-based training tool for the general aviation Inspection Training System to improve visual detection of aircraft defects. The system allows for individualized training, as well as evaluation of a maintenance inspector's performance. The Design and Analysis module, for example, helps the instructor to customize the training program to suit individual training needs. If inspectors need help in locating corrosion defects, they can access information to different types, severity, and locations of corrosion. The simulator can be tailored to provide specific feedback to enhance the learning experience. This effort will reduce inspector errors in the general aviation maintenance environment.

Effects of Mixed Fleet Flying (Human Factors)

Identified the potential for human error if pilots trained in one aircraft and flew in another type of aircraft without training. Found one safety concern related to the design of the Takeoff/Go-Around switches. Showed that several procedural and training items must be addressed for pilots to fly successfully two types of airplanes. Determined that for most of the operations and maneuvers tested, a six-month currency cycle is acceptable. Research results will help the FAA and the airlines identify constraints and establish requirements for air carriers that have pilots who fly two different types of aircraft.

Electronic Flight Bags (Human Factors)

Refined the Electronic Flight Bag Usability Assessment tools for the FAA Aircraft Certification and Flight Standards specialists. An electronic flight bag is an electronic information management device used by crew members to obtain information currently provided in paper form. Developed an initial usability assessment checklist for inspectors using products previously developed for aircraft certification. Research will lead to better inspection of electronic flight bags by inspectors.

Human Factors in Aviation Maintenance (Human Factors)

Released "The Operator's Manual for Human Factors in Aviation Maintenance" to respond to industry requests for simplified instructions. The manual provides a short and concise listing of six key factors that will help ensure appropriate human factors input into any maintenance organization, including information on event investigation, documentation, training, shift turnover, and fatigue/alertness. Users of the manual include aviation maintenance managers, quality managers, and training personnel. It also provides supplemental information for the FAA aviation safety inspectors and personnel overseeing airline maintenance, repair, and overhaul.

Human Factors Knowledge (Human Factors)

Provided on-line access to the Human Factors Workbench tool to provide the FAA employees, system developers, and researchers easy access to human factors information. Added new reports, enhanced the search capability, and finalized the evaluation components of an on-line human factors training course. Users can print a course completion certificate on line. Research will enhance the development of human-centered aviation systems.

Proficiency Standards for Advanced Aircraft (Human Factors)

Produced with NASA and the aviation community a comprehensive list of knowledge and skills that are important for pilots, instructors, and evaluators who operate, teach, and test in technically advanced aircraft, such as the Eclipse 500. The results will be used to develop a new technical publication to serve as an official information source for these new areas of proficiency, similar to the *Airplane Flying Handbook* (FAA-H-8083-3), *Instrument Flying Handbook* (FAA-H-8083-15), and the P*ilot's Handbook of Aeronautical Knowledge* (FAA-H-8083-25).

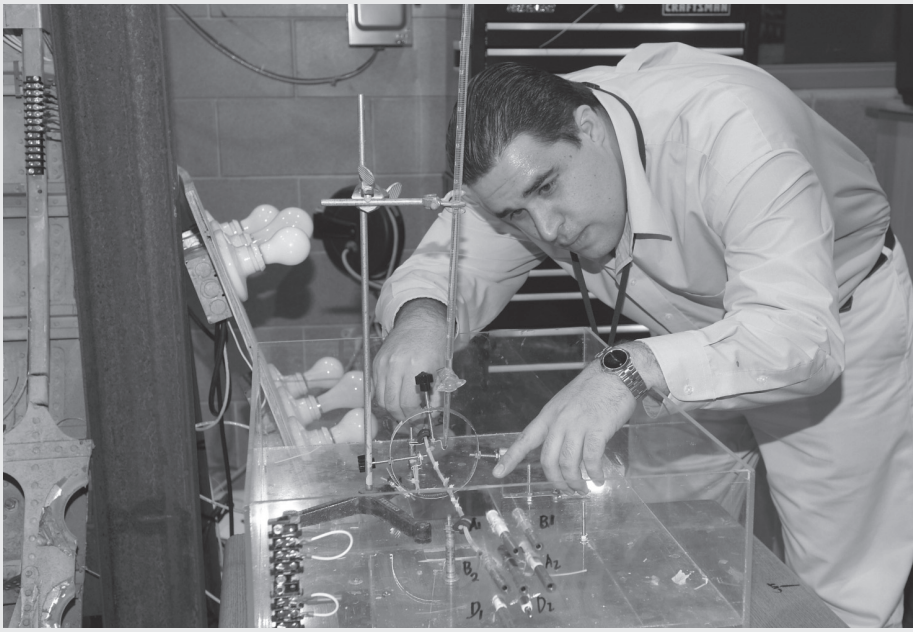
Safety Culture (Human Factors)

Conducted a series of focus-group sessions at the Seattle, St. Louis, and Potomac Terminal Radar Approach Control facilities to understand and improve the safety cultures at the FAA Technical Operations facilities.

These facilities provide a realistic sampling of work environments and job types without having to conduct a large-scale, nation-wide study. Developed a safety culture survey to determine overall trends in the safety culture and the effectiveness of various actions to change the culture.

Training Pilots for Unexpected Events (Human Factors)

Completed a field study investigating factors underlying a pilot's ability to recognize and react to various flight abnormalities, including upset recovery. Analyzed the field data and issued a final report outlining preliminary suggestions for training development and recommendations for further research. Suggested actions include development of training interventions to manage unexpected events. These interventions will be prototyped and tested in upcoming years.



human-centered desi

Aerospace systems adapt to, compensate for, and augment the performance of the human

2025 Benefit

This R&D goal will result in aerospace systems that adapt to, compensate for, and augment the performance of the human. This will result in improved operator (e.g., pilots, aircrews, controllers, inspectors, maintenance personnel) and system performance to achieve dramatic increases in safety and greater capacity. All operations, procedures, and information will be standard and predictable for users of the aviation system.

R&D Milestones

2010: Complete human factors design and certification information for flight-deck systems

2015: Demonstrate that operations (e.g., day and night, all weather), procedures, and information can be standard and predictable for users (e.g., pilots, controllers, airlines, passengers) at all types of airports and aircraft

R&D Programs

Aeromedical Research – develops knowledge, guidance, and standards to reduce accidents associated with the performance of pilots and aircrews, maintainers, inspectors, and others who fill important roles in the safety of the national airspace system

2008: Assess aircraft seat certification criteria and performance for impact protection

2008: Establish an accident medical database

2008: Develop advanced mathematical dynamic modeling and computer simulation to provide enhanced analysis of occupant injury and aircraft design features

2008: Develop performance-based narrow and wide-bodied aircraft cabin evacuation approval guidelines

Airport Cooperative Research – mandated by Congress in Vision 100-Century of Aviation Reauthorization Act to carry out applied research on problems that are shared by airport operating agencies (This program is beginning in 2006.)

Airports Technology Research – Safety – develops standards and guidance material for airport design

2006: Complete design for end around taxiway barriers

2006: Complete evaluation of radar to detect foreign object debris under various weather conditions

Air Traffic Control/Airway Facilities Human Factors – develops knowledge, guidance, and standards to assess and improve the performance of controllers and maintainers of the air traffic system

2007: Complete Air Traffic Organization Technical Operations human factor design specifications

2008: Complete guidelines and human factors standards for integrating advanced technologies into the Air Traffic Control and Technical Operations environments

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Center for Advanced Aviation System Development (CAASD) – develops and tests new technologies, systems, and operational concepts to produce a safer, more efficient air transportation system

2008: Conduct evaluation of airspace redesign enhancements in all operational domains to improve system performance and use of resources

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

Flightdeck/Maintenance/System Integration Human Factors – develops knowledge, guidance, requirements, and standards for assessing and improving the performance of pilots and maintenance personnel

2007: Complete implementation of Aircraft Certification Job Aid (version 8)[7] for Federal Aviation Regulations Part 23 (Commuter Category Airplanes) and Part 25 (Transport Category Airplanes)

2007: Develop human factors guidelines for instrument procedure design

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

NAS Requirements – develops policies, standards, and requirements at the national airspace system level to reduce accidents caused by weather and decrease avoidable weather delays

2007: Evaluate effectiveness of weather information in reducing weather delays

[7] Computer-based, decision support tool that integrates safety and capacity considerations for aircraft design and certification

Operations Concept Validation – develops and validates new performance requirements and operational concepts for the next generation of decision-support systems for pilots and air traffic controllers to increase capacity while simultaneously reducing safety risk

2009: Determine how to split en route operations between high and low airspace to increase efficiency and effectiveness

Runway Incursion – selects and evaluates runway incursion technologies to validate their performance and operational suitability and identifies non-technology solutions, such as marking and signage, education, training, and advisory circulars

2008: Perform operational evaluation of runway status lights

System Capacity Planning and Improvement – develops tools, procedures, and technology and collects data to measure and enhance NAS operational performance

2007: Install the Performance Data and Analysis Reporting System at twelve Operational Evolution Plan airports

2008: Model and simulate new large aircraft ground movement

Weather Program – integrates weather information into user-friendly presentations for pilots and controllers so that they can make better decisions

Convective Weather Product Display

2006: Add terminal forecast on Integrated Terminal Weather System
2007: Add national 2-hour probability forecast
2010: Add national high resolution forecast
2011: Add national 6-hour probability forecast

Turbulence Product Display

2006: Add forecast product for 10,000 feet and above
2009: Add probability forecast
2009: Add mountain-wave turbulence forecast product
2010: Add convectively-induced turbulence forecast product
2011: Add forecast product for all altitudes
2012: Add Alaskan turbulence forecast product

In-Flight Icing Product Display

2007: Add forecast product including super-cooled large drops
2007: Add diagnosis product with severity
2008: Add forecast product with severity
2008: Add Alaskan forecast product
2009: Add Alaskan diagnosis product
2010: Add terminal diagnosis product

National Ceiling & Visibility Product Display

2008: Add Continental United States (CONUS) analysis product
2009: Add CONUS forecast product
2009: Add Alaskan analysis product
2010: Add Alaskan forecast product

Oceanic Product Display

2008: Add cloud-top height product
2009: Add convective diagnosis product
2009: Add turbulence forecast product
2010: Add volcanic ash product
2011: Add convectively-induced turbulence forecast product
2012: Add in-flight icing diagnosis product
2012: Add convective nowcast product
2013: Add in-flight icing forecast product
2013: Add convective 2-15 hour forecast product

human-centered design

2005 R&D Highlights

Benefits of the En Route Information Display System (Human Factors)

Assessed a prototype display system at the Boston, Jacksonville, and Salt Lake City Air Route Traffic Control Centers to identify controller information needs and ways in which to reduce workload. The system will provide controllers real-time electronic access to weather data, aeronautical data, air traffic control procedures documents, Notices to Airmen, pilot reports, and other information. Research will help the FAA determine the human performance benefits of the new system and perform a cost-benefit analysis prior to making a final decision on system acquisition and national deployment.

Effective Flight Symbology (Human Factors)

Continued research to determine what aeronautical chart symbology (e.g., airports, roads, railroads, terrain features, obstructions) is most effective on moving maps and electronic chart displays. Identified features of navigation symbology that are problematic when presented on electronic displays. Developed a method to design and evaluate symbology that takes into account different media (e.g., paper vs. electronic) and displays. Research will help the FAA and industry establish standards for symbols.

Future En Route Workstation (Human Factors)

Conducted complex person-in-the-loop simulation studies at the FAA's William J. Hughes Technical Center to identify future en route workstation requirements. Examined ways to present and integrate information, measure controller operations, and address human factors considerations. Exposed controllers to various workstation concepts, traffic levels, and scenarios. Research will help increase controller productivity and enable the air traffic system to increase capacity through user-centered automation.

Modular Display Concept for Air Traffic Control Towers (Human Factors)

Developed a modular concept for an air traffic control tower design. Collected data that will help understand controller work patterns and the information required to perform controller tasks. Identified controller tasks, communications and coordination activities, and the information required to support tasks for each position in the tower. Research will provide the FAA a master concept for tower design that uses a modular approach to meet the tailored display needs for each tower.

Tower Siting and Visibility (Human Factors)

Developed, tested, and validated a set of human performance metrics that can be used to assess the impact of tower height and location on air traffic control tower specialist's performance. Developed a web-based airport traffic control tower tool that allows planners and engineers to determine the best height and location for towers to ensure air traffic controllers can see objects and maintain separation. Research will reduce the cost of tower construction as well as improve safety.


3
LAB SAFETY

human protection

No fatalities, injuries, and adverse health impacts on the human due to aerospace operations

2025 Benefit

This R&D goal will significantly reduce fatalities and injuries and adverse health impacts on the human due to aerospace operations. The FAA will enhance crashworthiness, improve fire prevention and evacuation procedures, provide better occupant restraint and aircraft arresting systems, and protect against airborne threats, such as chemical and biological agents.

R&D Milestones

2010: Develop initial standards for fireproof cabin

Identify cabin environmental threats (clean air, emergency treatment, life support, chemical/biological hazards) and demonstrate mitigation strategies

2015: Demonstrate a two-thirds reduction in the rate of aerospace-related fatalities and significant injuries[8]

[8] Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan,* December 2004, www.jpdo.aero. The two thirds reduction in aviation fatalities and injuries is based on the JPDO objective for 2025 to, "Satisfy future growth in demand (up to 3 times current levels) and operational diversity." Two thirds assumes that the number of fatalities or injuries will be the same as today's.

R&D Programs

Advanced Materials/Structural Safety – develops knowledge, rules, and tools to support both the development of regulations and standards and the certification of materials that will result in the safe use of advanced materials in aircraft and improved crash characteristics of aircraft structures and systems

2007: Develop neck injury criteria for side-facing seats

2008: Develop neck injury certification criteria for side-facing seats

2010: Develop enhanced means of occupant impact protection that can form the basis for improved certification guidelines and standards

2011: Develop analytical methodology for modeling crash testing

Aeromedical Research – develops knowledge, recommendations, and guidelines to support regulations and certification that will reduce health risks to aircraft crews and passengers from hazards, including poor air quality, cosmic and other radiation, and sudden decompression; develops knowledge and design and procedural guidelines to enhance the effectiveness, speed, and safety of aircraft evacuation

2007: Model air flow and disease/chemical biological agent transmission/dissemination in aircraft cabins

2008: Develop instructional materials on the radiation (cosmic and visual) environment during air travel

2008: Update aircraft-specific cabin evacuation guidelines

2009: Establish an aircraft accident medical database

2010: Develop protective equipment fit, comfort, and performance standards

Airport Cooperative Research – mandated by Congress in Vision 100-Century of Aviation Reauthorization Act to carry out applied research on problems that are shared by airport operating agencies (This program is beginning in 2006.)

Airports Technology Research – Safety – provides technical information to support and update advisory circulars, standards, and guidance material to cover the design of airport safety areas, visual aids, rescue and firefighting, ice and snow control, and wildlife control

2008: Complete design and construction of prototype next generation elevated waterway with aircraft skin penetrating device

2010: Develop aircraft rescue and firefighting procedures and equipment standards to address double-decked large aircraft

2011: Evaluate new formulations for soft ground arrestor systems

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

2006: Identify requirements to monitor, measure, and record the medical and biological effects experienced by the human body during sub-orbital and orbital flights

2006: Create biomedical database and analysis plan for data generated from commercial space transportation activities

Fire Research and Safety – develops information to support regulations, advisory circulars, standards, certification, and operational procedures that will: prevent ignition and flame propagation of cabin materials; detect in flight fires; suppress fires; protect against aircraft fuel tank explosions; and improve post crash fire survivability

2007: Develop improved fire test standards for electrical wiring and air conditioning ducting as part of hidden area material flammability improvement

2008: Develop criteria for effective use of hand-held or fixed extinguishing systems against hidden fires

2008: Complete tests of ultra-fire-resistant materials

2008: Develop fire test methods for composite fuselage

2009: Improve oxygen system design guidelines and requirements

2009: Characterize cabin fires in very large aircraft

2010: Evaluate improvements in post-crash fire survivability from ultra-fire-resistant materials

2011: Develop very large aircraft fire protection methodologies

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

Weather Program – develops weather products that support revisions to regulations and certification that will lessen accidents due to hazardous weather conditions

2010: Add volcanic ash product

2010: Add national convective weather high resolution forecast

National Ceiling & Visibility Product Display

2008: Add CONUS analysis product
2009: Add CONUS forecast product
2009: Add Alaskan analysis product
2010: Add Alaskan forecast product

In-Flight Icing Product Display

2007: Add forecast product including super-cooled large drops
2007: Add diagnosis product with severity
2008: Add forecast product with severity
2008: Add Alaskan forecast product
2009: Add Alaskan diagnosis product
2010: Add terminal diagnosis product

Turbulence Product Display

2006: Add forecast product for 10,000 feet and above
2009: Add probability forecast
2009: Add mountain-wave turbulence forecast product
2010: Add convectively-induced turbulence forecast product
2011: Add forecast product for all altitudes

human protection

2005 R&D Highlights

Aircraft Cabin Evacuation (Aeromedical Research)

Collaborated with Rutgers University to develop a computational aircraft evacuation model that uses features, such as the shortest distance to exits, speed of an evacuation, and flow rate at exits. The model will provide information on aircraft designs and potentially supplement certification procedures.

Laser Transmissivity of Aircraft Windows (Aeromedical Research)

Collaborated with the U.S. Army in laser testing of aircraft window transmissivity to address safety concerns of both the Department of Homeland Security and the FAA. Partial analysis indicated that lasers in the visible light spectrum easily transmit through cockpit glass. Brief exposure to a laser beam can cause discomfort and temporary visual impairment, such as glare, flash-blinding, and afterimages. To a pilot, these visual distractions can produce spatial disorientation and/or loss of situational awareness.

Aircraft Rescue and Fire Fighting (Airport Research)

Acquired a new state-of-the-art research vehicle that will enable the FAA to conduct live tests and develop standards for fire protection in new large aircraft, such as the Airbus 380. Completed pre-delivery testing and inspection of the research vehicle at the Oshkosh Truck Corporation's Test and Development Laboratory to ensure that it complied with all of the testing procedures specified for prototype vehicle designs in the FAA Advisory Circular 150/5220-10C, "Guide Specification for Water/Foam Aircraft rescue and Fire Fighting Vehicles." The new vehicles met all criteria, and the FAA accepted it for delivery.

Debris Risk (Commercial Space)

Tested a computer model, which is used to develop public casualty expectations associated with space launch accidents and to help establish insurance requirements and liability limits, to see if it could calculate the hazards to victims inside of buildings struck by falling debris. Using historical data from the Khobar Towers bombing, completed a comparison of the results from the model with actual damage data from the explosion. Data suggest that the model is not as conservative as some had suspected. When completed, the project should provide a better basis for predicting potential debris-related casualties resulting from launch accidents.

Forecasting Turbulence (Weather Program)

Conducted a regional demonstration that used information from the Next Generation Weather Radars (NEXRAD) located in the upper Midwest region to create a 3-dimensional image (mosaic) of detected turbulent conditions. From this data, identified eddy dissipation rate as a key measure of the actual atmospheric conditions. Combined with the radar information, the data provides a 15-minute look ahead of in-cloud aviation hazards, emphasizing convectively-induced turbulence. The FAA plans to install this capability, when approved for operational use, on all operational NEXRAD radars.

Forecasting Turbulence (Weather Program)

Entered the final phase of research needed to advance the Graphical Turbulence Guidance tool to operational status. The tool refines turbulence assessments by comparing information from several weather prediction models with current pilot reports of turbulence. It produces various forecasts on turbulence. In the future, the tool will provide turbulence forecasts for all altitudes and have the capability to forecast mountain-wave and convectively-induced (regions involving thunderstorm activity) turbulence. This will give pilots sufficient warning of turbulence ahead of the aircraft to alert passengers and crew or to take evasive action.


5
FAA
AIRCRAFT RESCUE & FIRE FIGHTING
RESEARCH PROGRAM
35011

safe aerospace vehicl

No accidents and incidents due to aerospace vehicle design, structure, and subsystems

2025 Benefit

This R&D goal will significantly reduce aviation accidents and incidents due to aerospace vehicle design, structure, and subsystems. This goal will result in no accidents or incidents due to failures of the aircraft or its systems, degradation due to aging, cracking that is not detected and repaired, electrical faults, failures in software-based digital flight controls or avionics systems, and structural failures.

R&D Milestones

2010: Develop initial standards for unmanned aircraft systems to operate in commercial airspace

Develop initial standards for systems and materials that can monitor, identify, and compensate for faults and failures

2015: Demonstrate damage and fault tolerant vehicles and systems

R&D Programs

Advanced Materials/Structural Safety – develops knowledge, rules, and tools to support both the development of regulations and standards and the certification of materials that will result in the safe use of advanced materials in aircraft and improved crash characteristics of aircraft structures and systems

2007: Establish feasibility of imbedded sensors to track damage

2007: Identify methods to improve crash worthiness of fuel tanks

2009: Identify data for certification of materials at elevated temperatures

2009: Develop certification methodology for high-cycle fatigue of composite structures

2010: Develop data for certification of composite materials at elevated temperatures

2012: Identify data for certification of ceramic composites

Aeromedical Research – develops knowledge, recommendations, and guidelines to support regulations and certification that will reduce health risks to aircraft crews and passengers from hazards, including poor air quality, cosmic and other radiation, and sudden decompression; develops knowledge and design and procedural guidelines to enhance the effectiveness, speed and safety of aircraft evacuation

2008: Establish a model to evaluate aircraft design relative to evacuation conditions, passenger behavior, and emergency response capability

2010: Develop design and performance criteria of transport aircraft emergency communications systems between flight attendants and passengers

2011: Evaluate and develop oxygen system guidelines for high altitude capable experimental and certified aircraft, including systems for use in the sub-orbital environment

Aging Aircraft – develops technologies and technical information to support the development of regulations, standards, and procedures to ensure continued airworthiness of current aircraft structures, engine components, and mechanical and electrical systems

2008: Develop enhanced repair techniques for bonded repairs

2009: Develop advanced circuit protection devices including second generation arc-fault circuit breakers

2009: Develop rotorcraft damage tolerance methodologies

2010: Validate advanced inspection techniques

2010: Develop technical data for policy guidance on aging transport aircraft structural integrity

2010: Provide technical data for use in policy guidance on continued airworthiness of commuter aircraft

2011: Develop technical data for use in guidance material for installation and credit usage of rotorcraft health monitoring systems

Aircraft Catastrophic Failure Prevention Research – develops technologies and methods to support regulations and advisory circulars to assess risk and prevent occurrence of potentially catastrophic defects, failures and malfunctions in aircraft, components and systems

2009: Develop prototype engine crack detection system

2009: Develop recommendations for propulsion monitoring system

2011: Conduct propulsion monitoring flight test

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Atmospheric Hazards/Digital System Safety – develops technologies and advisory and guidance materials to ensure safe operation in electromagnetic hazards resulting from electromagnetic interference, cosmic radiation, high intensity radiated fields, and lightning, and ensures the safe operation of emerging, highly-complex, software-based, digital flight controls and avionics systems

2006: Complete a handbook and guidelines for avionics semiconductors

2007: Develop reference materials for updating certification regulations in flight critical design assurance

2008: Identify criteria for burn-in testing

2008: Evaluate safety engineering in software

2008: Develop data to update regulations for flight critical systems design assurance

2009: Evaluate integrated flight guidance and control systems

2009: Complete characterization of aircraft lightning

2011: Develop model techniques and facility for testing the effect of high ice water content on engines

2011: Report on software service history in reliability models

Aviation Safety Risk Analysis – monitors and analyzes aviation system operations and safety risks and develops risk management methodologies, prototype tools, technical information, procedures, and practices to improve aviation safety

2008: Develop standards for carbon monoxide detection devices, including the development of inspection methods to determine the integrity of exhaust systems

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

Fire Research and Safety – develops information to support regulations, advisory circulars, standards, certification, and operational procedures that will prevent ignition and flame propagation of cabin materials; detect in flight fires; suppress fires; protect against aircraft fuel tank explosions; and improve post crash fire survivability

2007: Develop improved fire test standards for electrical wiring and air conditioning ducting as part of hidden area material flammability improvement

2008: Develop criteria for effective use of hand-held or fixed extinguishing systems against hidden fires

2008: Complete tests of ultra-fire resistant materials

2008: Develop fire test methods for composite fuselage

2009: Improve oxygen system design guidelines and requirements

2009: Characterize cabin fires in very large aircraft

2010: Evaluate improvements in post-crash fire survivability from ultra-fire resistant materials

2011: Develop very large aircraft fire protection methodologies

Flightdeck/Maintenace/System Integration Human Factors – develops educational materials for unmanned aircraft system (UAS) operator training and guidance for UAS optical systems

2008: Develop guidance for minimum UAS see-and-avoid optical system capabilities to detect an approaching airborne object

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

Propulsion and Fuel Systems – develops and validates improved processing and manufacturing techniques to support the development of regulations, advisory circulars, standards, and procedures for critical engine components to eliminate engine failures and enhance the airworthiness, reliability, and performance of civil turbine and piston engines, propellers, fuels, and fuel management systems

2007: Develop design methodology to prevent cold dwell fatigue in turbine engines

2010: Complete enhancements to probabilistic design and life management methodology for engine rotors

Safer Skies – develops regulations, advisory circulars, standards, and procedures to reduce commercial aviation accidents attributed to controlled flight into terrain, approach and landing, loss of control, runway incursions, and weather

Unmanned Aircraft Systems Research – ensures the safety of civil UAS operations and provides the FAA with the necessary knowledge, tools, and supporting data to take regulatory actions and provide guidance materials for the FAA and industry

2008: Determine detect, sense, and avoid characteristics and operational requirements

2009: Define airworthiness assurance requirements for design and performance characteristics

2009: Determine command, control, and communication performance requirements and conduct field tests of prototype technology

2011: Conduct detect, sense, and avoid technology field evaluation

Weather Program – provides information for advisories to help aircraft avoid severe weather encounters that may cause them to be removed from service for inspection; supports the use of weather information in the design, regulation, and certification of unmanned aircraft systems

safe aerospace vehicles

2005 R&D Highlights

Commercial Aircraft Lap Joint Damage (Aging Aircraft)

Disassembled the fuselage of a retired Boeing 727 aircraft to collect data on an aircraft near the end of its design service goal of 60,000 flights. Focused on the fuselage crown lap joint, which has a known history of multiple-site damage cracking. The FAA will use the data to: characterize crack initiation, crack linkup, and residual strength; assess the inspection capability of nondestructive inspection techniques to detect cracks; and determine widespread fatigue damage average behavior in the structures removed and examined.

Metallic Materials Properties Development and Standardization Handbook (Aging Aircraft)

Issued the first commercial version of the *Metallic Materials Properties Development and Standardization Handbook* that provides standardized information on aircraft and aerospace material and fastener properties that comply with the FAA regulations. Granted Battelle Memorial Institute, a not-for-profit organization, an exclusive license to reproduce and distribute the handbook and related products. Published *Metallic Materials and Elements for Aerospace Vehicle Structures,* formerly known as *Military Handbook-5* (MIL-HDBK-5) that is recognized worldwide as the most reliable source of information for metallic materials, fasteners, and joints used in the design and maintenance of aircraft, missiles, and space vehicles.

Multiple-Site Damage in Fuselage Structure (Aging Aircraft)

Developed numerical methods and engineering approaches to predict crack initiation, growth, linkup, and residual strength in aircraft fuselages. Used the FAA Full-Scale Aircraft Structural Test Evaluation and Research facility to investigate multiple-site damage initiation and growth in a pristine fuselage lap joint panel. This study provides key data to verify and validate fatigue damage assessments approaches.

Nondestructive Inspection Methods for Composite Aircraft Structures (Aging Aircraft)

Developed a prototype, air-coupled, ultrasonic system that works on composite structures, since current ultrasonic inspection techniques for metal fuselages are not effective on composites. Successfully demonstrated the first-of-a-kind non-contacting, non-contaminating, air-coupled, ultrasonic inspection tool in the field. This will enable quick assessment of composite damage and structural soundness after repair. Initiated efforts to license the technology and transfer it to the commercial sector.

Side Load Factors during Aircraft Ground Operations (Aging Aircraft)

Used information from digital flight data recorders to assess the 0.5G limit lateral load criteria for wide-body aircraft, specifically the Airbus 380 airplane. Data showed that the size and weight of the aircraft significantly affects the magnitude of touchdown lateral acceleration. Smaller airplane models, such as the Boeing 737, incur higher lateral acceleration values while turning. Heavier airplanes encounter lower values of lateral acceleration while taxiing and have their highest lateral accelerations during the touchdown event and subsequent rollout. As a result, the FAA Aviation Rulemaking Advisory Committee recommended a special condition to 14 CFR 25.495 to reduce the ground turning requirement from 0.5G to 0.42G for the Airbus A-380.

Structural Cracks in Helicopters (Aging Aircraft)

The FAA Airworthiness Assurance Nondestructive Inspection Validation Center at Sandia National Laboratories collaborated with the rotorcraft industry to evaluate nondestructive inspection techniques to detect small cracks in rotorcraft structures, especially in high cycle fatigue joints. Designed a series of tests to isolate and study the effects of different rivet scenarios. Demonstrated two promising techniques to detect small cracks under the rivet heads.

Reconfigurable Control Allocations for Reusable Launch Vehicles (Commercial Space)

Initiated a study to evaluate advanced guidance and control methods to compensate for control surface damage or failure in reusable launch vehicles. Found that the most desirable solution would be for the control algorithms to adapt to changing conditions using available control surfaces and other actuators. Developed an executive reconfiguration control scheme that is independent of the physical hardware. Such a hierarchical scheme has the advantage of being design and device independent and, therefore, applicable to all generic reusable launch vehicle physical equipment types.

Fire Safety of Insulation Material (Fire Research and Safety)

Demonstrated that the thermal acoustic insulation blankets made of a Mylar® film could be ignited by electrical arcing and sparks, resulting in a fire aboard an aircraft. Aircraft insulation blankets protect passengers and crew from engine noise and, at high altitudes, from frigid temperatures. Proposed an airworthiness directive that requires certain Boeing transport category airplanes to replace the Mylar® film with a new insulation blanket. Due to the large cost to remove the insulation, evaluated alternate means of compliance with the directive.

Flame Retardant Composites (Fire Research and Safety)

Developed with NASA new aerospace epoxy resins and curing agents containing phosphorus to provide environmentally-acceptable, low flammability structural composites with little or no compromise in processing, handling, and mechanical properties. Showed that the fracture toughness and compressive strength of these formulations had no detrimental effect due to the phosphorus content. Observed a three-fold reduction in flammability. This will enable aircraft manufacturers to improve the flammability of composites used in airplanes while phasing out the use of halogen flame retardants, which are being phased out world-wide because of environmental concerns.

Flammability of Aircraft Electrical Wiring (Fire Research and Safety)

Subjected samples of electrical wiring and insulation to the standard 60-degree single wire Bunsen burner flammability test and a secondary type of test to determine the adequacy of current flammability requirements for new wiring and insulation materials and manufacturing processes. Found that the standard test might not be adequate to qualify wire when bundled and subjected to a severe ignition source. As a result, research is being expanded to upgrade the fire test criteria for electrical wiring and materials in other hidden areas, such as the attic above the cabin ceiling, areas beneath the floor, and in or around the lavatories.

In-Flight Flammability and Fuel Tank Inerting (Fire Research and Safety)

Demonstrate the use of air separation modules in an inert gas generation system to reduce the risk of fuel tank explosions in the center and inboard wing fuel tanks of commercial transport airplane. Developed models and experimental methods to predict the progression of flammability in an aircraft fuel tank throughout a typical flight cycle. Conducted a series of ground and flight tests with NASA to evaluate the inert gas generation system. Proved the viability of the system. Results will contribute to the development of improved flammability models.

Micro-scale Combustion Calorimeter (Fire Research and Safety)

Patented flammability tester that determines the fire resistance of a material using small samples. Licensed two companies to manufacture and sell them. The FAA is already receiving royalties. Provides a quick and less expensive way to test new materials that will enable us to develop a fireproof cabin.

New Fire Test Methods (Fire Research and Safety)

Developed two new tests that are used to implement a rule pertaining to the flammability of thermal acoustic insulation in transport category aircraft and the installation of insulation in aircraft. The first test measures a material's capability to resist flame spread from a small ignition source. The second determines the ability of a material to resist penetration or burn through from an external fuel fire. Both tests are much better than the previous test method used to qualify insulation materials. Developed advisory circulars for both new test methods.

Winter Weather (Weather Program)

Added a new freezing drizzle detection product to the Weather Support to Decision-Making system. The system uses information from multiple sources, such as Doppler radar, to produce real-time, short-term forecasts in the terminal area to support ground deicing and terminal management of runways during winter storms. At Denver International Airport, the system correctly diagnosed a freezing drizzle event. Since implementation, airlines have reported no further engine damage due to freezing drizzle.

separation assurance

No accidents and incidents due to aerospace vehicle operations in the air and on the ground

2025 Benefit

This R&D goal will enable safe operations and greater freedom of movement in all conditions (e.g., high density, severe weather) in the air and on the ground. It will result in no accidents or incidents due to aerospace operations. The FAA will have systems and procedures that will enable aerospace vehicles to maintain self separation from each other and from other obstacles in the air and on the ground.

R&D Milestones

2010: Develop initial standards and procedures for pair-wise self separation in the air and on the ground, such as to prevent runway incursion

Develop initial standards for handling new large aircraft and unmanned aircraft systems

2015: Develop initial standards and procedures for self separation

R&D Programs

Airport Cooperative Research – mandated by Congress in Vision 100-Century of Aviation Reauthorization Act to carry out applied research on problems that are shared by airport operating agencies (This program is beginning in 2006.)

Airports Technology Research – Capacity – develops advisory circulars, standards and guidance material for airport design

2008: Develop design standards for general aviation airports

Airports Technology Research – Safety – develops standards and guidance material for airport design

2008: Complete testing of proposed heliport/vertiport lighting standards

2010: Improve standards for airport planning

2010: Improve methods for handling new large aircraft

Air Traffic Control/Airway Facilities Human Factors – develops requirements, knowledge, guidance, and standards for design and use of automation-based technologies, tools and support systems to improve performance of air traffic controllers and airway facilities personnel (e.g., reduce human error)

Center for Advanced Aviation System Development (CAASD) – develops and tests new technologies, systems, and operational concepts to produce a safer, more efficient air transportation system

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

2006: Analyze vehicle concepts in their respective operational environments to identify what the safe and most efficient separation standards would be in the air traffic environment

Flightdeck/Maintenance/System Integration Human Factors – develops knowledge, guidance, requirements, and standards for selecting and training pilots, maintenance personnel and inspectors as well as assessing their performance in relation to the design of displays, controls, flight deck systems, tasks, and procedures

2008: Develop training guidelines for flight deck error management

General Aviation and Vertical Flight Technology (GA & VF) – develops standards and procedures that enable simultaneous non-interfering operations between fixed-wing and vertical-flight aircraft

2008: Establish a test bed in the New York terminal area

2010: Demonstrate WAAS/LAAS standards in the New York terminal area

2010: Develop recommendations for WAAS/LAAS national simultaneous non-interfering operations development

2011: Develop helicopter/tilt-rotor criteria for complex approaches

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

Runway Incursion – selects and evaluates runway incursion technologies to validate their performance and operational suitability, and identifies non-technology solutions, such as marking and signage, education, training and advisory circulars

2008: Perform operational evaluation of runway status lights

2008: Install and evaluate low-cost surface surveillance system

Safe Flight 21 – Alaska Capstone – tests and evaluates, develops procedures, and demonstrates operations with the capstone avionics equipment

2007: Expand use of arrival/departure procedures in Southeast Alaska

Safer Skies – develops regulations, advisory circulars, standards, and procedures to reduce commercial aviation accidents attributed to controlled flight into terrain, approach and landing, loss of control, runway incursions, and weather

System Capacity Planning and Improvement – develops tools, procedures, and technology and collects data to measure and enhance NAS operational performance

2007: Install the Performance Data and Analysis Reporting System at twelve Operational Evolution Plan airports

2008: Model and simulate new large aircraft ground movement

Wake Turbulence – develops knowledge, guidance, standards, and operational procedures for wake avoidance under various weather conditions to increase airport arrival and departure rates

2007: Upgrade statistical models to evaluate the constraints on aircraft separation due to wake turbulence

2007: Develop and validate weather dependent wake-avoidance concepts for less than visual flight operations conditions

2007: Develop national modification to Air Traffic Control Order 7110.65[9] as it affects closely-spaced parallel runways for less than visual flight conditions

Weather Program – develops knowledge, guidance and weather products to maintain safe separation between aircraft and weather hazards

[9] FAA Order 7110.65, "AirTraffic Control," prescribes procedures and phraseology for use by personnel providing air traffic control services.

separation assurance

2005 R&D Highlights

Aircraft Landing Lights (Airport Research)

Explored using landing lights to let pilots know which aircraft has clearance to depart. Used a Boeing 747-400 simulator to study the benefit of using standardized landing lights or current practices. Measured runway incursion severity and situation awareness after each simulator scenario. Results suggest that standardizing the use of aircraft landing lights to indicate that aircraft were cleared to depart prevented or reduced the severity of runway incursions or accidents and increased pilot situational awareness.

Alternating Yellow/Green Taxiway Centerline Lights (Airport Research)

Examined the feasibility of altering the existing concept for using alternating yellow and green taxiway centerline lights, using the same color coding in the reverse direction as a warning of approach to the runway environment from an intersecting taxiway. To study this theory, temporarily constructed a curved taxiway entrance lighting configuration, using standard FAA approved taxiway lighting fixtures at the FAA's William J. Hughes Technical Center. From this study, proved the concept would be a cost-efficient way to improve safety at those airports that have existing taxiway centerline lights.

Runway Incursions (Airport Research)

Conducted a system engineering feasibility study to identify the specific functional and implementation changes required to transition from the prototype runway obstruction warning system to a national airspace system-compatible technology insertion candidate. System involves a network of sensors embedded in runways and taxiways that can be monitored in the control tower. It includes runway lights visible to flight crews.

Runway Status Lights (Airport Research)

Conducted a successful operational evaluation of the runway status light system at the Dallas Fort Worth airport. The system consists of an array of red lights placed at taxiway entrances to warn pilots and vehicle operators that a runway is unsafe to enter. The FAA plans to extend this evaluation to additional field sites.

situational awareness

Common, accurate, and real–time information of aerospace operations, events, crisis, obstacles, and weather

2025 Benefit

This R&D goal will enable safe operations in all conditions by providing timely, accurate, and relevant information about aerospace system operations to decision makers in the air and on the ground. The FAA will ensure that operators of the system know everything they need to know, when and where they need it, to ensure safety in all operating conditions, including super-density operations and severe weather. It will provide the systems and procedures that will enable the use of visual flight rules in all weather conditions, night and day.

R&D Milestones

2010: Implement national, high-resolution, convective weather forecast into operations

Demonstrate Wide-Area Augmentation System (WAAS)/Local-Area Augmentation System (LAAS) standards for general aviation and vertical flight

2015: Demonstrate common real-time awareness of ongoing air operations, events, crisis, and weather at all types of airports by pilots and controllers

R&D Programs

Airport Cooperative Research – mandated by Congress in Vision 100-Century of Aviation Reauthorization Act to carry out applied research on problems that are shared by airport operating agencies (This program is beginning in 2006.)

Airports Technology Research – Capacity – develops advisory circulars, standards, and guidance material for airport design

2008: Develop design standards for general aviation airports

Airports Technology Research – Safety – provides technical information to support and update advisory circulars covering the design of airport safety areas, visual aids, rescue and firefighting, ice and snow control, and wildlife control

2006: Develop guidelines to better delineate taxi-ways from runways

2008: Develop heliport/vertiport lighting standards

2008: Develop guidance on landing site lighting using point-in-space approaches to heliports

2008: Develop a basic radar system for bird detection with the ability to detect birds on and above the ground, the ability to perform data processing in real-time, and the ability to determine bird altitude

2008: Develop design standards for general aviation airports

2011: Develop a radar-based National Bird Strike Advisory System for airports and their vicinity

Air Traffic Control/Airway Facilities Human Factors – develops requirements, knowledge, guidance, and standards for design and use of automation-based technologies, tools and support systems to improve performance of air traffic controllers and airway facilities personnel (e.g., reduce human error)

2008: Develop controller information requirements for weather in en route operations

2010: Complete investigation of human factors in air-ground integration involving proposed roles and responsibilities, decision support tools, concept of operations, and procedures

Center for Advanced Aviation System Development (CAASD) – develops and tests new technologies, systems, and operational concepts to produce a safer, more efficient air transportation system

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

Flightdeck/Maintenance/System Integration Human Factors – develops requirements, knowledge, guidance, and standards for design, certification, and use of automation-based technologies, tools, and support systems to improve performance of pilots

2008: Develop human factor guidelines for the display of weather on multi-function displays

2008: Complete assessment of pilot performance from analysis of Line Operations Safety Audit data

General Aviation and Vertical Flight Technology (GA & VF) – develops standards and procedures that enable simultaneous non-interfering operations between fixed wing and vertical flight aircraft

2008: Establish a test bed in the New York terminal area

2010: Demonstrate WAAS/LAAS standards

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

NAS Requirements – develops policies, standards, and requirements at the NAS level to reduce accidents caused by weather and decrease avoidable weather delays

2007: Evaluate effectiveness of weather information in reducing weather delays

Runway Incursion – selects and evaluates runway incursion technologies to validate their performance and operational suitability and identifies non-technology solutions, such as marking and signage, education, training, and advisory circulars

2008: Perform operational evaluation of runway status lights

2008: Install and evaluate low-cost surface surveillance system

Safe Flight 21 – Alaska Capstone – demonstrates new communications, navigation, and surveillance technologies in Alaska to improve aviation safety

2007: Upgrade avionics and ground-based transceivers to meet recent industry-approved standards

2007: Install primary flight and navigation displays into ADS-B avionics in up to 200 aircraft

2007: Commission two communication sites

2007: Test surveillance of mixed-equipped (transponder and ADS-B) aircraft via multi-lateration in the Juneau area

2007: Develop and demonstrate a prototype satellite communications system that will complement Capstone ground-based transceivers

Unmanned Aircraft Systems Research – ensures the safety of civil UAS operations and provides the FAA with the necessary knowledge, tools, and supporting data to take regulatory actions and provide guidance materials for the FAA and UAS industry

2008: Determine detect, sense, and avoid characteristics and operational requirements

2009: Define airworthiness assurance requirements for design and performance characteristics

2009: Determine command, control, and communication performance requirements and conduct field tests of prototype technology

2011: Conduct detect, sense, and avoid technology field evaluation

Wake Turbulence – develops knowledge, guidance, standards, and operational procedures for wake avoidance under various weather conditions to increase aircraft arrival and departure rates

2007: Develop and validate weather dependent wake-avoidance concepts for less than visual flight operations conditions

2007: Develop national modification to Air Traffic Control Order 7110.65[10] as it affects closely-spaced parallel runways for less than visual flight conditions

[10] FAA Order 7110.65, "AirTraffic Control," prescribes procedures and phraseology for use by personnel providing air traffic control services.

Weather Program – develops new technologies to provide weather observations, warnings, and forecasts that are accurate, accessible, and efficient and that enhance pilot and controller knowledge of the weather so that they can make better decisions

2009: Complete development of 6-12 hour freezing precipitation forecasts

2009: Demonstrate winter ceiling and visibility products at New York airports

2010: Complete operational implementation of convectively-induced turbulence product

2010: Implement high-resolution, national convective weather forecast into operation

2015: Develop high-glance-value weather products with longer forecast lead times and increased accuracy to be available electronically to all aviation users

Wind Profiling and Weather Research-Juneau – develops and demonstrates operational prototype software algorithms and hardware infrastructure for the Juneau airport wind system, generates turbulence advisories and wind information for commercial and general aviation in the Juneau area to allow Required Navigation Precision

situational awareness

2005 R&D Highlights

Foreign Object Debris (Airport Research)

Evaluated an experimental radar to detect foreign object debris (FOD) on runways. Conducted tests at New York's John F. Kennedy International Airport to assess the radar's ability to detect FOD, to recognize it among other items, and to locate it precisely on a runway. FOD is any substance alien to the vehicle or system that can potentially cause damage. It can result from the manufacture or maintenance of aircraft and from the loss of parts from aircraft, pavement cracking, wildlife, ice and salt accumulation, and construction debris. Published a report of the radar tests, "Evaluation of the Tarsier FOD Detection Radar."

North American Bird Strike Advisory System Strategic Plan (Airport Research)

Developed, with the U.S. Air Force and Transport Canada, a draft strategic plan for an integrated and consolidated bird strike advisory system for North America. Bird strikes represent a significant safety risk to civilian and military aircraft. A key element of the plan is to develop a robust communications infrastructure and network to enhance the timeliness and scope of bird advisory information. When implemented, the plan will be a critical first step to develop a system that will help protect aviators and aircraft from the deadly and costly effects of bird hazards.

Obstruction Lighting Standards (Airport Research)

Initiated development of obstruction lighting standards for wind turbine farms to ensure pilots can easily see, identify, and avoid turbines and to minimize any affect of those lights on the surrounding community or wildlife. Established a wind turbine farm test site in Lawton, Oklahoma. Conducted test flights and confirmed that the proposed lighting configuration provided sufficient guidance to approaching aircraft. Will publish the results of this evaluation in an FAA technical note in 2006, which will recommend new lighting standards for illuminating wind turbine farms as obstructions.

Alaska Capstone (Safe Flight 21)

Demonstrated that Capstone technologies can improve aviation safety and efficiency in Southwest and Southeast Alaska. Aircraft in both areas are now equipped with avionics that display the positions of other aircraft along with weather and terrain data. Demonstrated that automatic dependent surveillance - broadcast capabilities can be augmented by using a network of ground sensors. The technology improves situational awareness in areas that lack radar coverage. This four-year effort will reduce operational costs and improve safety in Alaska.

Forecasting Oceanic Weather (Weather Program)

Developed an Oceanic Cloud Top Height product that provides pilots with an automated graphical display showing areas of convection relative to the aircraft's flight path and altitude. Received the FAA and National Weather Service approval to enter the experimental phase of research to refine the product prior to seeking an operational decision. Having convection information will allow pilots to avoid dangerous convection and turbulence conditions that occur around clouds along their oceanic routes.

In-flight Icing Conditions (Weather Program)

Developed the Current and Forecast Icing Potential products to alert users to areas of in-flight icing by displaying graphically the likelihood that icing will occur along their route of flight. The Aviation Weather Technology Transfer Board approved an upgrade to the Current Icing Potential product for operational use. The upgrade provides a more detailed look, at greater spatial resolution, of icing conditions. Users can now see the finer details of weather structure contributing to potentially hazardous icing conditions, providing a more accurate depiction of the icing hazard. This will allow pilots to devise flight plans that more effectively avoid these regions and thus enhance safety.

National Ceiling and Visibility Tools (Weather Program)

Received the FAA and National Weather Service approval to use a National Ceiling and Visibility Analysis product on an experimental basis. The product provides users in the lower 48 states an automated graphical display showing current ceiling, visibility, and flight category conditions along their route of flight. Received their approval to enter the testing phase of research on a companion product, the National Ceiling and Visibility Alaska Forecast product. When fully developed, the Alaskan forecast product will provide users with an automated graphic display containing forecasts from 1 to 12 hours of ceiling, visibility, and flight category conditions.

Weather Models (Weather Program)

Worked with the National Oceanic and Atmospheric Administration on the Rapid Update Cycle system to provide higher resolution graphics and the assimilation of additional weather information, including improved moisture analysis and cloud/precipitation physics, to increase forecast accuracy. The operational weather prediction system is made up primarily of a numerical forecast model and provides improved aviation and surface forecasts of interest to aviation as well as the general public.

Phased Array Radar (Weather Program)

Installed a track processor in a phased-array radar at the National Weather Radar Testbed at the National Severe Storms Laboratory in Norman, Oklahoma. The processor enables dual use capabilities – tracking aircraft while simultaneously gathering meteorological data. Conducted a study with the Massachusetts Institute of Technology Lincoln Laboratory that showed phased array radar technology is becoming affordable for civilian use.


EXIT

system knowledge

Thorough understanding of how the aerospace system operates, the impact of change on system performance and risk, and how the system impacts the nation

2025 Benefit

This R&D goal will enable a complete understanding of the aerospace system, the impact of change on system performance, and how the system impacts the nation. System design and operations will not limit capacity. The FAA will collect, analyze, and share pertinent data to foresee trends and precursors, including development of a risk analysis methodology and safety management system. It will understand the impact of the system on the environment and on our economy and quality of life. It will be proactive in delivering the safest and most efficient aerospace system in the world quickly and affordably.

R&D Milestones

2010: Develop initial specification for a Safety Management System

Understand adaptive flow management concepts and alternatives

Implement national, high-resolution, convective weather forecast into operations

2015: Understand economic (including implementation) and operational impact of system alternatives

R&D Programs

Aeromedical Research – investigates and analyzes injury and death patterns in civilian flight accidents and incidents to determine their cause and develop preventive strategies

2008: Establish an aircraft accident medical database
2010: Develop advanced molecular biochemical techniques for forensic use in fatal accidents to differentiate between ingested alcohol and alcohol formed as a result of decomposition

Airspace Management Laboratory – develops data management and simulation tools for the evaluation of airspace design alternatives, develops and manages information management systems to improve the end-to-end integrity of National Airspace System support and post-operational data

Airspace Redesign – investigates and demonstrates new airspace concepts and procedures to increase national aviation system capacity, focuses on the Nation's major metropolitan areas to shorten flight distances, to provide more fuel-efficient routes, and to reduce arrival and departure delays

Airport Cooperative Research – mandated by Congress in Vision 100-Century of Aviation Reauthorization Act to carry out applied research on problems that are shared by airport operating agencies (This program is beginning in 2006.)

Airports Technology Research – Capacity – provides technical information needed to develop standards and guidance materials for airport design

2006: Develop advanced design standards for airport pavements to allow operations of Boeing 777 and Airbus 380 aircraft
2007: Determine failure modes for flexible pavements with thick asphalt layers
2007: Determine the effects of curling in rigid pavements
2008: Determine the effects of non-linearity, wander, and moving load on the design of flexible pavements
2011: Complete definition of software requirements and modeling characteristics to include non-linearity, wander and moving loads in the design of flexible pavements
2011: Develop software and model to include curling in the design of rigid pavements

Air Traffic Control/Airway Facilities Human Factors – develops knowledge and requirements for the design and use of automation-based technologies, tools, and support systems to improve performance of air traffic controllers and airway facilities personnel

2008: Develop guidelines and human factors standards for integrating advanced technologies into the Air Traffic Control and Technical Operations environments
2008: Complete an assessment of the impact of new technologies on controller selection
2008: Complete an assessment of human factors concepts for converging TRACON and en route controller consoles into a standard automation platform

Aviation Safety Risk Analysis – monitors and analyzes aviation system operations and safety risks and develops risk management methodologies, prototype tools, technical information, procedures, and practices to improve aviation safety

2007: Develop the information requirements to support a decision support system that will allow the FAA oversight process to be more effective, efficient, and systematic
2008: Develop standards for carbon monoxide detection devices, including the development of inspection methods to determine the integrity of exhaust systems
2011: Evaluate terminal area operations using pilot-in-the-loop flight simulators

Center for Advanced Aviation System Development (CAASD) – conducts high-level operations research and systems engineering to meet the FAA's long-term requirements

2008: Evaluate airspace redesign enhancements in all operational domains to improve system performance and utilization of resources
2012: Complete development of the Aviation Environmental Portfolio Management Tool that provides the cost/benefit methodology needed to harmonize national aviation policy and environmental policy

Commercial Space Transportation – develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

Environment and Energy - improves aircraft science and knowledge concerning noise and emissions

2007: Deploy a first generation of integrated noise and emission prediction and modeling tools
2010: Deploy an Aviation Environmental Design Tool that quantifies and assesses interrelationships among noise and emissions at the local and global levels
2013: Deploy the Aviation Environmental Portfolio Management Tool to provide the cost/benefit methodology needed to harmonize national aviation policy and environmental policy

Flightdeck/Maintenance/System Integration Human Factors – develops requirements and knowledge for design and use of automation-based technologies, tools, and support systems to improve performance of pilots

2007: Complete an assessment of advanced methods to assess automation knowledge, diagnose of shortcomings and their causes, and develop remediation techniques
2007: Complete an assessment on the threat and error model to integrate data from the Aviation Safety Action Program, Line Operations Safety Audit, and the Advanced Qualification Program

General Aviation and Vertical Flight Technology (GA & VF) – develops standards and procedures that enable simultaneous non-interfering operations between fixed wing and vertical flight aircraft

2008: Establish a test bed in the New York terminal area
2010: Demonstrate WAAS/LAAS standards in the New York terminal area
2010: Develop recommendations for WAAS/LAAS national simultaneous non-interfering operations development

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

NAS Requirements – develops policies, standards, and requirements at the NAS level to reduce accidents caused by weather and decrease avoidable weather delays

2007: Evaluate effectiveness of weather information in reducing weather delays

Operations Concept Validation – develops and validates new performance requirements and operational concepts for the next generation of decision-support systems for pilots and air traffic controllers to increase capacity, while simultaneously reducing safety risk

2007: Update the RTCA NAS concept of operations
2009: Determine how to split en route operations between high and low airspace to increase efficiency and effectiveness

Safer Skies – develops knowledge and identifies trends on the causes of aviation accidents and incidents to reduce the fatal accident rate in commercial and general aviation

System Capacity Planning and Improvement – develops tools, procedures, and technology and collects data to measure and enhance NAS operational performance

2007: Install the Performance Data and Analysis Reporting System at twelve Operational Evolution Plan airports
2008: Model and simulate new large aircraft ground movement

System Planning and Resource Management – coordinates and supports domestic and international R&D of aviation-related products and services; helps the FAA R&D program meet customer needs, increases program efficiency, reduces management and operating costs; increase customer and stakeholder involvement in the FAA programs; fosters greater proliferation of U.S. standards and technology to meet global aviation needs

2007: Publish single, integrated and performance-based national aviation R&D plan
2008: Complete initial study assessing how long it takes for R&D products (e.g., regulations, standards, technologies) to transition into system capabilities

Weather Program – develops new technologies to provide weather observations, warnings, and forecasts that are accurate, accessible, and efficient to minimize the impact of adverse weather events on national airspace operational capacity

2009: Complete development of 6-12 hour freezing precipitation forecasts
2009: Demonstrate winter ceiling and visibility products at New York airports
2010: Complete operational implementation of convectively-induced turbulence product
2010: Implement high-resolution, national convective weather forecast into operation
2015: Develop high-glance-value weather products with longer forecast lead times and increased accuracy to be available electronically to all aviation users

system knowledge

2005 R&D Highlights

Pavement Tests for Heavy Vehicles (Airport Research)

Completed tests on three different types of pavement and confirmed that the quality of the pavement base has a specific, quantifiable effect on the durability of the pavement after cracks form. The FAA will use this data to update the thickness design standard for concrete pavements, which is required to support the next generation of heavy transport civil aircraft.

Ultra-Thin White-topping for General Aviation Airport Pavements (Airport Research)

Conducted a field evaluation under the Innovative Rehabilitation of Pavement for Light Load Aircraft project to assess the viability of using ultra-thin white (UTW) for general aviation airport pavement rehabilitation. Used three general aviation airports to identify locations where heavy loads (e.g., from fuel trucks) had apparently led to debonding and cracking in the UTW area. Determined that neither the freeze/thaw nor the wet/dry exposure cycles caused significant deterioration in the UTW bond. Found that the bond retention at the concrete/asphalt interface was excellent.

Radio Frequency Blackouts (Commercial Space)

Assessed the radio frequency blackout phenomena caused by plasma generation during the critical reentry of space vehicles into the atmosphere. Evaluated four mitigation methods that might apply to commercial space vehicles. Passive methods, such as aerodynamic shaping and use of high frequencies, showed the most potential. Research will continue to identify specific frequency bands that are suitable for communications in the presence of high-temperature plasmas.

Flight Safety Systems (Commercial Space)

Completed a follow-on study to an earlier report on non-traditional flight safety systems. Conventional flight safety systems minimize the threat to public safety and property posed by malfunctioning launch vehicles. Non-traditional versions of these systems include autonomous and semi-autonomous systems that interface with pilots and/or ground controllers. Gauged the effectiveness of a verification framework for the regulatory approval of non-traditional systems by applying it to an autonomous flight safety system being developed and tested by NASA at its Wallops Flight Facility. Yielded valuable initial insight into possible approaches to creating new regulations.

Weather Delays (Commercial Space)

Analyzed at data from over 300 expendable launch vehicle launches from 1988-2005 at the Eastern Range at Cape Canaveral Florida and the Western Range at Vandenberg Air Force Base in California to understand the effects of weather. Postponing or canceling a commercial launch directly affects operational costs, which often exceed millions of dollars. Reviewed several launches from the Kodiak Launch Complex in Kodiak, Alaska, to determine trends and predict problematic weather for future launch operations. The results will help commercial launch operators make sound decisions regarding launch operations and planning.

Event Reporting (Human Factors)

Developed, tested, and validated the Aviation Causal Classifications for Event Report system that air carriers can use to share data on human and aircraft performance and accident/incident mitigation strategies to enhance safety. Developed a taxonomy and document identified seven high-level causal contributors to human error in aviation. The taxonomy provides a uniform set of descriptors and is now available to industry.

Human Factors Analysis and Classification System (Human Factors)

Continued to conduct focused investigations of human error associated with a variety of aviation communities using the Human Factors Analysis and Classification System. The system is a theoretically based tool used to investigate and analyze human error associated with high-risk environments, such as aviation. Integrated the system with other traditional National Transportation Safety Board (NTSB) situational and demographic variables into a single, web-based database that allows examination of accident data for possible human error. Completed a preliminary investigation of the current FAA and proposed NTSB safety interventions using the system. Research will provide the baseline information to assess, modify and/or develop safety interventions.

Quality of Weather Forecasts (Weather Program)

Installed a prototype Real-Time Verification System at the National Weather Service Headquarters in Silver Spring, Maryland. The system is a tool for assessing the quality of weather forecasts. It provides verification of research and operational weather products in real time via the Internet allowing decision-makers to know how well a product is performing. The full system will become operational in 2006.

world leadership

Globally recognized leader in aerospace technology, systems, and operations

2025 Benefit

This R&D goal will result in the U.S. retaining its global leadership in aerospace. Global aviation standards and services will be based on U.S. performance-based standards and services. Customers of the aviation system will be satisfied with the services they receive. FAA R&D will be a place of choice to work and a world-class research organization based on recognized quality standards.

R&D Milestones

2010: Measure time and cost to market for R&D products and services (e.g., regulations, technologies, standards, procedures)

Show that customers (and stakeholders) are satisfied with R&D products and services

Ensure that the FAA R&D programs are peer reviewed and judged to be world class

2015: Increase revenues from U.S. aviation-related products and services through international adoption of U.S. aviation standards

R&D Programs

Center for Advanced Aviation System Development (CAASD) – contributes to the development of ICAO world-wide navigation capabilities, including WAAS/LAAS and air-ground communications; develops and tests new technologies, systems and operational concepts to produce a safer, more efficient air transportation system

Commercial Space Transportation - develops regulations, advisory circulars, and guidelines to identify the requirements for safe commercial space transportation operations

Environment and Energy – represents the United States on the ICAO Committee on Aviation Protection, which assesses the adequacy of international aviation environmental standards for aviation noise and engine exhaust emissions

Aircraft Noise

2008: Create a metric that will assess supersonic aircraft impact

2009: Release a new ICAO noise standard for subsonic jets and large aircraft

Engine Emissions

2008: Establish methodologies to quantify and assess the impact of Particulate Matter and Hazardous Air Pollutants policy

2010: Release an assessment of the impacts of aviation on regional air quality, including the effects of climb/cruise NOx emissions, that could be used by ICAO for regions worldwide

2011: Release an assessment of the impact of aviation on climate change with special emphasis on the effects of contrails

2013: Collect direct measurements of hazardous air pollutants and particulate matter from engines to replace factors used in modeling tools

Noise and Emissions Analysis

2007: Deploy a first generation of integrated noise and emission prediction and modeling tools

2010: Deploy an Aviation Environmental Design Tool that quantifies and assesses interrelationships among noise and emissions at the local and global levels

2010: Deploy the Aviation Environmental Portfolio Management Tool that will provide cost-effectiveness analyses of noise, air quality, and global emissions mitigation strategies

2010: Deploy noise and emissions exposure models for airspace management activities

2013: Deploy the Aviation Environmental Portfolio Management Tool that will provide the cost/benefit methodology needed to harmonize national aviation policy and environmental policy

Fire Research and Safety – leads development of international standards and operational procedures for aircraft fire and cabin safety

Flightdeck/Maintenace/System Integration Human Factors – develops requirements and knowledge for design and use of automation-based technologies, tools and support systems to improve performance of pilots

Joint Planning and Development Office (JPDO) – plans and designs the next generation air transportation system by coordinating goals, priorities and implementation requirements within the federal government and with the U.S. aviation community

2007: Develop future architecture for the national air transportation system

System Planning and Resource Management – coordinates and supports domestic and international R&D of aviation-related products and services; helps the FAA R&D program meet customer needs, increases program efficiency, reduces management and operating costs; increase customer and stakeholder involvement in the FAA programs; fosters greater proliferation of U.S. standards and technology to meet global aviation needs

2007: Publish single, integrated and performance-based national aviation R&D plan

2008: Complete initial study assessing how long it takes for R&D products and services (e.g., regulations, standards, technologies) to transition into system capabilities

William J. Hughes Technical Center Laboratory Facility (WJHTC) – provides world-class research and test facilities to emulate and evaluate field conditions and develops, integrates, and tests future aviation technologies, concepts and procedures. The center works in collaboration with other government agencies, industry, academia and international organizations.

world leadership

2005 R&D Highlights

Usability and Reliability of Aviation Technical Manuals (Aviation Safety Risk Analysis)

Conducted experiments under a cooperative agreement with the Wichita State University National Institute for Aviation Research and aircraft manufacturers to identify the most effective techniques for developing and validating maintenance procedures for technical manuals. Based on the research results, developed the on-line Evaluation Toolbox for Aviation Technical Writers (http://www.niar.twsu.edu/humanfactors/toolbox/default.htm) to educate and assist technical writers in developing better technical documentation. This will reduce publication errors that can generate process errors and, hence, can lead to equipment failure and costly rework.

Aviation's Effect on Climate Change (Environment and Energy)

The World Meteorological Organization and the United Nations Environment Programme established the Intergovernmental Panel on Climate Change to assess scientific, technical, and socio-economic information relevant to the understanding of human-induced climate change, potential impacts of climate change, and options for mitigation and adaptation. This research will help the FAA revise international, "Guidelines for National Greenhouse Gas Inventories," which will be published in 2006.

Global Atmosphere (Environment and Energy)

Developed a report to summarize key insights into the global atmosphere and identify research to address key uncertainties, such as investigating relationships between aircraft parameters and the properties of the condensation trails generated by aircraft under a variety of atmospheric conditions. Research will be critical to the deliberations of the ICAO's Committee on Aviation Environmental Protection.

International Aircraft Fire and Cabin Safety Research Cooperation (Fire Research and Safety)

Sponsored with the Cabin Safety Research Technical Group, which is comprised of representatives from the major aviation authorities throughout the world, the Fourth Triennial International Aircraft Fire and Cabin Safety Research Conference in Lisbon, Portugal. The conference provided the aviation community information on recent, ongoing, and planned research activities in aircraft fire and cabin safety in civil transport aircraft throughout the world. Covered a wide range of issues, including evacuation from the new, high capacity Airbus 380, passenger performance and awareness, passenger protection, neck injury criteria for occupants in side facing seats, and aircraft seat dynamic test requirements.

Aircraft Certification Job Aid (Human Factors)

Updated the computer-based, decision-support tool to provide an integrated database of regulatory information and human factors considerations that is used by certification personnel to ensure aircraft flight technologies are user friendly and safe. The tool provides a single source for requirements to integrate safety and capacity considerations, streamline and improve processes for both industry and the FAA, and reduce the cycle-time from design through certification. Estimated savings to FAA are $3 million per year and to industry are $6 million per year.

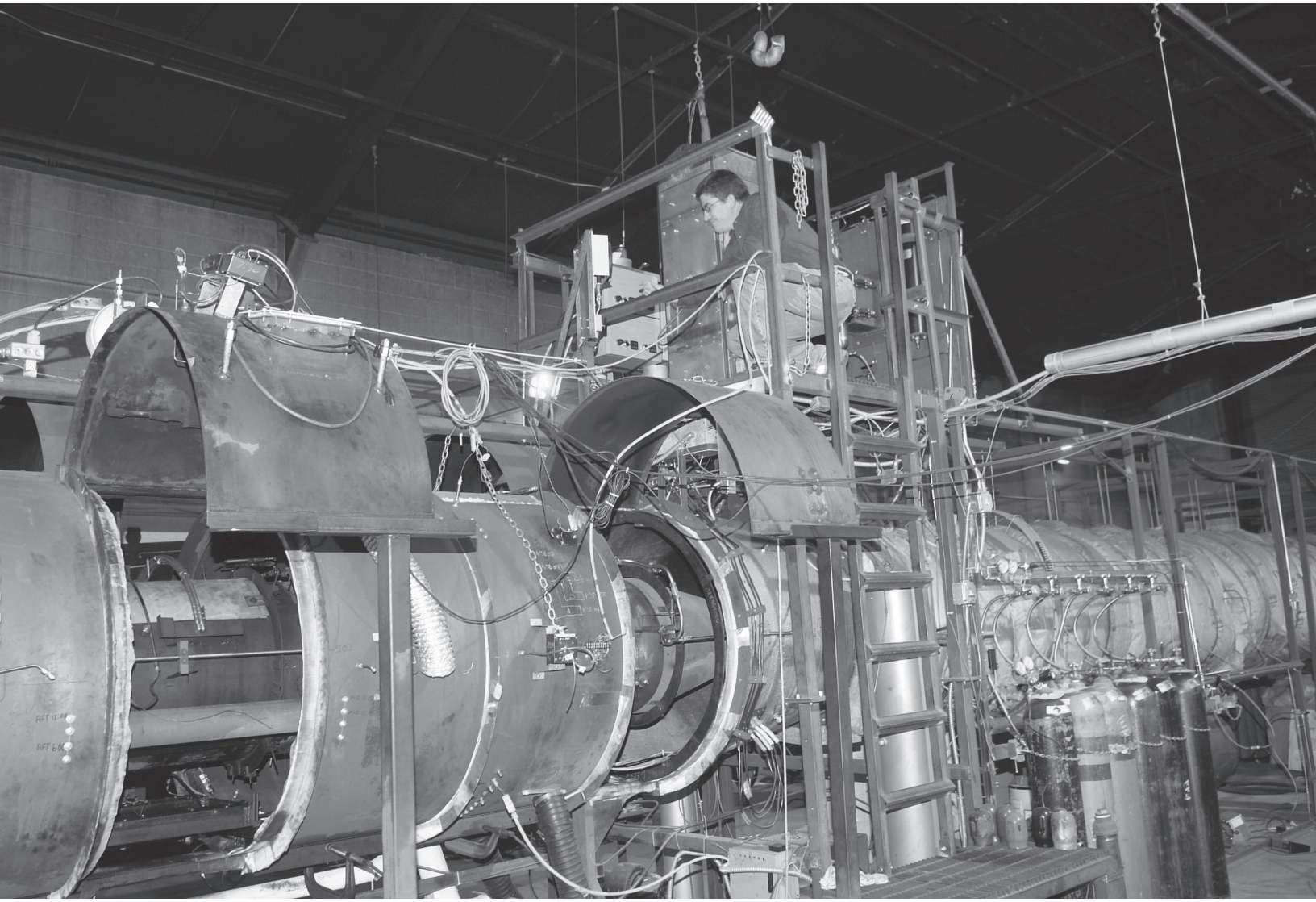
Small Aircraft Transportation System Concept (William J. Hughes Technical Center Laboratory Facility)

Successfully completed a proof-of-concept demonstration of four operating capabilities for the small aircraft transportation system (SATS) concept. The capabilities include: higher volume operations at non-towered, non-radar airports; lower landing minima; single pilot performance; and integration of SATS operations into the national airspace system. SATS is a collaborative research effort between NASA, the FAA, and industry focused on increasing public access and mobility within the national airspace system. When implemented, these capabilities will enable point-to-point, on-demand travel between more than 5,400 existing small airports.

Traffic Management Advisor Multi-Center (William J. Hughes Technical Center Laboratory Facility)

Conducted with NASA an operational field evaluation of the Traffic Management Advisory-Multi-Center system to assess potential benefits. The system enables traffic management advisor time-based scheduling of arrivals to airports in the complex airspace of the Northeastern United States, especially those that are fed by more than one Center. Completed a successful operational trial at Philadelphia Airport that demonstrated that average delays were significantly lower using system as compared with the average delay when not using it.


AD86 5G
PUSH



chapter three

Research & Development

The *Flight Plan* and the *Next Generation Air Transportation System Integrated Plan* provide the near-term and long-term requirements, respectively, for the Federal Aviation Administration (FAA) research and development (R&D) program. The development of the master schedule is FAA's first attempt to align and plan its R&D program with these requirements. This chapter presents a summary of what FAA R&D is doing (programs), how much it is spending (budget), how it performs its programs (partnerships), and how well its programs are doing (evaluation).

sponsors & progra

Sponsors & Programs

3.1 Sponsors

The FAA R&D program includes both near- and long-term R&D to enable technical and operational innovation and to support informed decision making in all areas of the FAA responsibility. The FAA R&D program supports: regulation, certification, and standards development; modernization of the national airspace system; and policy and planning. To support the FAA goals, R&D addresses the specific needs of sponsoring organizations including: Aviation Safety; the Air Traffic Organization; Airports; Aviation Policy, Planning and Environment; and Commercial Space Transportation. The Air Traffic Organization, Operations Planning Office of Aviation R&D manages the R&D program for the Administrator.

3.2 Programs

The R&D programs are funded in four appropriation accounts: Research, Engineering and Development (R,E&D); Facilities and Equipment (F&E); Airport Improvement Program (AIP); and Operations (Ops). In general, the R,E&D account funds R&D programs that improve the national airspace system (NAS) by increasing its safety, security, productivity, capacity, and environmental compatibility to meet the expected air traffic demands of the future.[1] The F&E account generally funds capital investment for the procurement and installation of new equipment, facilities, and construction projects included in the Aviation System Capital Investment Plan. The AIP account generally funds airport improvement grants, including those emphasizing capacity development, safety, and security needs; and funds grants for aircraft noise compatibility planning and programs and low emissions airport equipment[2,3] It also funds administrative and technical support costs to support airport programs. The Operations account funds the recurring administrative, operating, and maintenance costs of doing the FAA's business. [4]

The programs summarized below are for the fiscal year (FY) 2007 R&D budget request. The program descriptions in Appendix A provide detailed information for each program, including intended outcomes, outputs, programmatic structure, partnerships, and a long-range outlook for the program.

[1] FAA Order 2500.8A, *Funding Criteria for Operations, Facilities and Equipment (F&E), and Research, Engineering and Development (R,E&D) Accounts,* dated April 9, 1993.

[2] *FAA Budget Estimates FY 2005 submitted for use by The Committees on Appropriations, Appendix 6 Grants-In-Aid for Airports, page 3.*

[3] *Vision 100 – Century of Aviation Reauthorization Act, Public Law 108-176, December 12, 2003.*

[4] FAA Order 2500.8A, *Funding Criteria for Operations, Facilities and Equipment (F&E), and Research, Engineering and Development (R,E&D) Accounts,* dated April 9, 1993.

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Research, Engineering and Development (R,E&D)

Fire Research and Safety (A11.a.): Develops technologies, procedures, test methods, and criteria to reduce the risk of commercial airline accidents caused by hidden in-flight fires and fuel tank explosions and improves survivability during a post-crash fire.

Propulsion and Fuel Systems (A11.b.): Develops and validates technologies, tools, methodologies, and materials to enhance the airworthiness, reliability, and performance of civil turbine and piston engines, propellers, fuels, and fuel management systems.

Advanced Materials/Structural Safety (A11.c.): Ensures the safety of civil aircraft constructed of advanced materials by developing analytical and testing methods to understand how design, load, and damage can affect composite structures. Develops maintenance and repair methods. Increases the ability of passengers to survive aviation accidents by improving crash characteristics of aircraft structures and by modeling crash events to improve aircraft certification.

Atmospheric Hazards/Digital System Safety (A11.d.): Develops technologies to detect frozen contamination, predict anti-icing fluid failure, and ensure safe operations during and after flight in atmospheric icing conditions. Develops technologies, advisory, and guidance material to ensure safe operation in electromagnetic hazards resulting from electro-magnetic interference, cosmic radiation, high-intensity radiated fields, and lightning. Ensures the safe operation of emerging, highly complex software-based digital flight controls and avionics systems.

Aging Aircraft (A11.e.): Develops technologies, technical information, procedures, and practices to help ensure the continued airworthiness of aircraft structures and systems. Assesses the causes and consequences of fatigue damage of aging aircraft. Ensures the continued safe operation of aircraft electrical and mechanical systems. Detects and quantifies damage, such as cracking, corrosion, disbanding, and material processing defects through nondestructive inspection techniques. Updates and validates airworthiness standards. Establishes damage-tolerant design and maintenance criteria for rotorcraft

Aircraft Catastrophic Failure Prevention Research (A11.f.): Develops technologies and methods to assess risk and prevent the occurrence of potentially catastrophic defects, failures, and malfunctions in aircraft, aircraft components, and aircraft systems. Uses historic accident data to investigate turbine engine "uncontainment" events and propulsion malfunctions.

Flightdeck/Maintenance/System Integration Human Factors (A11.g.): Provides the human factor research foundation for the FAA guidelines, handbooks, advisory circulars, rules, and regulations to ensure safe and efficient aircraft operations. Improves task performance and training for aircrew, inspectors, and maintenance technicians. Develops and applies error management strategies to flight and maintenance operations. Ensures that human factors are considered in certifying new aircraft and in designing and modifying equipment.

Aviation Safety Risk Analysis (A11.h.): Monitors and analyzes aviation system operations and safety risks and develops risk management methodologies, prototype tools, technical information, procedures, and practices to improve aviation safety.

Air Traffic Control/Airway Facilities Human Factors (A11.i.): Identifies and analyzes trends in air traffic operational errors and airway facilities incidents, and develops and implements strategies to mitigate these problems. Manages human error hazards, their consequences, and recovery methods in early stages of system design or procedural development.

Aeromedical Research (A11.j.): Identifies pilot, flight attendant, and passenger medical conditions that indicate an inability to meet flight demands, both in the absence and in the presence of emergency flight conditions. Defines cabin air quality and analyzes requirements for occupant protection and aircraft decontamination.

Weather Program (A11.k.): Develops new technologies to provide weather observations, warnings, and forecasts that are accurate, accessible, and efficient. Works with the National Weather Service, National Aeronautics and Space Administration and Department of Defense to produce more accurate and rapid forecasts.

Unmanned Aircraft Systems Research (A11.l): Ensures safe integration of unmanned aircraft system (UAS) into the nation's aviation system. Provides information to support certification procedures, airworthiness standards, operational requirements, maintenance procedures, and safety oversight activities for UAS civil applications and operations.

Joint Planning and Development Office (JPDO) (A12.a.): Plans and designs the next generation air transportation system by coordinating goals, priorities, and implementation requirements within the federal government and with the U.S. aviation community.

Wake Turbulence (A12.b.): Provides a better understanding of the swirling air masses (wakes) trailing downstream from aircraft wingtips to reduce separation distances between aircraft safely, to support the safe use of parallel runways, and to facilitate the ability of airports to operate closer to their design capacity.

Environment and Energy (A13.a.): Develops and validates methodologies, models, metrics, and tools to assess and mitigate the effect of aircraft noise and aviation emissions. Analyses and balances the interrelationships between noise and emissions, considers local and global impacts, and determines economic consequences. Reduces scientific uncertainties on aviation environmental issues to enable appropriate action.

System Planning and Resource Management (A14.a.): Helps the R&D programs meet customer needs, increase program efficiency, and reduce management and operating costs. Increases customer and stakeholder involvement in the FAA programs, and fosters greater proliferation of U.S. standards and technology to meet global aviation needs.

William J. Hughes Technical Center Laboratory Facility (WJHTC) (A14.b.): Provides well-equipped, routinely available facilities to emulate and evaluate field conditions; performs human-in-the-loop simulations; measures human performance; evaluates human factors issues; and provides research aircraft that are specially instrumented and re-configurable.

Facilities and Equipment (F&E)

Runway Incursion Reduction (1A01A): Minimizes the chance of injury, death, damage, or loss of property caused by runway accidents or incidents. Selects and evaluates technologies; validates technical performance and operational suitability; and develops a business case to support program implementation. Focuses current program on pilot situational awareness.

System Capacity Planning and Improvement (1A01B): Develops programs to provide capacity enhancements, airport improvements, and modern infrastructure. Delivers products and services to alleviate traffic congestion, system delays, and operational inefficiencies in the aviation system through the development of new runways, new technologies, and modified operational procedures. Develops performance metrics; implements performance measurement tools; and collects, processes, and analyzes data to measure and report performance on a routine basis.

Operations Concept Validation (1A01C): Conducts modeling and simulation to validate new operational concepts for the next generation of decision support systems for pilots and air traffic controllers. Validates performance requirements and identifies research criteria at the system and subsystem level. Assesses safety, identifies risk and takes actions necessary to reduce risk, and examines the interactions required between flight crew or air traffic controllers and the system.

General Aviation and Vertical Flight Technology (GA & VF) (1A01D): Supports the general aviation requirement for: better communications, navigation, and surveillance services; improved avionics technologies; increased situational awareness; and improved adverse weather capabilities.

Safer Skies (1A01E): Analyzes causes of accidents and develops and implements new intervention technologies and strategies to prevent or reduce the leading causes of commercial aviation accidents, including accidents attributed to uncontained engine failure, controlled flight into terrain, approach and landing, loss of control, runway incursions, and weather.

NAS Requirements (1A01F): Examines current and future NAS needs and develops preliminary acquisition requirements to fill any identified gaps. Evaluates services and technologies, independent of their venders, to identify the best options available to increase system efficiency. Develops procedures; defines performance; analyzes impacts, workload, and hazards; and develops system architectures.

Wind Profiling and Weather Research - Juneau (1A01G): Funds operations and maintenance of the Juneau Area Wind System operational prototype. Implements end-state system that consists of operational prototype software algorithms and a hardware infrastructure and is acceptable for use in the NAS.

Airspace Management Laboratory (1A01H): Provides a better understanding of the impact of changes to airspace design (sectors and routes) in high-density traffic areas, such as the New York metropolitan airspace, to improve airspace operations, reduce delays, and mitigate noise impacts. Studies alternatives for airspace redesign that, when combined with new decision support tools and procedures, will optimize the nation's airspace.

Airspace Redesign (1A01I): Investigates and demonstrates new airspace concepts and procedures to increase national aviation system capacity, focuses on the nation's major metropolitan areas to shorten flight distances, provides more fuel-efficient routes, and reduces arrival and departure delays.

Wake Turbulence (1A01J): Evaluates NASA technology prototypes for decision support tools that may allow reduced wake turbulence departure spacing and increased airport capacity. Develops requirement for validating the tools and displaying the separation information to controllers.

Safe Flight 21 – Alaska Capstone (1A02A): Demonstrates technologies to improve safety and pilot situational awareness by displaying the location of nearby aircraft in an airborne cockpit display; provides critical weather observations to pilots in mountainous passes; and, provides "radar-like services" in non-radar areas.

Center for Advanced Aviation System Development (CAASD) (4A09): Identifies and tests new technologies for application to air traffic management, navigation, communication, separation assurance, surveillance, and system safety. Conducts R&D and high-level system engineering to meet the FAA's long-term requirements.

Airport Improvement Program (AIP)
– (requested in FY 2007)

Airports Technology Research – Capacity: Provides better airport planning and designs and improves runway pavement design, construction, and maintenance. Ensures new pavement standards will be ready to support safe international operation of next-generation heavy aircraft. Makes pavement design standards available to users worldwide.

Airports Technology Research – Safety: Increases airport safety by conducting research to improve airport lighting and marking, reduce wildlife hazards near airport runways, improve airport fire and rescue capability, and reduce surface accidents.

Airport Cooperative Research – Capacity: Addresses airport design, perimeter taxiways and modeling; mitigation of environmental impacts, including noise and emissions and run-off from deicing and anti-icing operations; introduction of new large aircraft; and improved pavement maintenance and materials.

Airport Cooperative Research – Safety: Addresses all aspects of improving airport safety, including improved lighting and marking, mitigation of wildlife hazards, airport design and geometry, reduction of runway incursions, and improvement or aircraft rescue and firefighting.

Operations (Ops)

Commercial Space Transportation Safety: Examines safety considerations for commercial space transportation, including those that involve crew and space-flight participants' health and safety, spacecraft vehicle safety, launch and re-entry risks, public safety, and personal property risk.

budget

Budget

3.3 Budget

This section provides four tables that explain the FAA R&D budget by appropriation, program sponsor, R&D category, and performance goal. Budget numbers for FY 2008-2011 are for planning purposes and subject to change.

Appropriation Account.
Table 3.1 shows the FAA R&D budget planned for FY 2007, including the five-year plan through 2011, grouped by appropriation account. The previous section on programs defined the four appropriation types. The F&E budget in Table 3.1 is broken down into three line items: Advanced Technology Development and Prototyping (ATD&P) line item number 1A01, Safe Flight 21 (SF-21) line item number 1A02, and the CAASD line item number 4A09. Not all programs in these F&E line items are R&D. Only R&D programs are shown.

Sponsoring Organization
Table 3.2 shows the FAA R&D budget planned for FY 2007, including the five-year plan through 2011, grouped by sponsoring organization. Sponsoring organizations include: Aviation Safety (AVS); Air Traffic Organization (ATO); Airports (ARP); Aviation Policy, Planning and Environment (AEP); and Commercial Space Transportation (AST). Section 3.1 describes the type of R&D required by each sponsoring organization.

R&D Category
The FAA research includes both development and applied research as defined by the Office of Management and Budget Circular A-11. Table 3.3 shows the FAA R&D program by category for FY 2007, including the five-year plan through 2011, with the percent applied research and development.

Performance Goal
Table 3.4 shows the FAA R&D budget by performance goal as defined in Exhibit IV of the FAA budget request for FY 2007. The R&D programs apply to three performance goals – safety, mobility, and environment. Programs may support more than one goal; however, each program is listed only once under its primary goal for budget purposes. The table provides information on contract costs, personnel costs, and other in-house costs planned for FY 2007.

Table 3.1
FAA R&D Program Budget by Appropriations Account

Project Number	FY 2007 Budget Line Item	Program	Appropriation Account	2006 Enacted Budget ($000)	2007 Requested ($000)	2008 Planned ($000)	2009 Planned ($000)	2010 Planned ($000)	2011 Planned ($000)	
Research, Engineering and Development (R,E&D)										
061-110	A11.a	Fire Research and Safety	R,E&D	6,182	6,638	6,597	6,651	6,676	6,826	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	5,741	4,048	3,948	3,932	3,889	3,958	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	5,881	2,843	2,811	2,824	2,824	2,884	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	3,407	3,848	3,779	3,781	3,760	3,834	
065-110	A11.e.	Aging Aircraft	R,E&D	19,807	18,621	17,962	17,765	17,412	17,673	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	3,306	1,512	1,476	1,472	1,457	1,483	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	8,099	7,999	7,815	7,794	7,719	7,861	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	4,883	5,292	5,174	5,162	5,116	5,211	
082-110	A11.i.	Air Traffic Control/Airway Facilities Human Factors	R,E&D	9,558	9,654	9,592	9,667	9,702	9,919	
086-110	A11.j.	Aeromedical Research	R,E&D	8,800	6,962	7,044	7,180	7,304	7,498	
041-110	A11.k.	Weather Program	R,E&D	20,376	19,545	18,551	18,150	17,543	17,728	
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	0	1,200	1,133	1,105	1,063	1,073	
027-110	A12.a.	Joint Planning and Development Office (JPDO)	R,E&D	17,919	18,100	17,262	16,943	16,445	16,641	
041-150	A12.b.	Wake Turbulence	R,E&D	2,273	3,066	2,915	2,855	2,764	2,795	
091-110/111/116	A13.a.	Environment and Energy	R,E&D	15,840	16,008	15,302	15,043	14,631	14,815	
011-130	A14.a.	System Planning and Resource Management	R,E&D	1,189	1,234	1,172	1,144	1,104	1,116	
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	3,359	3,430	3,467	3,532	3,591	3,685	
		TOTAL	**R,E&D**	**136,620**	**130,000**	**126,000**	**125,000**	**123,000**	**125,000**	
Facilities and Equipment (F&E)										
S09.02-00	1A01A	Runway Incursion Reduction	F&E ATD&P	6,440	8,000	5,000	5,000	5,000	0	
M08.28-00	1A01B	System Capacity, Planning and Improvement	F&E ATD&P	6,435	5,500	6,500	6,500	6,500	6,500	
M08.29-00	1A01C	Operations Concept Validation	F&E ATD&P	2,970	3,000	3,000	3,000	3,000	3,000	
M35.01-00	1A01D	General Aviation and Vertical Flight Technology (GA & VF)	F&E ATD&P	1,490	2,000	2,000	2,000	2,000	2,000	
M42.01-00	1A01E	Safer Skies	F&E ATD&P	3,370	3,600	3,000	3,000	3,000	3,000	
M08.27-00	1A01F	NAS Requirements	F&E ATD&P	790	800	2,000	2,000	3,200	3,300	
W10.01-00	1A01G	Wind Profiling and Weather Research Juneau	F&E ATD&P	3,130	1,100	0	0	0	0	
M08.28-02	1A01H	Airspace Management Lab	F&E ATD&P	6,930	4,000	4,000	4,000	4,000	4,000	
M08.28-04	1A01I	Airspace Redesign	F&E ATD&P	0	2,800	3,000	3,000	3,000	3,000	
M08.36-01	1A01J	Wake Turbulence	F&E ATD&P	3,960	1,000	0	0	0	0	
M34.01-00	--	Airports Technology - Capacity	F&E ATD&P	8,440	0	0	0	0	0	
M34.01-00	--	Airports Technology - Safety	F&E ATD&P	8,885	0	0	0	0	0	
M08.32-01	--	NAS Safety Assessment	F&E ATD&P	1,490	0	0	0	0	0	
M08.28-01	--	Separation Standards	F&E ATD&P	2,480	0	0	0	0	0	
--	--	Airfield Pavement Research	F&E ATD&P	3,960	0	0	0	0	0	/1
--	--	Fogeye	F&E ATD&P	495	0	0	0	0	0	/1
--	--	GPS Anti-Jam Technologies	F&E ATD&P	990	0	0	0	0	0	/1
--	--	Lithium Technologies to reduce ASR	F&E ATD&P	990	0	0	0	0	0	/1
--	--	Mobil Object Infrastructures Technology	F&E ATD&P	2,722	0	0	0	0	0	/1
--	--	Runway Obstruction Warning System	F&E ATD&P	990	0	0	0	0	0	/1
		Subtotal	**F&E ATD&P**	66,957	31,800	28,500	28,500	29,700	24,800	/2
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	F&E SF-21	14,360	16,800	20,000	20,000	20,000	20,000	
M36.02-00	--	Safe Flight 21 - Ohio River Valley	F&E SF-21	8,000	0	0	0	0	0	
M36.02-01	--	Surface Moving Maps	F&E SF-21	2,000	0	0	0	0	0	
S10.02-00	--	Automatic Dependent Surveillance Broadcast (ADS-B)	F&E SF-21	1,980	0	0	0	0	0	
		Subtotal	**F&E SF-21**	26,340	16,800	20,000	20,000	20,000	20,000	
M03.02-00	4A09A	Center for Advanced Aviation System Development (CAASD)	F&E CAASD	37,894	30,100	34,400	36,550	38,700	49,020	/3
		TOTAL	**F&E**	**131,191**	**78,700**	**82,900**	**85,050**	**88,400**	**93,820**	
Airport Improvement Program (AIP)										
--	--	Airports Technology Research - Capacity	AIP	0	8,503	8,503	8,503	8,503	8,503	
--	--	Airports Technology Research - Safety	AIP	0	9,367	9,367	9,367	9,367	9,367	
--	--	Airport Cooperative Research Program -- Capacity	AIP	4,950	5,000	5,000	5,000	5,000	5,000	/4
--	--	Airport Cooperative Research Program -- Safety	AIP	4,950	5,000	5,000	5,000	5,000	5,000	/4
		TOTAL	**AIP**	**9,900**	**27,870**	**27,870**	**27,870**	**27,870**	**27,870**	
Operations (Ops)										
--	--	Commercial Space Transportation Safety	Ops	75	125	125	125	125	125	
		TOTAL	**Ops**	**75**	**125**	**125**	**125**	**125**	**125**	
		GRAND TOTAL		**$277,786**	**$236,695**	**$236,895**	**$238,045**	**$239,395**	**$246,815**	

/1 Congressional earmark: Congress added this program into the FY 2006 budget.
/2 The amount shown for ATD&P reflects only R&D activities: it does not include acquisition, operational testing, or other non-R&D activities.
/3 The amount shown for CAASD includes only the R&D portion of the total CAASD line item amount. R&D represents 49.2% in FY 2006 and 43% in FY 2007-2011.
/4 Airport Cooperative Research Program - Safety and Airport Cooperative Research Program - Capacity are combined into a single white sheet write-up in Appendix A.

Appropriation Account

Table 3.1 shows the FAA R&D budget planned for FY 2007, including the five-year plan through 2011, grouped by appropriation account

Table 3.2
FAA R&D Program Budget by Sponsoring Organization

Project Number	FY 2007 Budget Line Item	Program	Appropriation Account	2006 Enacted Budget ($000)	2007 Requested ($000)	2008 Planned ($000)	2009 Planned ($000)	2010 Planned ($000)	2011 Planned ($000)	
Aviation Safety (AVS)										
061-110	A11.a	Fire Research and Safety	R,E&D	6,182	6,638	6,597	6,651	6,676	6,826	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	5,741	4,048	3,948	3,932	3,889	3,958	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	5,881	2,843	2,811	2,824	2,824	2,884	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	3,407	3,848	3,779	3,781	3,760	3,834	
065-110	A11.e.	Aging Aircraft	R,E&D	19,807	18,621	17,962	17,765	17,412	17,673	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	3,306	1,512	1,476	1,472	1,457	1,483	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	8,099	7,999	7,815	7,794	7,719	7,861	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	4,883	5,292	5,174	5,162	5,116	5,211	
086-110	A11.j.	Aeromedical Research	R,E&D	8,800	6,962	7,044	7,180	7,304	7,498	
041-110	A11.k.	Weather Program	R,E&D	0	0	18,551	18,150	17,543	17,728	/1
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	0	1,200	1,133	1,105	1,063	1,073	
		Subtotal	**R,E&D**	66,106	58,963	76,290	75,816	74,763	76,029	
M35.01-00	1A01D	General Aviation and Vertical Flight Technology (GA & VF)	F&E ATD&P	1,490	2,000	2,000	2,000	2,000	2,000	
M42.01-00	1A01E	Safer Skies	F&E ATD&P	3,370	3,600	3,000	3,000	3,000	3,000	
		Subtotal	**F&E**	4,860	5,600	5,000	5,000	5,000	5,000	
		Aviation Safety		**70,966**	**64,563**	**81,290**	**80,816**	**79,763**	**81,029**	
Air Traffic Organization (ATO)										
082-110	A11.i.	Air Traffic Control/Airway Facilities Human Factors	R,E&D	9,558	9,654	9,592	9,667	9,702	9,919	
041-110	A11.k.	Weather Program	R,E&D	20,376	19,545	0	0	0	0	/1
027-110	A12.a.	Joint Planning and Development Office (JPDO)	R,E&D	17,919	18,100	17,262	16,943	16,445	16,641	
041-150	A12.b.	Wake Turbulence	R,E&D	2,273	3,066	2,915	2,855	2,764	2,795	
011-130	A14.a.	System Planning and Resource Management	R,E&D	1,189	1,234	1,172	1,144	1,104	1,116	
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	3,359	3,430	3,467	3,532	3,591	3,685	
		Subtotal	**R,E&D**	54,674	55,029	34,408	34,141	33,606	34,156	
S09.02-00	1A01A	Runway Incursion Reduction	F&E ATD&P	6,440	8,000	5,000	5,000	5,000	0	
M08.28-00	1A01B	System Capacity, Planning and Improvement	F&E ATD&P	6,435	5,500	6,500	6,500	6,500	6,500	
M08.29-00	1A01C	Operations Concept Validation	F&E ATD&P	2,970	3,000	3,000	3,000	3,000	3,000	
M08.27-00	1A01F	NAS Requirements	F&E ATD&P	790	800	2,000	2,000	3,200	3,300	
W10.01-00	1A01G	Wind Profiling and Weather Research Juneau	F&E ATD&P	3,130	1,100	0	0	0	0	
M08.28-02	1A01H	Airspace Management Lab	F&E ATD&P	6,930	4,000	4,000	4,000	4,000	4,000	
M08.28-04	1A01I	Airspace Redesign	F&E ATD&P	0	2,800	3,000	3,000	3,000	3,000	
M08.36-01	1A01J	Wake Turbulence	F&E ATD&P	3,960	1,000	0	0	0	0	
M08.32-01	--	NAS Safety Assessment	F&E ATD&P	1,490	0	0	0	0	0	
M08.28-01	--	Separation Standards	F&E ATD&P	2,480	0	0	0	0	0	
--	--	Fogeye	F&E ATD&P	495	0	0	0	0	0	/2
--	--	GPS Anti-Jam Technologies	F&E ATD&P	990	0	0	0	0	0	/2
--	--	Mobil Object Infrastructures Technology	F&E ATD&P	2,722	0	0	0	0	0	/2
--	--	Runway Obstruction Warning System	F&E ATD&P	990	0	0	0	0	0	/2
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	F&E SF-21	14,360	16,800	20,000	20,000	20,000	20,000	
M36.02-00	--	Safe Flight 21 - Ohio River Valley	F&E SF-21	8,000	0	0	0	0	0	
M36.02-01	--	Surface Moving Maps	F&E SF-21	2,000	0	0	0	0	0	
S10.02-00	--	Automatic Dependent Surveillance Broadcast (ADS-B)	F&E SF-21	1,980	0	0	0	0	0	
M03.02-00	4A09A	Center for Advanced Aviation System Development (CAASD)	F&E CAASD	37,894	30,100	34,400	36,550	38,700	49,020	/3
		Subtotal	**F&E**	104,056	73,100	77,900	80,050	83,400	88,820	
		Air Traffic Organization		**158,730**	**128,129**	**112,308**	**114,191**	**117,006**	**122,976**	
Airports (ARP)										
M34.01-00	--	Airports Technology - Capacity	F&E ATD&P	8,440	0	0	0	0	0	
M34.01-00	--	Airports Technology - Safety	F&E ATD&P	8,885	0	0	0	0	0	
--	--	Airfield Pavement Research	F&E ATD&P	3,960	0	0	0	0	0	/2
--	--	Lithium Technologies to reduce ASR	F&E ATD&P	990	0	0	0	0	0	/2
		Subtotal	**F&E**	22,275	0	0	0	0	0	
--	--	Airports Technology Research - Capacity	AIP	0	8,503	8,503	8,503	8,503	8,503	
--	--	Airports Technology Research - Safety	AIP	0	9,367	9,367	9,367	9,367	9,367	
--	--	Airport Cooperative Research Program -- Capacity	AIP	4,950	5,000	5,000	5,000	5,000	5,000	
--	--	Airport Cooperative Research Program -- Safety	AIP	4,950	5,000	5,000	5,000	5,000	5,000	
		Subtotal	***AIP***	9,900	27,870	27,870	27,870	27,870	27,870	
		Airports		**32,175**	**27,870**	**27,870**	**27,870**	**27,870**	**27,870**	
Aviation Policy, Planning and Environment (AEP)										
091-110/111/116	A13.a.	Environment and Energy	R,E&D	15,840	16,008	15,302	15,043	14,631	14,815	
		Aviation Policy, Planning and Environment		**15,840**	**16,008**	**15,302**	**15,043**	**14,631**	**14,815**	
Commercial Space Transportation (AST)										
--	--	Commercial Space Transportation Safety	Ops	75	125	125	125	125	125	
		Commercial Space Transportation Safety		**75**	**125**	**125**	**125**	**125**	**125**	
		TOTAL		**$277,786**	**$236,695**	**$236,895**	**$238,045**	**$239,395**	**$246,815**	

/1 The ATO sponsors the Weather Program (R,E&D line item A11.k) in FY 2006-2007, but sponsorship transfers to AVS in FY 2008 and beyond.
/2 Congressional earmark: Congress added this program into the FY 2006 budget.
/3 The amount shown for CAASD includes only the R&D portion of the total CAASD line item amount. R&D represents 49.2% in FY 2006 and 43% in FY 2007-2011.

Sponsoring Organization

Table 3.2 shows the FAA R&D budget planned for FY 2007, including the five-year plan through 2011, grouped by sponsoring organization.

Table 3.3
FAA R&D Program Budget by **Research and Development Category**

Project Number	FY 2007 Budget Line Item	Program	Appropriation Account	2006 Enacted Budget ($000)	2007 Requested ($000)	2008 Planned ($000)	2009 Planned ($000)	2010 Planned ($000)	2011 Planned ($000)	
Applied Research										
061-110	A11.a	Fire Research and Safety	R,E&D	6,182	6,638	6,597	6,651	6,676	6,826	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	5,741	4,048	3,948	3,932	3,889	3,958	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	5,881	2,843	2,811	2,824	2,824	2,884	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	3,407	3,848	3,779	3,781	3,760	3,834	
065-110	A11.e.	Aging Aircraft	R,E&D	19,807	18,621	17,962	17,765	17,412	17,673	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	3,306	1,512	1,476	1,472	1,457	1,483	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	8,099	7,999	7,815	7,794	7,719	7,861	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	4,883	5,292	5,174	5,162	5,116	5,211	
082-110	A11.i.	Air Traffic Control/Airway Facilities Human Factors	R,E&D	9,558	9,654	9,592	9,667	9,702	9,919	
086-110	A11.j.	Aeromedical Research	R,E&D	8,800	6,962	7,044	7,180	7,304	7,498	
041-110	A11.k.	Weather Program	R,E&D	20,376	19,545	18,551	18,150	17,543	17,728	
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	0	1,200	1,133	1,105	1,063	1,073	
027-110	A12.a.	Joint Planning and Development Office (JPDO)	R,E&D	17,919	18,100	17,262	16,943	16,445	16,641	
041-150	A12.b.	Wake Turbulence	R,E&D	2,273	3,066	2,915	2,855	2,764	2,795	
091-110/111/116	A13.a.	Environment and Energy	R,E&D	15,840	16,008	15,302	15,043	14,631	14,815	
011-130	A14.a.	System Planning and Resource Management	R,E&D	1,189	1,234	1,172	1,144	1,104	1,116	
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	3,359	3,430	3,467	3,532	3,591	3,685	
		Subtotal	**R,E&D**	136,620	130,000	126,000	125,000	123,000	125,000	
M03.02-00	4A09A	Center for Advanced Aviation System Development (CAASD)	F&E CAASD	37,894	30,100	34,400	36,550	38,700	49,020	/1
		Subtotal	**F&E**	37,894	30,100	34,400	36,550	38,700	49,020	
--	--	Airport Cooperative Research Program -- Capacity	AIP	4,950	5,000	5,000	5,000	5,000	5,000	
--	--	Airport Cooperative Research Program -- Safety	AIP	4,950	5,000	5,000	5,000	5,000	5,000	
		Subtotal	**AIP**	9,900	10,000	10,000	10,000	10,000	10,000	
--	--	Commercial Space Transportation Safety	Ops	38	63	63	63	63	63	/2
		Subtotal	**Ops**	38	63	63	63	63	63	
		Applied Research		**184,451**	**170,163**	**170,463**	**171,613**	**171,763**	**184,083**	
		Percent *Applied Research*		**66.4%**	**71.9%**	**72.0%**	**72.1%**	**71.7%**	**74.6%**	
Development										
S09.02-00	1A01A	Runway Incursion Reduction	F&E ATD&P	6,440	8,000	5,000	5,000	5,000	0	
M08.28-00	1A01B	System Capacity, Planning and Improvement	F&E ATD&P	6,435	5,500	6,500	6,500	6,500	6,500	
M08.29-00	1A01C	Operations Concept Validation	F&E ATD&P	2,970	3,000	3,000	3,000	3,000	3,000	
M35.01-00	1A01D	General Aviation and Vertical Flight Technology (GA & VF)	F&E ATD&P	1,490	2,000	2,000	2,000	2,000	2,000	
M42.01-00	1A01E	Safer Skies	F&E ATD&P	3,370	3,600	3,000	3,000	3,000	3,000	
M08.27-00	1A01F	NAS Requirements	F&E ATD&P	790	800	2,000	2,000	3,200	3,300	
W10.01-00	1A01G	Wind Profiling and Weather Research Juneau	F&E ATD&P	3,130	1,100	0	0	0	0	
M08.28-02	1A01H	Airspace Management Lab	F&E ATD&P	6,930	4,000	4,000	4,000	4,000	4,000	
M08.28-04	1A01I	Airspace Redesign	F&E ATD&P	0	2,800	3,000	3,000	3,000	3,000	
M08.36-01	1A01J	Wake Turbulence	F&E ATD&P	3,960	1,000	0	0	0	0	
M34.01-00	--	Airports Technology - Capacity	F&E ATD&P	8,440	0	0	0	0	0	
M34.01-00	--	Airports Technology - Safety	F&E ATD&P	8,885	0	0	0	0	0	
M08.32-01	--	NAS Safety Assessment	F&E ATD&P	1,490	0	0	0	0	0	
M08.28-01	--	Separation Standards	F&E ATD&P	2,480	0	0	0	0	0	
--	--	Airfield Pavement Research	F&E ATD&P	3,960	0	0	0	0	0	/3
--	--	Fogeye	F&E ATD&P	495	0	0	0	0	0	/3
--	--	GPS Anti-Jam Technologies	F&E ATD&P	990	0	0	0	0	0	/3
--	--	Lithium Technologies to reduce ASR	F&E ATD&P	990	0	0	0	0	0	/3
--	--	Mobil Object Infrastructures Technology	F&E ATD&P	2,722	0	0	0	0	0	/3
--	--	Runway Obstruction Warning System	F&E ATD&P	990	0	0	0	0	0	/3
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	F&E SF-21	14,360	16,800	20,000	20,000	20,000	20,000	
M36.02-00	--	Safe Flight 21 - Ohio River Valley	F&E SF-21	8,000	0	0	0	0	0	
M36.02-01	--	Surface Moving Maps	F&E SF-21	2,000	0	0	0	0	0	
S10.02-00	--	Automatic Dependent Surveillance Broadcast (ADS-B)	F&E SF-21	1,980	0	0	0	0	0	
		Subtotal	**F&E**	93,297	48,600	48,500	48,500	49,700	44,800	
--	--	Airports Technology Research - Capacity	AIP	0	8,503	8,503	8,503	8,503	8,503	
--	--	Airports Technology Research - Safety	AIP	0	9,367	9,367	9,367	9,367	9,367	
		Subtotal	**AIP**	0	17,870	17,870	17,870	17,870	17,870	
--	--	Commercial Space Transportation Safety	Ops	38	63	63	63	63	63	/2
		Subtotal	**Ops**	38	63	63	63	63	63	
		Development		**93,335**	**66,533**	**66,433**	**66,433**	**67,633**	**62,733**	
		Percent *Development*		**33.6%**	**28.1%**	**28.0%**	**27.9%**	**28.3%**	**25.4%**	
		TOTAL		**$277,786**	**$236,695**	**$236,895**	**$238,045**	**$239,395**	**$246,815**	

/1 The amount shown for CAASD includes only the R&D portion of the total CAASD line item amount. R&D represents 49.2% in FY 2006 and 43% in FY 2007-2011.
/2 The Commercial Space Transportation Program is 50 percent applied research and 50 percent development or $37.5K for FY 2006 and $62.5 for FY 2007-2011, which is rounded to $38K for FY 2006 and $63 for FY 2007-2011.

R&D Category

Table 3.3 shows the FAA R&D program by research and development category for FY 2006-2011, including the percent applied research and percent development.

Table 3.4
FAA R&D Program Budget by Performance Goals
(Organized According to Exhibit IV of the FAA FY 2007 Budget Request)

Project Number	FY 2007 Budget Line Item	Program	Appropriation Account	FY 2007 Contract Costs ($000)	FY 2007 Personnel Costs ($000)	FY 2007 Other In-house Costs ($000)	FY 2007 Total Planned ($000)	
1. SAFETY								
a. Reduce Commercial Air Carrier Fatal Accident Rate								
061-110	A11.a	Fire Research and Safety	R,E&D	2,816	3,588	234	6,638	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	2,592	1,366	90	4,048	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	1,376	1,394	73	2,843	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	2,158	1,614	76	3,848	
065-110	A11.e.	Aging Aircraft	R,E&D	14,211	4,159	251	18,621	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	947	533	32	1,512	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	4,954	2,902	143	7,999	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	3,232	1,947	113	5,292	
082-110	A11.i.	Air Traffic Control/Airway Facilities Human Factors	R,E&D	4,130	5,285	239	9,654	
086-110	A11.j.	Aeromedical Research	R,E&D	1,504	5,313	145	6,962	
041-110	A11.k.	Weather Program	R,E&D	18,432	1,035	78	19,545	
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	1,200	0	0	1,200	
011-130	A14.a.	System Planning and Resource Management	R,E&D	838	27	2	868	/1
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	548	1,818	47	2,413	/1
		Subtotal	**R,E&D**	58,938	30,981	1,523	91,443	/2
S09.02-00	1A01A	Runway Incursion Reduction	F&E ATD&P	8,000	0	0	8,000	
M42.01-00	1A01E	Safer Skies	F&E ATD&P	3,600	0	0	3,600	
W10.01-00	1A01G	Wind Profiling and Weather Research Juneau	F&E ATD&P	1,100	0	0	1,100	
		Subtotal	**F&E**	12,700	0	0	12,700	
--	--	Airports Technology Research - Safety	AIP	7,653	1,318	0	8,971	/3
--	--	Airport Cooperative Research Program -- Safety	AIP	4,933	67	0	5,000	
		Subtotal	**AIP**	12,586	1,385	0	13,971	
		Reduce the Commercial Air Carrier Fatal Accident Rate		**84,224**	**32,366**	**1,523**	**118,114**	
b. Reduce the Number of General Aviation Fatal Accidents								
M35.01-00	1A01D	General Aviation and Vertical Flight Technology (GA & VF)	F&E ATD&P	2,000	0	0	2,000	
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	F&E SF-21	16,800	0	0	16,800	
		Subtotal	**F&E**	18,800	0	0	18,800	
--	--	Airports Technology Research - Safety	AIP	396	0	0	396	/3
		Reduce the Number of General Aviation Fatal Accidents		**19,196**	**0**	**0**	**19,196**	
c. Maintain Zero Commercial Space Transportation Accidents								
--	--	Commercial Space Transportation Safety	Ops	94	31	0	125	
		Maintain Zero Commercial Space Transportation Accidents		**94**	**31**	**0**	**125**	
		TOTAL SAFETY		**103,514**	**32,397**	**1,523**	**137,435**	
2. MOBILITY								
a. Increase Percent of On-time Arrivals								
027-110	A12.a.	Joint Planning and Development Office (JPDO)	R,E&D	16,112	1,867	121	18,100	
041-150	A12.b.	Wake Turbulence	R,E&D	2,833	222	11	3,066	
011-130	A14.a.	System Planning and Resource Management	R,E&D	201	7	1	208	/1
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	132	436	11	579	/1
		Subtotal	**R,E&D**	19,278	2,532	144	21,954	/2
M08.28-00	1A01B	System Capacity, Planning and Improvement	F&E ATD&P	5,500	0	0	5,500	
M08.29-00	1A01C	Operations Concept Validation	F&E ATD&P	3,000	0	0	3,000	
M08.27-00	1A01F	NAS Requirements	F&E ATD&P	800	0	0	800	
M08.28-02	1A01H	Airspace Management Lab	F&E ATD&P	4,000	0	0	4,000	
M08.36-01	1A01J	Wake Turbulence	F&E ATD&P	1,000	0	0	1,000	
M08.28-04	1A01I	Airspace Redesign	F&E ATD&P	2,800	0	0	2,800	
M03.02-00	4A09A	Center for Advanced Aviation System Development (CAASD)	F&E CAASD	30,100	0	0	30,100	/4
		Subtotal	**F&E**	47,200	0	0	47,200	
--	--	Airports Technology Research - Capacity	AIP	7,185	1,318	0	8,503	
--	--	Airport Cooperative Research Program -- Capacity	AIP	5,000	0	0	5,000	
		Subtotal	**AIP**	12,185	1,318	0	13,503	
		Increase Percent of On-time Arrivals		**78,663**	**3,850**	**144**	**82,657**	
		TOTAL MOBILITY		**78,663**	**3,850**	**144**	**82,657**	
4. ENVIRONMENT								
091-110/111/116	A13.a.	Environment and Energy	R,E&D	13,833	2,005	170	16,008	
011-130	A14.a.	System Planning and Resource Management	R,E&D	152	5	0	158	/1
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	99	330	9	438	/1
		Subtotal	**R,E&D**	14,085	2,340	179	16,604	/2
		TOTAL ENVIRONMENT		**14,085**	**2,340**	**179**	**16,604**	
		GRAND TOTAL		**196,262**	**38,587**	**1,846**	**236,695**	

Notes:

/1 System Planning and Resource Management and William J. Hughes Technical Center Laboratory Facility are considered Mission Support for the R,E&D program and are pro-rated across the three goals areas as follows: Safety at 70 percent; Mobility at 17 percent; and Environment at 13 percent. The total other in-house costs for Systems Planning and Resource Management is $3K, which is divided three ways and rounded to the nearest thousand so one entry appears as zero due to rounding.

/2 Personnel for R,E&D measured in full time equivalents is as follows: 266 for Safety; 13 for Mobility; and 19 for Environment.

/3 The Airport Technology Research - Safety program total budget request is divided between reducing the commercial air carrier fatal accident rate ($8,971K) and reducing the number of general aviation fatal accidents ($396K).

/4 The budget request amount shown for CAASD is only the R&D program portion of the total CAASD line item amount (43% of the total CAASD line item).

/5 Many R&D programs apply to more than one goal area; however, for budgeting purposes most programs are included in only one goal area.

Performance Goals

Table 3.4 shows the FAA R&D budget by performance goal as defined in Exhibit IV of the FAA budget request for FY 2007.

Partnerships

3.4 Partnerships

The FAA enhances and expands its R&D capabilities by partnering with other government, academic, or industry organizations. Such partnerships help leverage critical national capabilities, ensuring the FAA's R&D program attains its goals.

Federal Government

Other federal departments and agencies conduct aviation-related R&D that directly or indirectly supports the FAA goals and objectives. To leverage this R&D, the FAA enters into many cooperative-working arrangements through formal agreements, such as memoranda of understanding/agreement (MOU/MOA), cooperative efforts, such as interagency integrated product teams, and technical coordination, such as on-site personnel at field offices at other federal research laboratories and centers. The establishment of the multi-agency JPDO reflects a new effort by the government to leverage the R&D capabilities of multiple agencies to transform the nation's air transportation system over the long-term.

Memoranda of Understanding/ Agreement

Joint research activities are performed via MOUs/MOAs that set forth areas for cooperative endeavor. An MOU is a high-level agreement describing a broad area of R&D that fosters cooperation between departments or agencies and develops a basis for establishing joint research activities. An MOA is an agreement describing a specific area of R&D and is used to implement a broader MOU. The FAA MOUs/MOAs with the National Aeronautics and Space Administration (NASA) and the Department of Defense are listed in Appendix B.

R&D Field Offices

The FAA has R&D field offices at two NASA research centers to foster and provide technical coordination of research that contributes to the modernization and safety enhancements in the NAS. The first field office opened in 1971 at NASA's Ames Research Center located in Moffett Field, California. The second field office, located at NASA's Langley Research Center in Hampton, Virginia, opened in 1978. Both offices report directly to the FAA headquarters in Washington, D.C. Additional information can be found at http://faa-www.larc.nasa.gov (government only).

Joint Planning and Development Office

The JPDO provides government-wide planning and coordination for aviation R&D. The JPDO is working with the Departments of Defense, Transportation, Homeland Security, and Commerce, FAA, NASA, and the Office of Science and Technology Policy to plan federal aviation R&D strategically and to focus it on the long-term needs of the nation's air transportation system. To help define the next generation air transportation system, the JPDO has created eight Integrated Product Teams (IPTs). For more information on the JPDO and IPTs see http://www.jpdo.aero.

The Climate Change Science Program

Thirteen federal departments and agencies participate in the U.S. Climate Change Science Program to coordinate scientific research through a set of seven linked interdisciplinary research elements that, together, support scientific research across a wide range of related climate and global change issues. These research elements pertain to major components of the Earth's environmental and human systems, which are undergoing changes caused by a variety of natural and human-induced causes. *The Climate Change Science Program Strategic Plan*[5] contains a more detailed discussion

[5] *Strategic Plan for the Climate Change Science Program*, report by the Climate Change Science Program and the Subcommittee on Climate Change Research, July 2003.

of the research elements and a set of strategic research questions associated with each element. The research elements include: atmospheric composition; ecosystems; global carbon cycle; land use and cover change; human contribution and response; climate variability and change; and global water cycle. The FAA plays a key role in helping to understand the impact of aviation on the environment and, in particular, the impact on the troposphere.

Global Earth Observation System of Systems

Over the next decade, a Global Earth Observation System of Systems (GEOSS) will revolutionize our understanding of the Earth and how it works. With benefits as broad as the planet itself, this U.S.-led initiative promises to make peoples and economies around the globe healthier, safer and better equipped to manage basic daily needs. The aim is to make 21st century technology as interrelated as the planet it observes, predicts and protects, providing the science on which sound policy and decision-making must be built. The U.S. and other developed nations have a unique role in developing and maintaining the system, collecting data, enhancing data distribution, and providing models to help all of the world's nations. For example, today in the United States, weather is responsible for about two-thirds of aviation delays in the U.S. at a cost of approximately $4 billion annually. It is estimated that $1.7 billion of this cost would be avoided with better observation and forecasts. Within the federal government, GEOSS provides an umbrella for 15 federal departments and agencies and several White House offices to work collaboratively to address a wide range of environmental issues pertaining to aviation, including enhanced weather observation, modeling and forecasting, air and water quality monitoring, and emissions. Under GEOSS, the Environmental Protection Agency and the FAA work together to address air quality and emissions issues facing aviation, helping the FAA in its regulatory compliance mission. For additional information see: www.epa.gov/geoss.

Center for Climate Change and Environmental Forecasting

The U.S. Department of Transportation Center for Climate Change and Environmental Forecasting is a "virtual" center within the department that brings together all operating administrations to promote a better understanding of the links between transportation and the climate. The center performs activities that will increase transportation energy efficiency, reduce green house gas emissions, improve our understanding of the potential impacts of climate change on transportation, and enable the department and its operating administrations to participate more effectively in domestic and international climate change policy forums. The FAA participates in the center's activities, especially those dealing with climate issues within a multi-modal context. http://climate.volpe.dot.gov/

Government and Industry

The FAA technology transfer activities meet the objectives of the Stevenson-Wydler Technology Innovation Act of 1980, the Bayh-Dole Act of 1980, the Federal Technology Transfer Act of 1986, the National Cooperative Research and Production Act of 1993, and Executive Orders 12591 and 12618: Facilitating Access to Science and Technology. The purpose is to transfer knowledge, intellectual property, facilities, equipment, or other capabilities developed by federal laboratories or agencies to the private sec-

tor. The FAA uses various mechanisms to transfer its R&D results including Cooperative Research and Development Agreements (CRDAs), Small Business Innovation Research (SBIR) contracts, and patents. Appendix B provides a list of current FAA CRDAs, SBIR awards, and patents.

Cooperative Research and Development Agreements

The use of CRDAs allow the FAA to share facilities, equipment, services, intellectual property, personnel resources, and other resources with private industry, academia, or state/local government agencies.

Contracts

The FAA R&D contracts range from conducting applied research studies to developing, prototyping, demonstrating, and testing new hardware and software. The FAA also makes contracts with small businesses in compliance with the terms of the Small Business Innovation Research Program. For information on how to contract to do business with the FAA, please see: http://www.asu.faa.gov/faaco/kenproj.htm or http://www.eps.gov.

Patents

As part of its commitment to assist industry through technology transfer, the FAA encourages the commercialization of its R&D products or results, known as intellectual property. Among the most transferred intellectual property are inventions, which may be protected by patents.

Government and Academia

The FAA also has an aggressive program to foster research and innovative aviation solutions through the nation's colleges and universities. By doing so, it not only leverages the nation's significant investment in basic and applied research but also helps to build the next generation of aerospace engineers, managers and operators. The FAA does this through the following mechanisms:

Joint University Program

The FAA/NASA Joint University Program for Air Transportation Research is a long-term cooperative research partnership among three universities (Ohio University, the Massachusetts Institute of Technology, and Princeton University) to conduct aviation-related scientific and engineering research. The FAA and NASA benefit directly from the results of specific research projects and the valuable feedback from university researchers regarding the goals and effectiveness of government programs.

Aviation Research Grants

All colleges, universities, and legally incorporated non-profit research institutions qualify for the FAA research grants. The FAA grant-funded research may use any scientific methodology deemed appropriate by the grantee. The evaluation criteria for grant proposals include the potential application of research results to the FAA's long-term goals for civil aviation technology. For additional information on the FAA's research grant program, see http://www.tc.faa.gov/logistics/grants.

Air Transportation Centers of Excellence

The FAA currently has seven Centers of Excellence (COEs) through cooperative agreements with academic institutions to assist in mission-critical research and technology. Through these long-term collaborative, cost-sharing efforts, the government and university/industry teams leverage each other's resources to advance the technological future of the nation's aviation community. More information on the FAA aviation research grants and COEs can be found in Appendix B and at http://www.coe.faa.gov.

International

EUROCONTROL

EUROCONTROL is the European Organization for the Safety of Air Navigation. The primary objective of this civil and military organization is to develop a seamless, pan-European air traffic management (ATM) system. In 1986, EUROCONTROL and the FAA established the first memorandum of cooperation (MoC), which they updated in 1992 and again in 2004. The aim of the MoC and its governance structure is to broaden the scope of the cooperation between the two organizations and their respective partners in the areas of ATM research, strategic ATM analysis, technical harmonization, operational harmonization, and harmonizing safety and environment factors.

Transport Canada

In the spring of 2004, Transport Canada joined the FAA and NASA as a sponsor of the PARTNER (Partnership for AiR Transportation Noise and Emissions Reduction) Center of Excellence. Transport Canada has studied air quality at Canadian airports for a number of years, and will continue to look at ways to implement responsible practices on and around the airfield that can reduce the contribution of airports to air pollution. Canada, as a member state of the International Civil Aviation Organization, is working to reduce smog-forming pollutants from the aviation sector and sees the partnership in the COE as a means of advancing the state of knowledge in many key areas.

evaluation

Evaluation

3.5 Evaluation

Since R&D tends to be long-term in nature, it does not lend itself to traditional return-on-investment analysis, such as net present value. As a result, R&D is evaluated in terms of its quality, relevance, and performance. Today, we accomplish this through both formal and informal reviews performed by internal and external groups. We intend to strengthen the review process in the future and to evaluate how the R&D program is performing against the master schedule presented in Chapter 2. Ultimately, the NARP will show how R&D supports the FAA near- and long-term goals and objectives as well as how well we are doing to achieve them using both internal and external reviews.

Internal Program Reviews

The FAA R&D program receives continuous internal review to ensure that it meets customer needs, is high quality, and is well managed.

Integrated Capability Maturity Model (iCMM®)

The FAA uses the iCMM® to evaluate and improve the quality of its processes. ICMM® provides a single model of best practice for enterprise-wide improvement. It integrates the following standards and models: ISO 9001:2000, EIA/IS 731, Malcolm Baldrige National Quality Award and President's Quality Award criteria, CMMI-SE/SW/IPPD and CMMI-A, ISO/IEC TR 15504, ISO/IEC 12207, and ISO/IEC CD 15288. As a result of an internal review, the Office of Aviation R&D created a Portfolio Development Process Guidance/Reference Document to improve its management processes. Under an FAA iCMM® appraisal, these processes were rated at level 2 and 3.

Program Planning Teams

To ensure effective engagement with research stakeholders, the FAA Office of Aviation R&D uses program planning teams comprised of internal sponsors and researchers to review program outcomes and outputs, prioritize and plan research efforts, and recommend research priorities and programs.

R&D Executive Board

When R&D program formulation is complete, the FAA R&D Executive Board (REB) provides program approval. The REB is made up of senior executives representing the major FAA R&D sponsors. This process helps the FAA establish research priorities to meet its strategic goals and objectives.

Joint Resources Council

The Joint Resources Council (JRC) is the FAA's corporate-level, acquisition decision-making body that provides strategic guidance to the R&D portfolio process and ensures that the research requirements support the FAA national airspace system program. The JRC reviews and approves the proposed R&D portfolios in the four R&D appropriations accounts.

External Program Reviews

The FAA R&D program receives continuous external review to ensure that it meets customer needs and is technically sound. The FAA also seeks feedback through user surveys and discussion groups; presents progress reports at public forums and science reviews; publishes and presents technical papers; obtains formal peer validation of science; trains specific users on product usage; and maintains and shares lessons learned.

Research, Engineering and Development Advisory Committee

Established in 1989, the Research, Engineering and Development Advisory Committee (REDAC) advises the Administrator on R&D issues and coordinates the FAA's R,E&D activities with other government agencies and industry. The committee considers aviation research needs in six areas: air traffic services; airport technology; aircraft safety; aviation security; human factors; and environment; and energy.[6] A maximum of 30 members serve two-year terms on the Committee. Members represent corporations, universities, associations, consumers and government agencies. The Director of Operations Planning Aviation R & D serves as the executive director of the committee. Information on the REDAC is available on-line at http://research.faa.gov/redac.

During 2005, the REDAC held two committee meetings, fourteen subcommittee meetings, and ten working group meetings. The REDAC produced three reports: *Guidance for FAA Fiscal Year 2007 R&D*, November 15, 2004; *Transitioning Air Traffic Management Research into Operational Capabilities,* March 31, 2005 (Preliminary findings); and *Review of FAA Fiscal Year 2007 R&D Program Plans,* May 2, 2005. Appendix C contains the REDAC recommendations sent to the FAA Administrator in these reports and the Agency's responses.

National Academy Aeronautics and Space Engineering Board

The National Academy of Science established the Aeronautics and Space Engineering Board (ASEB) in 1967 to focus talents and energies of the engineering community on significant aerospace policies and programs. It recommends priorities and procedures for achieving aerospace engineering objectives and offers a way to bring engineering and other related expertise to bear on aerospace issues of national importance. In addition, the ASEB serves as a catalyst for introducing scientific and engineering ideas into existing aerospace programs.[7] The Board's primary sponsors are NASA's Aeronautics Research Mission Directorate and the Exploration Systems Mission Directorate. The Board also performs technical and policy studies for the FAA, the National Transportation Safety Board, the Government Accountability Office, the Defense Threat Reduction Agency, Air Force Space Command, and the Air Force Office of Scientific Research.

During 2005, the ASEB was asked to form a committee to assess the first edition of the *Next Generation Air Transportation System (NGATS) Integrated Plan,* which the JPDO submitted to Congress in December 2004. The final committee report, entitled *Technology Pathways – Assessing the Integrated Plan for the Next Generation Air Transportation System,* provides: a review of the vision and goals, the operational concepts, and the R&D roadmap developed by the Integrated Plan; an analysis of the JPDO integrated product teams; and an assessment of the implementation process. For a copy of the report, see: http://www7.nationalacademies.org/aseb/index.html.

[6] Aviation Safety Research Act of 1988, Public Law Number 100-591, November 3, 1988, and the FAA Research, Engineering and Development Authorization Act of 1990, Public Law Number 101-508, November 5, 1990.

[7] http://www7.nationalacademies.org/aseb/history_of_ASEB.html

acronyms & abbre

Acronyms & Abbreviations

A	
ADS-B	Automatic Dependent Surveillance – Broadcast
AEP	[FAA – Staff Office] Aviation Policy, Planning and Environment
AFIB	Atrial fibrillation
AIP	[FAA Budget Appropriations] Airport Improvement Program
ARP	[FAA – Line of Business] Airports
ASEB	National Academy Aeronautics and Space Engineering Board
ASR	Alkali Silica Reactivity
AST	[FAA – Line of Business] Commercial Space Transportation
ATD&P	Advanced Technology Development and Prototyping
ATM	Air Traffic Management
ATO	[FAA – Line of Business] Air Traffic Organization
AVS	[FAA – Line of Business] Aviation Safety
C	
CAASD	[MITRE] Center for Advanced Aviation System Development
CDA	Continuous-descent Approach
COE	Center of Excellence
CONUS	Continental United States
CRDA	Cooperative Research and Development Agreement
D	
DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOT	Department of Transportation
E	
EA	Enterprise Architecture
EDS	Environmental Design Space
EPA	Environmental Protection Agency
EUROCONTROL	European Organization for the Safety of Air Navigation
F	
F&E	[FAA Budget Appropriations] Facilities and Equipment
FAA	Federal Aviation Administration
FOD	Foreign Object Debris
FY	Fiscal Year
G	
GA&VF	General Aviation and Vertical Flight Technology
GEOSS	Global Earth Observation System of Systems
GPS	Global Positioning System
I	
ICAO	International Civil Aviation Organization
iCMM®	Integrated Capability Maturity Model
IEC	International Electrotechnical Commission
ISO	International Standards Organization

viations

J	
JPDO	Joint Planning and Development Office
JRC	[FAA] Joint Resources Council
L	
LAAS	Local-Area Augmentation System
M	
MOA	Memorandum of Agreement
MoC	Memorandum of Cooperation
MOU	Memorandum of Understanding
N	
NARP	National Aviation Research Plan
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NEXRAD	Next-Generation Weather Radar
NGATS	Next Generation Air Transportation System
NOx	Oxides of nitrogen
NTSB	National Transportation Safety Board
O	
Ops	[FAA Budget Appropriation] Operations
OSTP	[Executive Office of the President] Office of Science and Technology Policy
P	
PARTNER	Partnership for AiR Transportation Noise and Emissions Reduction
R	
R&D	Research and Development
REB	[FAA] Research and Development Executive Board
R,E&D	[FAA Budget Appropriation] Research, Engineering and Development
REDAC	[FAA] Research, Engineering and Development Advisory Committee
RTCA	Formerly Radio Technical Commission for Aeronautics
S	
SATS	Small Aircraft Transportation System
SBIR	Small Business Innovation Research
SF	Safe Flight
T	
TRACON	Terminal Radar Approach Control
U	
UAS	Unmanned Aircraft Systems
UTW	Ultra-thin white
W	
WAAS	Wide-Area Augmentation System
WJHTC	William J. Hughes Technical Center