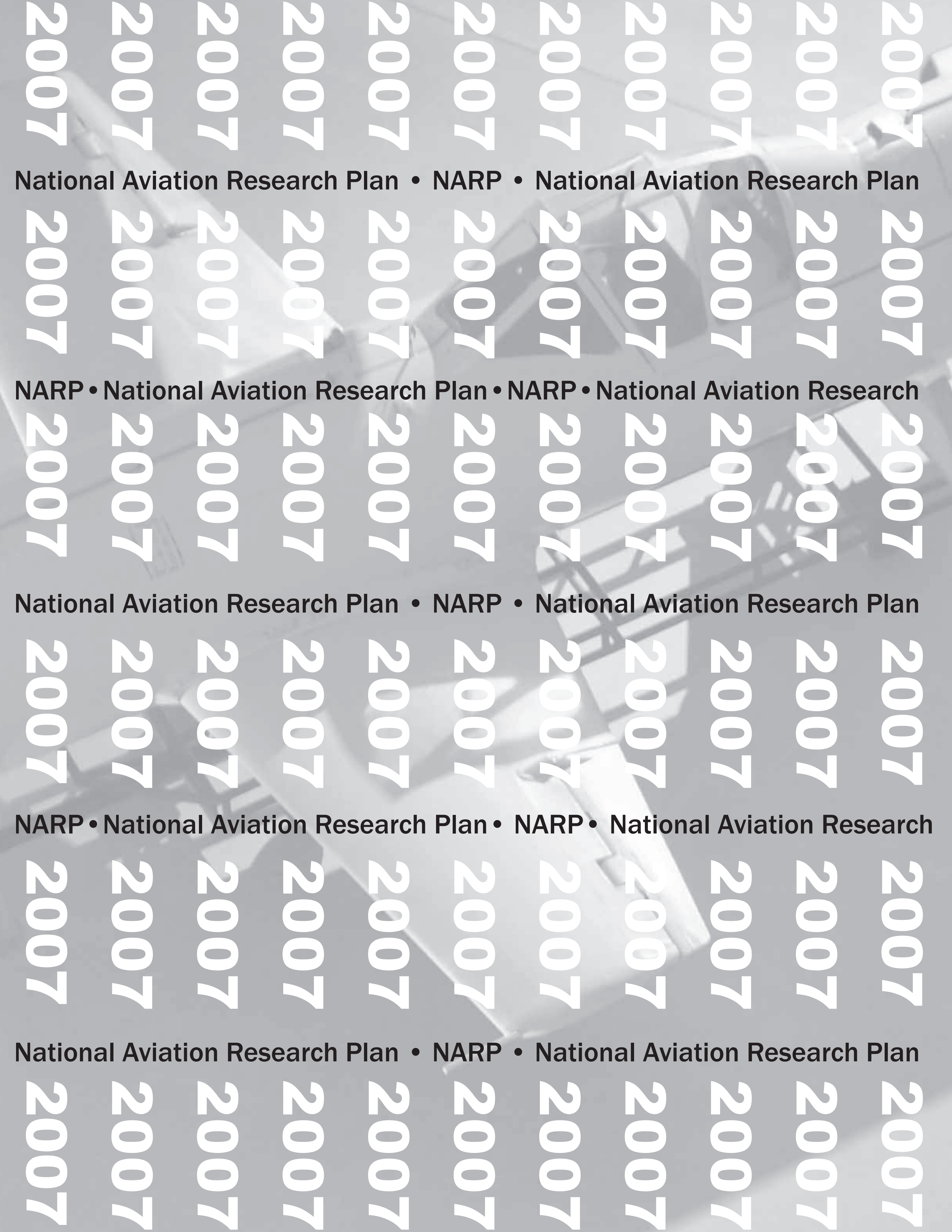
Federal Aviation Administration

NARP

2007 National Aviation Research Plan

February 2007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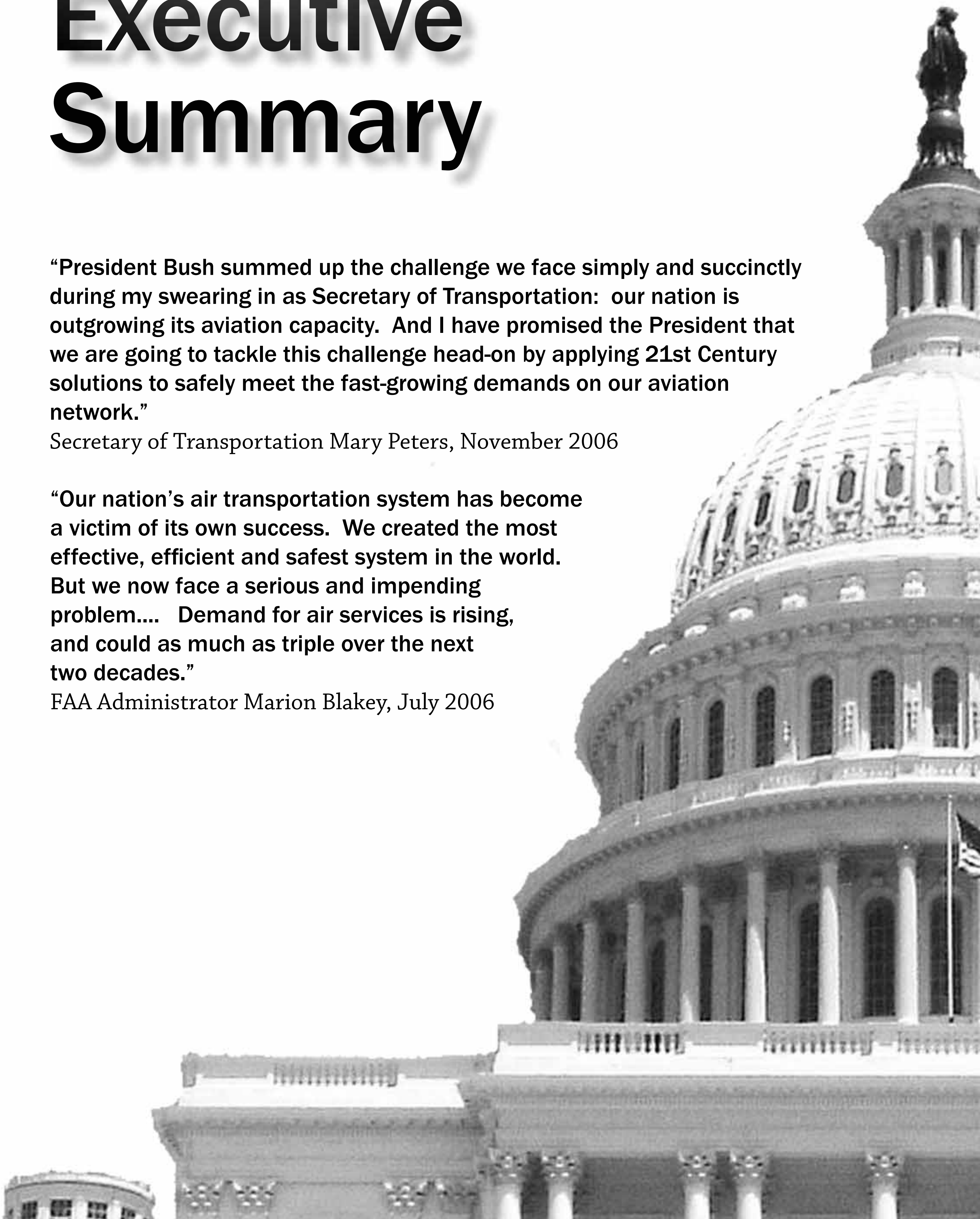
The National Aviation Research Plan (NARP) is a report of the Federal Aviation Administration to the United States Congress pursuant to 49 United States Code 44501(c). The NARP is available on the Internet at http://nasdocs.faa.gov or research.faa.gov.

Photos by Lockett Yee.

Executive Summary



"President Bush summed up the challenge we face simply and succinctly during my swearing in as Secretary of Transportation: our nation is outgrowing its aviation capacity. And I have promised the President that we are going to tackle this challenge head-on by applying 21st Century solutions to safely meet the fast-growing demands on our aviation network."
Secretary of Transportation Mary Peters, November 2006

"Our nation's air transportation system has become a victim of its own success. We created the most effective, efficient and safest system in the world. But we now face a serious and impending problem.... Demand for air services is rising, and could as much as triple over the next two decades."
FAA Administrator Marion Blakey, July 2006

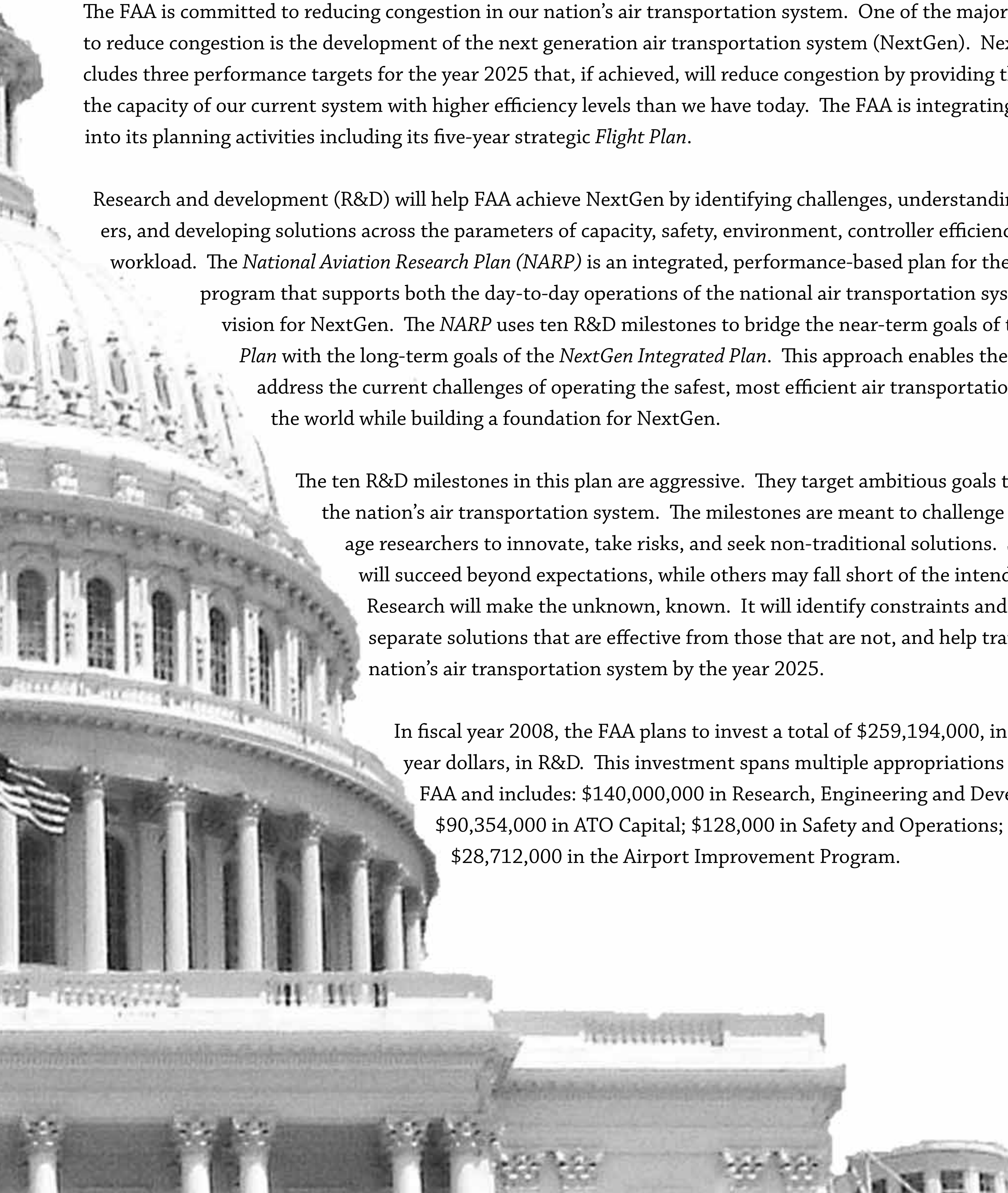
Aviation is a vital national resource for the United States. It provides opportunities for business, jobs, economic development, law enforcement, emergency response, and personal travel and leisure. It attracts investment to local communities and opens up new domestic and international markets and supply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

The FAA is committed to reducing congestion in our nation's air transportation system. One of the major initiatives to reduce congestion is the development of the next generation air transportation system (NextGen). NextGen includes three performance targets for the year 2025 that, if achieved, will reduce congestion by providing three-times the capacity of our current system with higher efficiency levels than we have today. The FAA is integrating NextGen into its planning activities including its five-year strategic *Flight Plan*.

Research and development (R&D) will help FAA achieve NextGen by identifying challenges, understanding barriers, and developing solutions across the parameters of capacity, safety, environment, controller efficiency, and pilot workload. The *National Aviation Research Plan (NARP)* is an integrated, performance-based plan for the FAA R&D program that supports both the day-to-day operations of the national air transportation system and the vision for NextGen. The *NARP* uses ten R&D milestones to bridge the near-term goals of the *Flight Plan* with the long-term goals of the *NextGen Integrated Plan*. This approach enables the FAA to address the current challenges of operating the safest, most efficient air transportation system in the world while building a foundation for NextGen.

The ten R&D milestones in this plan are aggressive. They target ambitious goals to transform the nation's air transportation system. The milestones are meant to challenge and encourage researchers to innovate, take risks, and seek non-traditional solutions. Some results will succeed beyond expectations, while others may fall short of the intended target. Research will make the unknown, known. It will identify constraints and barriers, separate solutions that are effective from those that are not, and help transform our nation's air transportation system by the year 2025.

In fiscal year 2008, the FAA plans to invest a total of $259,194,000, in current year dollars, in R&D. This investment spans multiple appropriations for the FAA and includes: $140,000,000 in Research, Engineering and Development; $90,354,000 in ATO Capital; $128,000 in Safety and Operations; and $28,712,000 in the Airport Improvement Program.



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 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[1] and is funded in four appropriations accounts: Research, Engineering and Development; ATO Capital; Airport Improvement Program; and Safety and Operations.

The *NARP* is evolving. The *2005 NARP* aligned the FAA R&D programs with the goals, objectives, and performance targets in the *Flight Plan* and suggested possible connections between the *Flight Plan* performance targets and the goals and objectives in the *Next Generation Air Transportation System (NextGen) Integrated Plan*.

The *2006 NARP* strengthened the alignment between the near-term and long-term goals by proposing common performance measures to span the next 20 years. It proposed notional performance targets for 2025, which formed ten R&D goals and allowed the creation of 2015 milestones as mid-term R&D performance targets.

The *2007 NARP* provides a high-level plan for each R&D goal to show how the programs are working together to achieve the 2015 milestones. Each 2015 milestone involves a demonstration. The demonstrations will prove concepts. The purpose of these demonstrations is to show that it is possible to meet the notional target by 2025, that the limitations and barriers are understood, and that there is a feasible solution.

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[1] OMB Circular A-11, *Preparation, Submission and Execution of the Budget,* June 2006, section 84, page 8 (www. whitehouse.gov/OMB/circulars).

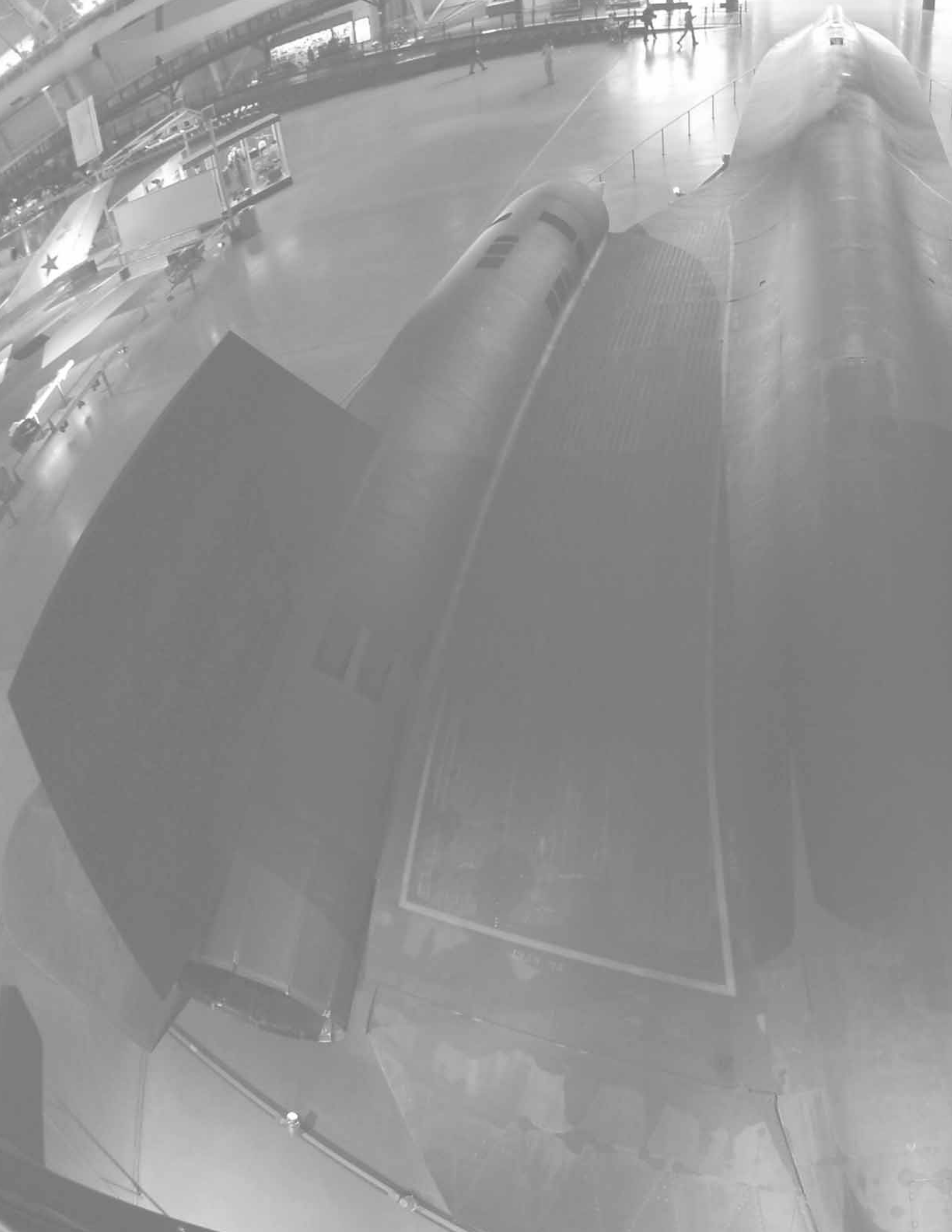
Future editions of the *NARP* will show how the FAA R&D programs are progressing toward achieving the R&D milestones. This will enable the FAA to address the near-term challenges facing the air transportation system and build the foundation for NextGen to increase safety, provide greater capacity, and reduce congestion.

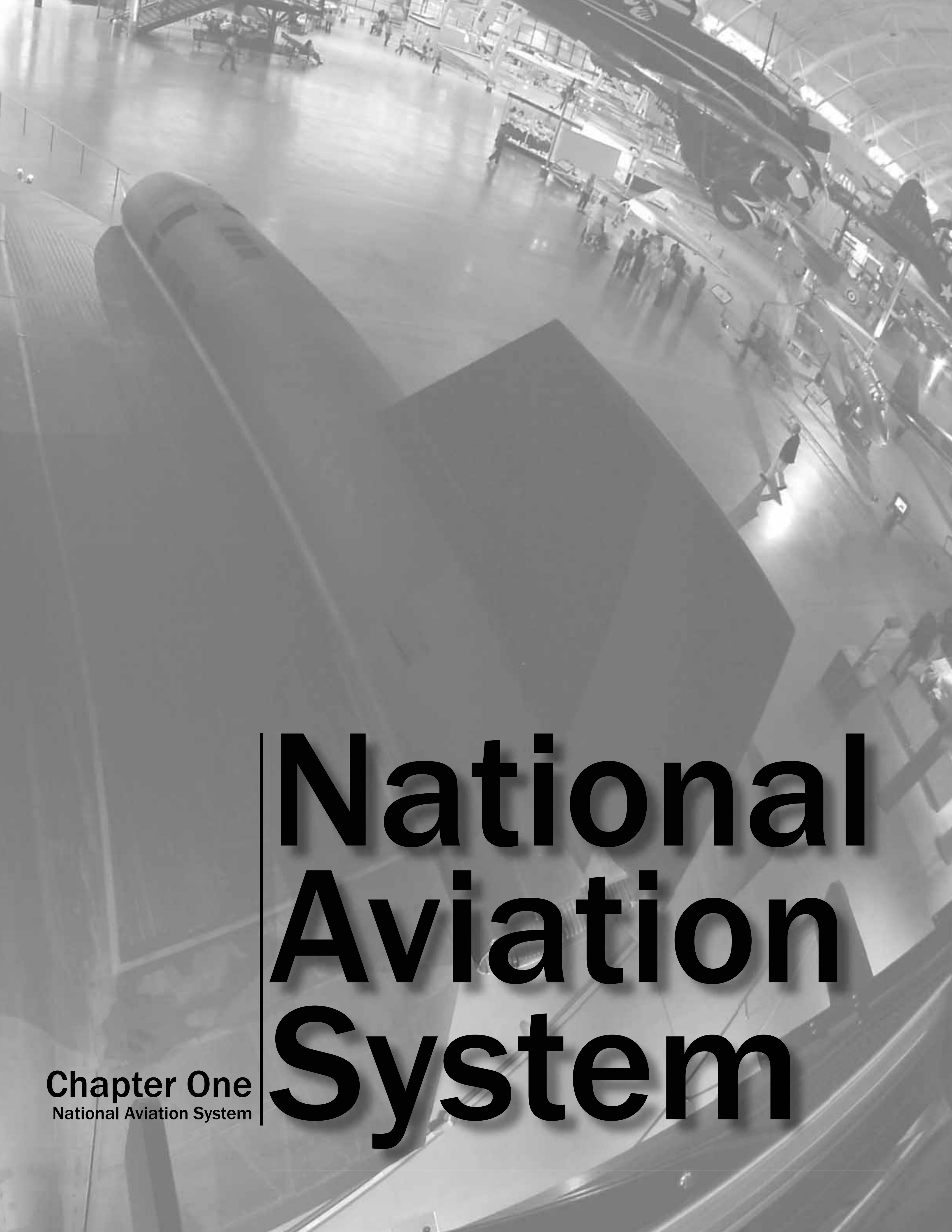
Chapter 1 of the *NARP* provides an overview of the national aviation system mission, vision, long-term goals, and near-term goals that help the FAA define its R&D needs. It has been updated to reflect changes in the *Flight Plan*, Operational Evolution Partnership (OEP), and NextGen planning.

Chapter 2 provides a master schedule and includes a high-level plan for each of the ten R&D goals. The plan integrates the supporting programs and focuses them on achieving the 2015 milestone. It explains how the 2015 milestone will be validated and what outputs are required to achieve the milestone.

Chapter 3 provides information on the R&D sponsors, programs, budget, evaluation, and partnerships. It presents the programs and the budget organized according to the President's budget submission for fiscal year 2008.

The appendices, included in a separate volume, provide individual program descriptions, recommendations by the research advisory committee, recent partnership activities, and acronyms and abbreviations.





National Aviation System

Chapter One

National Aviation System

Mission

Aviation is a vital 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 is responsive to 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 is central to this process. Research and development (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.

The FAA's mission is to provide the safest, most efficient aerospace system in the world.

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 and airfield configurations, space 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). Because the role and interactions of all of these elements determine the nature and performance of the system, it is important 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.

Vision

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

In November 2003, the Secretary of Transportation set forth a vision to transform the nation's air transportation system into a substantially 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), the Federal Aviation Administration (FAA), the 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."[2]

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, space launch sites and re-entry sites, and in all weather conditions, while simultaneously improving system performance and ensuring safety and security.

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 fatalities and injuries due to aerospace operations;
- Mitigating the risk of terrorists threats and other hostile actions;
- Reducing the environmental impact of aerospace transportation;
- 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 (NextGen) 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.

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

Long-term Goals

In 2003, Congress created a multi-agency Joint Planning and Development Office (JPDO)[3] that reports to a Senior Policy Committee, chaired by the Secretary of Transportation, to oversee planning related to NextGen. The JPDO includes representatives from the DOD, DOT, DHS, DOC, FAA, NASA, and OSTP. Working together with industry and academia, the JPDO established a set of long-term system goals and objectives for NextGen.[4]

- **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

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

[4] Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan*, December 12, 2004 (www.jpdo.aero/integrated_plan.html). Hereafter cited as *NextGen Integrated Plan*.

The eight capabilities are:

Net-enabled information access - This capability gives the right information to the right people at the right time, and meets 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 - This capability provides the air transportation system with the ability to transport people and goods to the desired destination on time, enables multiple service levels to a wide range of users, and tailors services to individual needs.

Weather assimilated into decision-making - This capability provides a “common weather picture” to all pilots, air traffic controllers, and users.

Layered, adaptive security - This capability creates “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 - This capability provides navigation services when and where needed to enable aircraft operations in nearly all conditions.

Aircraft trajectory-based operations - This capability manages daily operations based on aircraft trajectories, adjusting the airspace structure to meet user needs and DOD and DHS requirements.

Equivalent visual operations - The capability provides critical information needed to navigate without visual reference and maintain safe distances from other aircraft during non-visual conditions.

Super-density operations - This capability enables peak throughput performance at even the busiest airports.

The NextGen 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 operational capability in the 2025 timeframe. In 2006, the JPDO developed agency guidance for the 2008 budget to further align agency budgets with NextGen, and also developed an operational improvement (OI) roadmap to provide a more detailed plan for achieving the desired capabilities of NextGen. The roadmap includes specific milestones and agency responsibilities.

To achieve these system goals and objectives, the JPDO identified five guiding principles and eight key capabilities to guide the development of NextGen.[5] These capabilities provide a systems approach, 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
- Integrated environmental performance

[5]Joint Planning and Development Office, *Next Generation Air Transportation System 2005 Progress Report,* March 2006 (www.jpdo.aero/integrated_plan.html).

Near-term Goals

The FAA is committed to supporting the long-term NextGen vision, but it also has the day-to-day responsibility to promote 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 2007-2011*. The agency is also developing an *Enterprise Architecture* and transition strategy to NextGen. See figure 1.1.

The *Flight Plan 2007-2011*[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 increased capacity in the United States airspace system that reduces congestion and meets projected demand in an environmentally sound manner.

- Increase capacity to meet projected demand and reduce congestion
- Increase reliability and 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 and safer 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
- Enhance our ability to rapidly and effectively respond to crises, including security related to threats and natural disasters.

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[6]Federal Aviation Administration, *Flight Plan 2007-2011*, November 1, 2006 (www.faa.gov).
[7]Federal Aviation Administration, *Operational Evolution Plan (OEP),* Version 8.0, May 2006 (www.faa.gov/programs/oep).

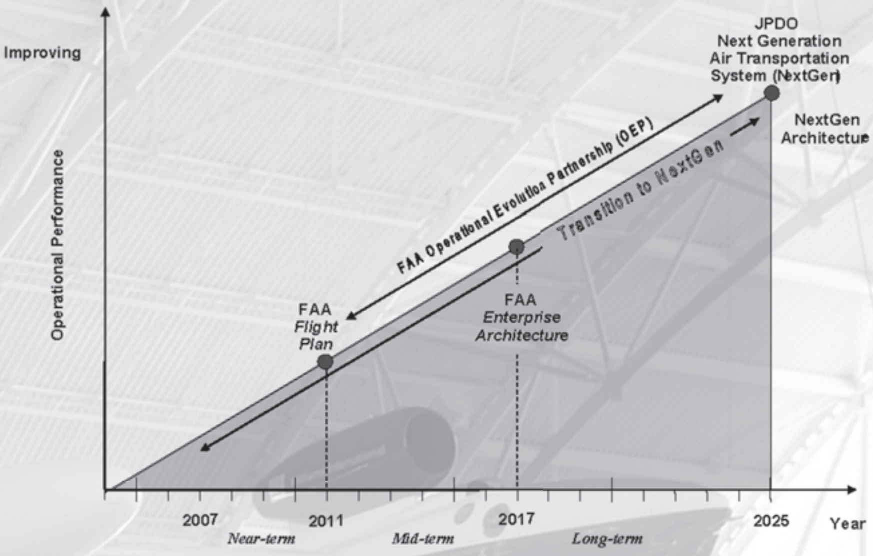

Figure 1.1- FAA Integrated Planning

The FAA *Enterprise Architecture (EA)* will represent a mid-term architecture for 2017 and the transition strategy to achieve that architecture. It will provide the operational and technical framework for all capital assets of the FAA and will guide the agency's capital investment plan. It will support the NextGen architecture, currently under development by the JPDO. The FAA is working to ensure that the transition roadmaps and resulting architectures of the FAA and NextGen are aligned.

In the past, the *Operational Evolution Plan*[7] provided a mid-term strategic plan for the FAA that extended ten years into the future. The new Operational Evolution Partnership (OEP) will include strategic milestones through the year 2025 to support the transition to NextGen. The new OEP will provide a process for the FAA to plan, execute, and implement NextGen. The FAA will use the process to obtain input from stakeholders; evaluate available technologies; define and prioritize research requirements; identify lead organizations; establish milestones and commitments; identify resource requirements; assess concept maturity; and provide oversight, status, and guidance for initiatives related to NextGen. The new OEP will create a single entry point for new initiatives that cross all FAA lines of business to focus efforts and achieve NextGen in a fully coordinated and transparent manner. Figure 1.2 explains the concept for the new OEP process. Projects will enter the outer rings in various stages of maturity. OEP tracking begins here for applied research projects, concept development and demonstrations, policy determinations, safety analysis, performance standards, certification requirements, and field prototypes. When projects reach sufficient maturity, OEP tracking follows into the core as implementation in the NAS begins.

Figure 1.2 Operational Evolution Partnership Process

Research & Development

The FAA uses R&D to achieve its near- and long-term goals and objectives. In the past, the R&D program was driven by the near-term operational needs of the aviation system and a large share of the agency's R&D was focused on specific near-term safety and capacity issues. Today, the R&D program is becoming more flexible, balanced, and dynamic to respond simultaneously to the critical near-term needs of the system while providing a foundation for the next generation system being defined by the JPDO.

Conduct, coordinate, and support domestic and international R&D of aviation-related products and services that will ensure a safe, efficient, and environmentally sound global air transportation system.

The R&D mission of the FAA 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 sound 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.

Provide the best air transportation system through the conduct of world-class, cutting edge research, engineering and development.

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."

The Agency R&D program adopted the following values:

- **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 scarce R&D resources to help achieve the national vision of a transformed aviation system

Research Goals

The FAA R&D program supports both the day-to-day operations of the national aerospace system and the development of NextGen. Hence, a long-term focus will have to be balanced with the research needed to address the day-to-day safety and capacity issues of the national aerospace system. To achieve a better balance between the near- and long-term, the FAA defined ten crosscutting R&D goals to focus and integrate its program. As shown in Table 1.1, the R&D goals are aligned with the near-term *Flight Plan* goals and the goals, guiding principles, and key capabilities identified by the JPDO for NextGen.

It will not be easy for the FAA to achieve these goals. They are meant to challenge the R&D community to think long-term and achieve breakthroughs in the future. The R&D program can help transform the system by aiming for ideal performance rather than by focusing on incremental improvements to current capabilities that may not achieve NextGen. The FAA R&D goals include:

- **Fast, flexible and efficient** – a system that safely and quickly moves anyone and anything, anywhere, anytime on schedules that meet customer needs

- **Clean and quiet** – a significant reduction of aerospace environmental impact in absolute terms

- **High quality teams and individuals** – the best qualified and trained workforce in the world

- **Human-centered design** – aerospace systems that adapt to, compensate for, and augment the performance of the human

- **Human protection** – no fatalities, injuries, or adverse health impacts due to aerospace operations

- **Safe aerospace vehicles** – no accidents and incidents due to aerospace vehicle design, structure, and subsystems

- **Self-separation** – 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, crises, obstacles, and weather

- **System knowledge** – a 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** – a globally recognized leader in aerospace technology, systems, and operations

Table 1.1 - Alignment of Goals, shows the primary relationship among the *Flight Plan* goals, the FAA R&D[8] goals, the NextGen guiding principles and key capabilities, and the *NextGen Integrated Plan* goals.

Flight Plan Goals	FAA R&D Goals
Increased Safety	Human-centered design Human protection Safe aerospace vehicle Self separation Situational awareness System knowledge
Greater Capacity	Fast, flexible, and efficient Clean and quiet
International Leadership	World leadership
Organizational Excellence	High quality teams and individuals
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[8]Each FAA R&D goal is aligned with its primary Flight Plan goal recognizing that there may be crossover relationships. For example, high quality teams and individuals is aligned with organizational excellence; however, it will also increase safety and support greater capacity.

NextGen Guiding Principles and Key Capabilities	***NextGen Integrated Plan*** **Goals**
Proactive safety risk management	Ensure Safety
Aircraft trajectory-based operations Broad-area precision navigation Equivalent visual operations Integrated environmental performance Performance-based services Super-density operations Weather assimilated into decision-making	Expand Capacity Protect the Environment
Global harmonization User focused	Retain U.S. Leadership in Global Aviation
Layered adaptive security Net-enabled information access	Ensure our National Defense Secure the Nation


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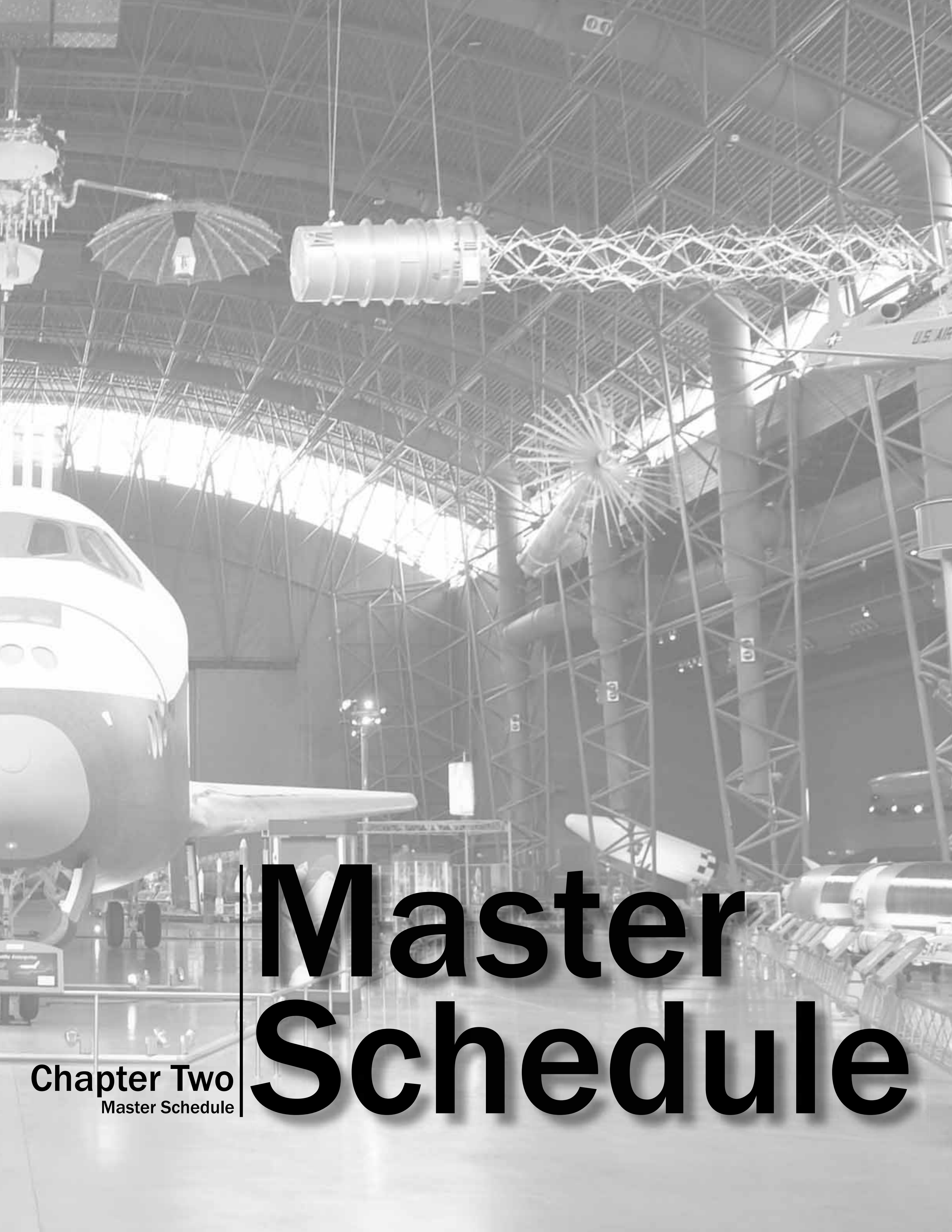

Master Schedule

Chapter Two
Master Schedule

R&D Goals

This chapter presents a master schedule to help align, plan, and evaluate the Federal Aviation Administration's research and development (R&D) activities to support both the near-term needs of the *Flight Plan* and the long-term needs of the next generation air transportation system (NextGen).

The *2005 National Aviation Research Plan (NARP)* aligned the R&D programs with the goals, objectives, and performance targets in the *Flight Plan* and suggested possible connections between the *Flight Plan* performance targets and the goals and objectives in the *NextGen Integrated Plan*.

The *2006 NARP* strengthened the alignment between the near-term and long-term by proposing common performance measures to span the next 20 years. The notional performance targets for 2025 formed ten R&D goals and allowed the creation of mid-term 2015 milestones for R&D. The ten R&D goals are as follows:

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

This year, the master schedule provides a high-level plan for each R&D goal that shows how the R&D programs are working together to achieve the 2015 milestone. Each 2015 milestone involves a demonstration. The demonstrations will prove concepts. The purpose of the demonstration is to show that it is possible to meet the notional target by 2025. By 2015, we will know where the problems are and how to solve them.

The method of validation describes what will be done in terms of modeling, simulation, physical demonstration, or initial standards to demonstrate completion of the 2015 milestone. The method of validation is followed by an outline of activities that include the major outputs required between 2008 and 2015 to achieve the 2015 milestone. The activities are organized to provide insight into what outputs need to be accomplished when, and how each output contributes to the plan. The outputs will be used to measure progress toward achieving the 2015 milestone.

The plan identifies contributing programs and provides assignments for delivery responsibilities for each program. Multiple programs work together to achieve the final demonstration. Some programs contribute more to near-term results while others focus on long-term objectives. Some programs reflect existing efforts, while others identify new requirements. The approach will help the FAA balance its R&D program to address near-term needs while making progress toward achieving long-term goals.

Figure 2.1 - Notional Targets for 2025, explains the derivation of the notional targets. The *NextGen Integrated Plan* objectives are applied to the *Flight Plan* performance targets. The capacity targets provide the connection and drive the targets for safety and organizational excellence. The intent is to maintain an acceptable level of safety given an increase in capacity to three times current levels. For organizational excellence, the intent is to provide three times capacity without a commensurate increase in cost.

Flight Plan

Goals & Performance Targets[1]

(near-term)

Increased Safety

- Reduce the airline fatal accident rate
- Reduce the number of GA fatal accidents
- Reduce the number of accidents in Alaska
- Reduce the rate of runway incursions
- No commercial space launch fatalities or injuries
- Reduce the rate of operational errors
- Implement Safety Risk Management

Greater Capacity

- Increase average daily airport capacity
- Increase annual service volume at airports
- Sustain adjusted operational availability for facilities
- Increase on-time arrival rates
- Reduce the number of people exposed to noise
- Improve aviation fuel efficiency

International Leadership

- Work with China on safety enhancements
- Increase the exchange of aviation products and services
- Strengthen global aviation infrastructure
- Expand the use of NextGen concepts

Organizational Excellence [2]

- Increase Employee Attitude Survey scores
- Reduce costs and improve productivity
- Increase agency scores on the American Customer Satisfaction Index

Notes:

1 The *Flight Plan* performance targets are generalized to indicate the type of measure used.

2 Organizational Excellence includes additional performance targets that are not listed here.

3 The *NextGen Integrated Plan* includes three performance targets in the objectives under the capacity goal.

Notional Targets for 2025

- Reduce the airline fatal accident rate
- Reduce the rate of GA fatal accidents
- Reduce the rate of accidents in Alaska
- Reduce the rate of runway incursions
- No commercial space launch fatalities or injuries
- Reduce the rate of operational errors
- Manage and mitigate risk

- Increase average daily airport capacity to 3 times current levels (proposed)
- Increase on-time arrival rate to 95%
- Reduce gate-to-gate transit time by 30%
- Reduce the number of people exposed to noise
- Improve aviation fuel efficiency

- Reduce time and cost to market for products and services (e.g., regulations, technologies, standards, procedures)
- Increase use of U.S. aviation-related products and services

- Increase controller efficiency to 3 times current levels (proposed)
- Reduce costs and improve productivity
- Increase Employee Attitude Survey scores
- Increase agency scores on the American Customer Satisfaction Index

NextGen Integrated Plan

Goals & Performance Targets[3]

(long-term)

Ensure Safety

Expand Capacity

- Increase capacity to 3 times current levels
- Reduce curb-to-curb transit time by 30%
- Increase on time arrival rates to 95%

Protect the Environment

Retain U.S. Leadership in Global Aviation

Ensure Our National Defense

Secure the Nation

Figure 2.2 - R&D Goals and Milestones, shows how the notional targets for 2025 drive the R&D goals and R&D milestones for 2015. Achieving the R&D milestone by 2015 will demonstrate that it is possible to meet the notional target by 2025. The R&D milestones focus on the year 2015 to allow 10 years between 2015 and 2025 for implementation of new regulations, standards, technologies, systems, and procedures.

Notional Targets for 2025

Increased Safety

- Reduce the airline fatal accident rate
- Reduce the rate of GA fatal accidents
- Reduce the rate of accidents in Alaska
- No commercial space launch fatalities or injuries

- Reduce the rate of runway incursions
- Reduce the rate of operational errors

- Manage and mitigate risk

Greater Capacity

- Increase average daily airport capacity to 3 times current levels (proposed)
- Increase on-time arrival rate to 95%
- Reduce gate-to-gate transit time by 30%

- Reduce the number of people exposed to noise
- Improve aviation fuel efficiency

International Leadership

- Reduce time and cost to market for products and services (e.g., regulations, technologies, standards, procedures)
- Increase the use of U.S. aviation-related products and services

Organizational Excellence

- Increase controller efficiency to 3 times current levels (proposed)
- Reduce costs and improve productivity
- Increase Employee Attitude Survey scores
- Increase agency scores on the American Customer Satisfaction Index

R&D Goals	R&D Milestones for 2015
Human protection	Demonstrate a two-thirds reduction in the rate of aerospace-related fatalities and significant injuries
Safe aerospace vehicles	Demonstrate damage and fault tolerant vehicles and systems
Self-separation	Develop initial standards and procedures for self-separation
Situational awareness	Demonstrate common real-time awareness of ongoing air operations, events, crises, and weather at all types of airports by pilots and controllers
Human-centered design	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
System knowledge	Understand economic (including implementation) and operational impact of system alternatives
Fast, flexible, and efficient	Demonstrate the system can handle growth in demand up to three times current levels; demonstrate that gate-to-gate transit time can be reduced by 30 percent
Clean and quiet	Demonstrate that aviation noise and emissions can be significantly reduced in absolute terms (to enable three times capacity) in a cost effective way and reduce uncertainties in particulate matter and climate impacts to levels that enable appropriate actions
World leadership	Demonstrate the value of working with international partners to leverage research programs and studies in order to improve safety and promote seamless operations worldwide
High quality teams and individuals	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

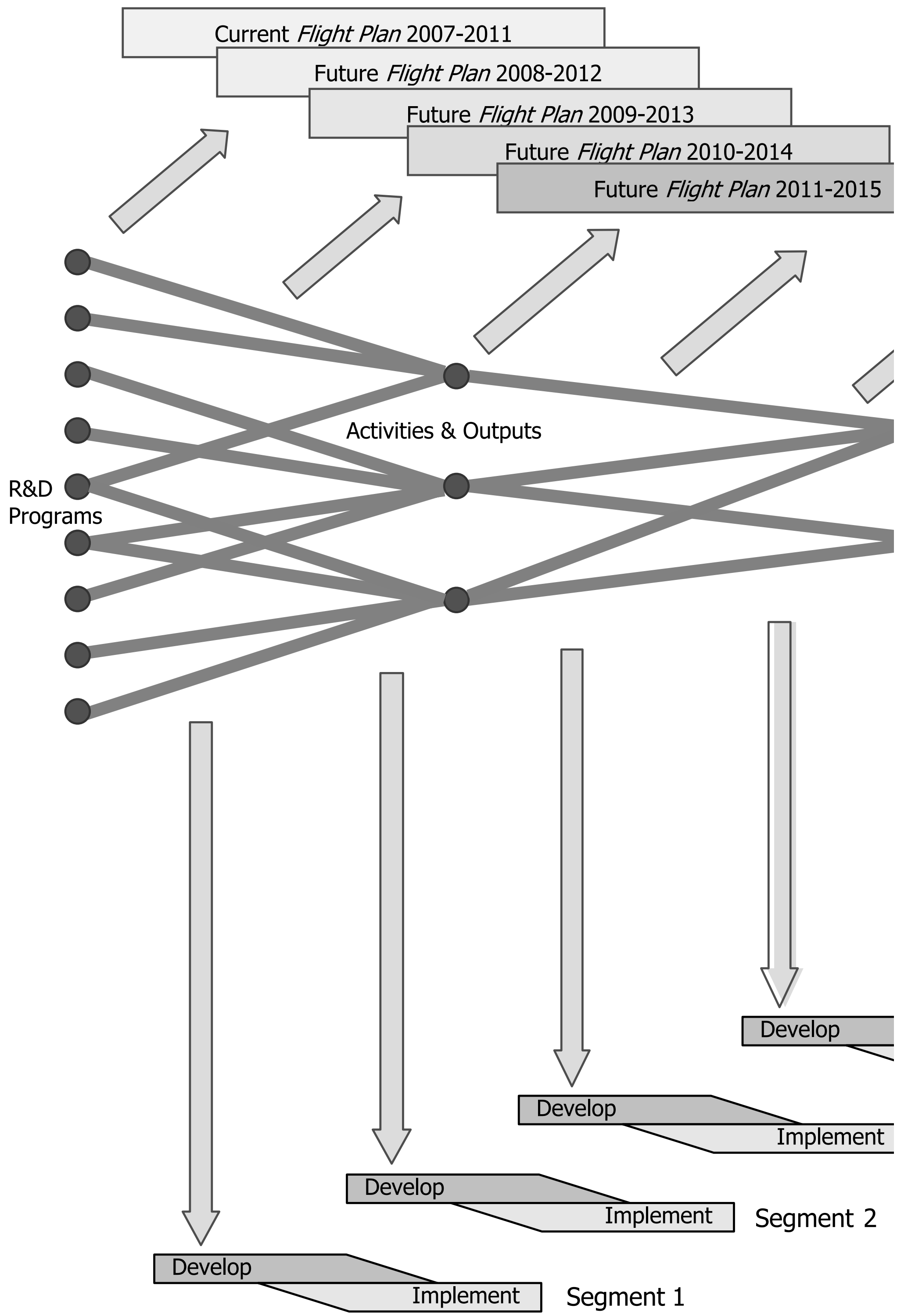

Figure 2.3 - Concept for Master Schedule, shows how the master schedule integrates and focuses the FAA R&D programs through the 2015 milestones to achieve the notional targets for 2025 while bridging the goals of the *Flight Plan* and the *NextGen Integrated Plan*.

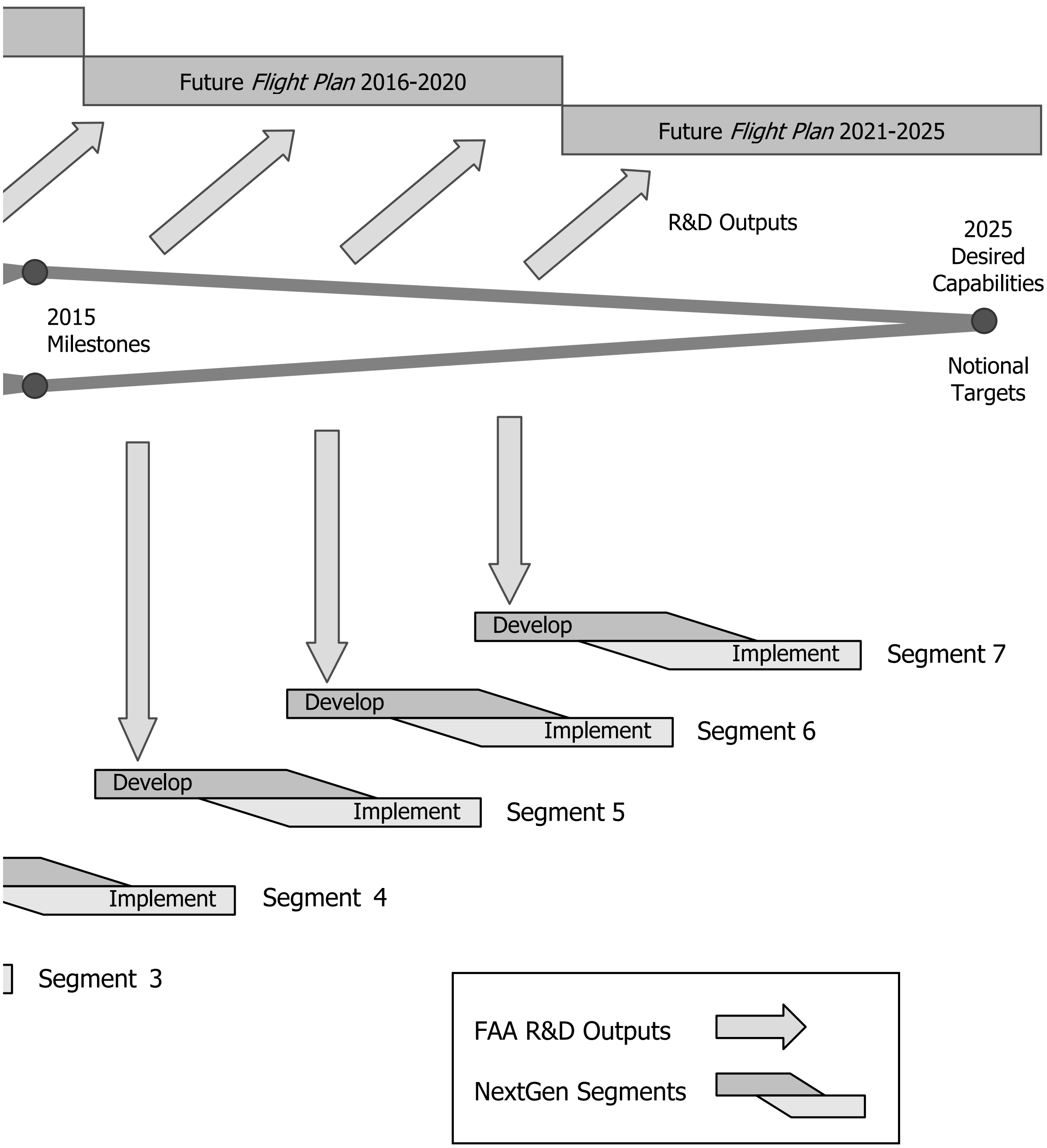
Future *Flight Plan* 2016-2020
Future *Flight Plan* 2021-2025
R&D Outputs
2025
Desired
Capabilities
2015
Milestones
Notional
Targets
Develop
Implement
Segment 7
Develop
Implement
Segment 6
Develop
Implement
Segment 5
Implement
Segment 4
Segment 3
FAA R&D Outputs
NextGen Segments

Table 2.1 - Map of R&D Programs to R&D Goals and Milestones, shows how the R&D programs support the R&D goals and 2015 R&D milestones. The intent is to identify clear responsibilities so that each program focuses on a specific or limited number of R&D goals.

	R&D Goal & Description	2015 R&D Milestone
1	**Fast, flexible, and efficient** *A system that safely and quickly moves anyone and anything, anywhere, anytime on schedules that meet customer needs*	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
2	**Clean and quiet** *A significant reduction of aerospace environmental impact in absolute terms*	By 2015, demonstrate that aviation noise and emissions can be significantly reduced in absolute terms (to enable three times capacity) in a cost effective way and reduce uncertainties in particulate matter and climate impacts to levels that enable appropriate actions.
3	**High quality teams and individuals** *The best qualified and trained workforce in the world*	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 that adapt to, compensate for, and augment the performance of the human*	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, or adverse health impacts due to aerospace operations*	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 2015, demonstrate damage and fault tolerant vehicles and systems
7	**Self-separation** *No accidents and incidents due to aerospace vehicle operations in the air and on the ground*	By 2015, develop initial standards and procedures for self-separation
8	**Situational awareness** *Common, accurate, and real-time information of aerospace operations, events, crises, obstacles, and weather*	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** *A 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 2015, understand economic (including implementation) and operational impact of system alternatives
10	**World leadership** *A globally recognized leader in aerospace technology, systems, and operations*	By 2015, demonstrate the value of working with international partners to leverage research programs and studies in order to improve safety and promote seamless operations worldwide.

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

Fast, Flexible & Efficient

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

R&D MILESTONES/TARGETS

By 2015, demonstrate that the system can handle growth in demand up to three times current levels[9] and demonstrate that gate-to-gate transit time can be reduced by thirty percent.[10]

METHOD OF VALIDATION

The approach includes developing and demonstrating NextGen according to the FAA responsibilities in the JPDO plan and continuing ongoing efforts related to increasing airport capacity and reducing costs. Validation of the 2015 milestone will include a combination of modeling, analysis, full scale testing, and initial standards. The capacity evaluation under the system knowledge goal supports the interim assessment of progress and the validation of this milestone.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change. Programs marked with ATO-Cap* form the R&D component of line item 1A14X

		2008	2009	2010	2011	2012		Notes
Airport Cooperative Research	AIP	2,000	5,000	5,000	5,000	5,000	100%	of Capacity component
Airports Technology Research – Capacity	AIP	8,907	8,907	8,907	8,907	8,907	100%	of total program
CAASD	ATO-Cap	8,323	9,535	10,096	12,788	13,349	36%	of total R&D program
GPS Civil Requirements	R,E&D	3,600	3,469	3,416	3,432	3,411	100%	of total program
JPDO	R,E&D	10,025	9,785	9,691	9,773	9,762	70%	of total program
Local Area Augmentation System	ATO-Cap	1,000	0	0	0	0	100%	of total program
New ATM Requirement	ATO-Cap*	0	27,000	27,000	29,300	31,000		Supports 3 times capacity
NextGen Demonstration	ATO-Cap	10,000	12,000	12,000	12,000	12,000	50%	of total R&D program in 2008
Wake Turbulence	R,E&D	7,055	6,927	6,830	6,869	6,834	66%	of total program
Wake Turbulence	ATO-Cap	3,000	1,000	1,000	1,000	1,000	100%	of total program
Wake Turbulence	ATO-Cap*	0	2,000	2,000	2,000	2,000	/1	Technology and standards
Total ($000)		53,910	85,623	85,940	91,068	93,262		

[9]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."

[10]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 cut by 30%)."

R&D ACTIVITIES

NextGen demonstrations

Develop and demonstrate NextGen technologies and concepts.

Demonstrate super-density operations.
(NextGen Demonstration, JPDO, CAASD)

2008: Demonstrate Traffic Management Advisor (TMA) and Area Navigation / Required Navigation Performance (RNAV/RNP) routing to increase throughput and efficiency for large, super density airports.
2010: Demonstrate greater throughput in congested, domestic, en route airspace using point-in-space metering linked to RNAV/RNP routes.

Demonstrate trajectory-based operations.
(NextGen Demonstration, JPDO, CAASD)

2008: Demonstrate improved trajectory-based operations in mixed-equipage, oceanic airspace with actual aircraft and procedures.
2008: Demonstrate standard separation in a full-equipage, fully automated environment with no voice communication.
2011: Demonstrate trajectory-based operations in transitional airspace, between oceanic and domestic en route, using oceanic data link and Advanced Technologies and Oceanic Procedures (ATOP) automation.
2013: Demonstrate trajectory-based operations in mixed-equipage, high altitude airspace with actual aircraft and procedures.
2015: Demonstrate auto-negotiations between flight automation and ground automation without human intervention.

Airport Capacity

Increase airport capacity while reducing costs.

2008: Increase airport capacity. (Airport Cooperative Research)
2008: Demonstrate Category II/III precision approaches (Local Area Augmentation System, GPS Civil Requirements)
2012: Develop new standards and guidelines for runway pavement design. (Airport Technology Research-Capacity)

Wake turbulence

Reduce separation with procedures only.

2008: Modify procedures to allow use of closely spaced parallel runways for arrival operations during non-visual conditions. (Wake Turbulence)

Demonstrate wake turbulence prediction and detection technologies.

2012: Demonstrate wake turbulence separation changes in en-route airspace. (Wake Turbulence)
2012: Develop safe wake-encounter, wake-avoidance zone and wake-free zone concepts. (Wake Turbulence)
2012: Determine characteristics of arriving and departing aircraft wakes. (Wake Turbulence)
2012: Develop new separation standards and procedures for wake-independent departures from parallel runways. (Wake Turbulence)
2015: Demonstrate reduced longitudinal separations for arrival and departure operations. [/1] (Wake Turbulence)

Clean & Quiet

A significant reduction of aerospace environmental impact in absolute terms

R&D MILESTONES/TARGETS

By 2015, demonstrate that aviation noise and emissions can be significantly reduced in absolute terms (to enable three times capacity) in a cost-effective way and reduce uncertainties in particulate matter and climate impacts to levels that enable appropriate action.

METHOD OF VALIDATION

The approach has four parts: measure current levels in the system; determine the target levels of noise and emissions; build models to assess and predict the impact of change; and develop reduction techniques and assess their cost-benefit. Validation of the 2015 milestone will include modeling, physical demonstrations, prototypes, full-scale tests, and software beta tests. The environmental evaluation under the system knowledge goal supports the interim assessment of progress and validation of this milestone.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change. Programs marked with ATO-Cap* form the R&D component of line item 1A14X

		2008	2009	2010	2011	2012	Notes
Airport Cooperative Research	AIP	3,000	5,000	5,000	5,000	5,000	100% of Environment component
CAASD	ATO-Cap	0	0	0	0	0	Coordination only
Environment and Energy	R,E&D	15,469	15,069	14,962	15,111	15,126	100% of total program in 2008
Environment and Energy	R,E&D	0	19,970	19,716	19,700	19,800	/2 Noise and emission reduction
Environment and Energy	ATO-Cap*	0	15,000	15,000	15,000	15,000	/2 Noise and emission reduction
JPDO	R,E&D	0	0	0	0	0	Coordination only
Total ($000)		18,469	55,039	54,678	54,811	54,926	

R&D ACTIVITIES

Baseline measurement

Measure current levels of aviation related noise and emissions.

2009: Develop methodologies to quantify and assess the impact of Particulate Matter and Hazardous Air Pollutants (HAP). (Environment and Energy, Airport Cooperative Research)
2010: Establish the relationship between aviation engine exhaust and the gases and particulate matter that are deposited in the atmosphere. [/2] (Environment and Energy)
2011: Expand noise data collection to very light jets, and supersonic aircraft. [/2] (Environment and Energy, Airport Cooperative Research)
2013: Obtain direct measurements of hazardous air pollutants and particulate matter data to update modeling tools. (Environment and Energy, Airport Cooperative Research)

Threshold levels

Determine acceptable levels of noise and emissions.

2009: Develop new standards and methodologies to quantify and assess the impact of aircraft noise and aviation emissions. (Environment and Energy, Airport Cooperative Research)
2009: Develop a new metric to assess the acceptability of sonic boom from supersonic aircraft. (Environment and Energy)
2010: Complete tests and data collection to determine if the right metrics are being used to assess the impact of aircraft noise. [/2] (Environment and Energy)
2010: Determine how aviation generated particulate matter and hazardous air pollutants impact local health, visibility, and global climate. [/2] (Environment and Energy, Airport Cooperative Research)

Prediction

Develop models to predict the impact and benefits of changes.

2008: Develop and distribute a first generation of integrated noise and emission prediction and modeling tools including an environmental cost module. (Environment and Energy)
2010: Develop a preliminary planning version of Aviation Environmental Design Tool that will allow integrated assessment of noise and emissions impact at the local and global levels. (Environment and Energy)
2010: Assess the impacts of aviation on regional air quality including the effects of oxides of nitrogen (NOx) emissions from aircraft climb and cruise. (Environment and Energy)
2010: Complete development of first generation ground plume model for aircraft engine exhaust. [/2] (Environment and Energy)
2011: Assess the level of certainty of aviation's impact on climate change, with special emphasis on the effects of contrails. (Environment and Energy)
2013: Complete development and field a fully validated suite of tools, including the Aviation Environmental Design and Aviation Environmental Portfolio Management tools, which will allow cost benefit analyses. (CAASD, Environment and Energy, Airport Cooperative Research)
2013: Update environmental assessments models to incorporate new noise metrics. [/2] (Environment and Energy)

Reduction techniques

Develop noise and emission reduction methods.

2008: Enable implementation of a new continuous-descent approach (CDA) noise abatement and fuel burn (emissions) reduction procedure at low-traffic airports during nighttime operations and optimize aircraft routing to reduce fuel usage. (Environment and Energy, JPDO, CAASD)
2010: Develop algorithms to optimize ground and airspace operations by leveraging communication, navigation and surveillance technology in the short- to medium-term to optimize aircraft sequencing and timing on the surface and in the terminal area. [/2] (Environment and Energy, CAASD)
2010: Complete detailed feasibility study, including economic feasibility, measure environmental impacts, and demonstrate “drop in” potential for alternative fuels. [/2] (Environment and Energy, Airport Cooperative Research)
2010: Identify and pursue the development of engine and airframe technologies that will be the most effective at producing environmental benefits. [/2] (Environment and Energy)
2011 Demonstrate optimized airport and terminal area operations that reduce or mitigate aviation impacts on noise, air quality or water quality in the vicinity of the airport. [/2] (Environment and Energy, Airport Cooperative Research, JPDO)
2012 Demonstrate optimized enroute operations that enhance fuel efficiency and reduce emissions. [/2] (Environment and Energy, JPDO)
2012: Establish engine design sensitivities by measuring particles emitted from combustor engine systems. [/2] (Environment and Energy)
2013: Demonstrate airframe and engine technologies to reduce noise and emissions. [/2] (Environment and Energy)

High Quality Teams & Individuals

The best qualified and trained workforce in the world

R&D MILESTONES/TARGETS

By 2015, demonstrate three times[11] 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.

METHOD OF VALIDATION

The approach includes continued pursuit of efficiency gains in en route and pursuit of new knowledge and results that produce efficiency gains in terminal and tower. The baseline for all demonstrations will be 2004 traffic levels. Validation of the interim and 2015 milestones rely on simulation and prototyping. Validation will involve field trials only to the extent that resources and funding are available. This goal contributes to the integrated demonstration under the human-centered design goal.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change. Programs marked with ATO-Cap* form the R&D component of line item 1A14X

		2008	2009	2010	2011	2012		Notes
ATC/Technical Operations Human Factors	R,E&D	10,254	10,323	10,471	10,715	10,919	100%	of total program
ATC/Technical Operations Human Factors	ATO-Cap*	0	9,000	11,500	11,500	11,500	/3	Controller efficiency
CAASD	ATO-Cap	9,160	10,493	11,110	14,073	14,690	40%	of total R&D program
JPDO	R,E&D	0	0	0	0	0		Coordination only
Total ($000)		19,414	29,816	33,081	36,288	37,109		

[11] 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 ACTIVITIES

Increase to 130 percent

Demonstrate 130 percent controller efficiency.

(Air Traffic Control/ Technical Operations Human Factors)

2007: Demonstrate how to reduce verbal communication workload between the pilot and controller for en route operations.
2007: Identify the performance limitations of the controller in the terminal and tower environments.
2008: Demonstrate efficiency improvements when controllers receive information on aircraft equipage, performance capabilities, and applicable procedures (in a mixed equipage environment).
2008: Conduct initial simulation to determine what weather information is required by en route and tower controllers to improve efficiency.

Increase to 166 percent [/3]

Demonstrate 166 percent controller efficiency.

(Air Traffic Control/ Technical Operations Human Factors)

2009: Measure efficiency improvements during limited self-separation, where aircraft are grouped and en route controllers communicate to the group as a whole.
2009: Explore the use of digital data link to reduce controller workload in the terminal area including data entry requirements and workload benefits.
2009: Identify benefits in the terminal domain of variable separation criteria, including enhanced visual flight rules where some responsibility for separation is transferred to the pilot.
2009: Define requirements and characteristics for merging and spacing tools to support continuous descent approach to reduce controller workload in the terminal area.

Increase to 230 percent[/3]

Demonstrate 230 percent controller efficiency.

(Air Traffic Control/ Technical Operations Human Factors)

2012: Define the new role for the controller that is more strategic in nature in the en route and terminal domains.
2012: Demonstrate shared situational awareness between pilot and controller.
2012: Define procedural requirements for controllers to manage and introduce change into the four dimensional (position plus time) dynamic environment

Increase to 300 percent[/3]

Demonstrate 300 percent controller efficiency.

(Air Traffic Control/ Technical Operations Human Factors, JPDO)

2015: Increase efficiency given the need to manage multiple airport streams for the terminal phases of flight in large metropolitan areas given a mixed-equipage environment.
2015: Redefine the controllers' role in terms of the services they provide during a given phase of flight as the differences between en route and terminal begin to blur.

Selection criteria

Select air traffic service providers with the aptitude and capability required to manage air traffic in the future system.

(Air Traffic Control/ Technical Operations Human Factors)

2012: Complete a strategic job analysis of the new roles of air traffic service providers using a highly automated system, sharing separation responsibilities with pilots, and moving toward performance-based services.
2015: Develop the selection procedures to transform the workforce into a new generation of service providers that can manage traffic flows in a highly automated system

Human Centered Design

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

R&D MILESTONES/TARGETS

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.

METHOD OF VALIDATION

The approach includes identifying roles and responsibilities, defining human and system performance requirements, applying error management strategies, and conducting an integrated demonstration across multiple goal areas. Validation of the 2015 milestone will include simulations and demonstrations to confirm the requirements and methodologies for human performance and error management. The final demonstration will integrate weather-in-the-cockpit technologies, self-separation procedures, air traffic controller productivity tools, and network-enabled collaborative decision-making to increase capacity, reduce delays, and promote safety.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change. Programs marked with ATO-Cap* form the R&D component of line item 1A14X

		2008	2009	2010	2011	2012		Notes
ATC/Technical Operations Human Factors	ATO-Cap*	0	7,500	7,500	7,500	7,500	/4	Air/ground integration
Aviation Safety Risk Analysis	ATO-Cap*	0	0	0	0	0		Coordination only
CAASD	ATO-Cap	315	361	383	485	506	1%	of total R&D program
Flightdeck/Maintenance/System Integration HF	R,E&D	9,651	9,541	9,568	9,724	9,818	100%	of total program in 2008
Flightdeck/Maintenance/System Integration HF	R,E&D	0	11,483	12,577	13,551	13,794	/5	Air/ground integration & error management
JPDO	R,E&D	0	0	0	0	0		Coordination only
Safe Flight 21 – Alaska Capstone	ATO-Cap	7,500	10,000	10,000	10,000	6,650	50%	of total program
Wake Turbulence	R,E&D	0	0	0	0	0		Coordination only
Weather Program	R,E&D	0	0	0	0	0		Coordination only
WJHTC Laboratory Facility	R,E&D	3,415	3,548	3,644	3,758	3,868	100%	of total program
Total ($000)		20,881	42,433	43,671	45,017	42,136		

R&D ACTIVITIES

Roles and responsibilities[/4/5]

Define the changes in roles and responsibilities, between pilots and controllers and between humans and automation, required to implement NextGen

2012: Develop a transition plan to implement pilot separation responsibility integrated with change in controller role. (Flightdeck/Maintenance/System Integration Human Factors, Air Traffic Control/ Technical Operations Human Factors)

Human system integration

Define human and system performance requirements for design and operation of aircraft and air traffic management systems.

(Flightdeck/Maintenance/System Integration Human Factors, Air Traffic Control/ Technical Operations Human Factors)

2010: Define procedural requirements for separation assisted by Cockpit Display of Traffic Information (CDTI).
2011: Identify requirements for use of probabilistic weather information by pilots and controllers.

Error management

Develop and apply error management strategies, mitigate risk factors, and reduce automation-related errors.

(Flightdeck/Maintenance/System Integration Human Factors, Air Traffic Control/ Technical Operations Human Factors)

2012: Provide design guidance for computer-human interfaces to reduce information overload and resulting errors.
2012: Develop training and procedural requirements for corrective mechanisms to compensate for pilot skills degradation or automation failure.
2012: Develop guidance on cognitive and contextual factors that improve human performance and reduce errors.

Integrated demonstrations[/4/5]

Conduct incremental and full mission demonstrations to increase the likelihood of successful implementation of research results.

2011: Demonstrate the transition of self-separation responsibility to pilots. (Flightdeck/Maintenance/System Integration Human Factors, Air Traffic Control/ Technical Operations Human Factors, CAASD)
2012: Demonstrate procedures for weather and wake separation on the flight deck. (Flightdeck/Maintenance/System Integration Human Factors, Wake Turbulence, Air Traffic Control/ Technical Operations Human Factors)
2013: Functional demonstration – demonstrate integrated pilot and controller functional capabilities. (Flightdeck/Maintenance/System Integration Human Factors, William J. Hughes Technical Center Laboratory Facility)
2013: Field trial – demonstrate the core capabilities of pilot separation responsibility. (Safe Flight 21 – Alaska Capstone)
2015: Full mission demonstration – demonstrate integrated NextGen air and ground capabilities for pilot separation responsibility and controller efficiency. (Flightdeck/Maintenance/System Integration Human Factors, Air Traffic Control/ Technical Operations Human Factors, Safe Flight 21 -- Alaska Capstone, Weather Program, Wake Turbulence, William J. Hughes Technical Center Laboratory Facility, JPDO, Aviation Safety Risk Analysis, CAASD)

Human Protection

No fatalities, injuries, or adverse health impacts due to aerospace operations

R&D MILESTONES/TARGETS

By 2015, demonstrate a two-thirds reduction in the rate of aerospace-related fatalities and significant injuries.[12]

METHOD OF VALIDATION

The approach includes preventing injuries during regular operations and protecting people in the event of a crash. Validation of the supporting milestones will include demonstrations, modeling, simulations, full scale testing, and initial standards. Validation of the 2015 milestone will include analysis of U.S. accident data. In 2010, progress will be measured based on accident data from 2003 to 2008; in 2012 based on data from 2003 to 2010; and in 2015 based on data from 2003 to 2012. Results from the safe aerospace vehicle goal will contribute to the interim and final measurements of the reduction. The safety evaluation under the system knowledge goal will support the interim assessment of progress and validation of the 2015 milestone. The 2015 demonstration will show that the R&D is complete, and it is possible to meet the targeted operational improvement by 2025.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change.

		2008	2009	2010	2011	2012	Notes
Aeromedical Research	R,E&D	6,780	6,932	7,149	7,390	7,630	100% of total program
Airport Cooperative Research	AIP	3,000	3,000	3,000	3,000	3,000	60% of Safety component
Airports Technology Research – Safety	AIP	3,432	3,432	3,432	3,432	3,432	35% of total program
Atmospheric Hazards/Digital System Safety	R,E&D	1,072	1,070	1,082	1,106	1,125	30% of total program
Commercial Space Transportation	S&O	64	64	64	64	64	50% of total program
Fire Research and Safety	R,E&D	6,174	6,182	6,267	6,412	6,531	84% of total program in 2008
Weather Program	R,E&D	1,520	1,471	1,453	1,463	1,457	9% of total program in 2008
Total ($000)		22,042	22,150	22,447	22,866	23,239	

[12] Joint Planning and Development Office, *Next Generation Air Transportation System Integrated Plan*, December 2004, www.jpdo.aero. The two thirds reduction in the rate of 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 ACTIVITIES

Safe evacuation

Prevent injuries or fatalities during evacuations.

2012: Define composite fuselage and very large transport safety design criteria for safe evacuation of aircraft (Fire Research and Safety)

2012: Develop aircraft rescue and fire fighting procedures and equipment standards to address double-decked large aircraft (Airport Technology Research - Safety)

2012: Validate mathematical models to evaluate whether aircraft designs meet requirements for evacuation and emergency response capability. (Aeromedical Research)

Turbulence

Prevent injuries and fatalities due to turbulence.

2011: Approve turbulence forecast at all altitudes for operational readiness. (Weather Program)

Hazardous weather

Prevent injuries and fatalities due to hazardous weather

2012: Provide guidance for certification of aircraft to operate in super cooled large droplet environments. (Atmospheric Hazards/Digital System Safety)

Occupant restraint

Improve occupant restraint systems to reduce injuries and fatalities.

2010: Establish design criteria for restraint systems that protect occupants at the highest impact levels that the aircraft structure can sustain. (Aeromedical Research)

Airports

Prevent injuries and fatalities due to aircraft overrun.

2011: Evaluate new formulations for soft ground arrestor systems. (Airport Technology Research – Safety; Airport Cooperative Research)

2011: Complete development of airport design methods to improve runway friction. (Airport Technology Research – Safety)

Cabin air quality

Reduce health risk to aircrew and passenger due to cabin environmental threats.

2010: Develop and analyze methods to detect and analyze aircraft cabin contamination including chemical-biological hazards and other airborne irritants. (Aeromedical Research)

Commercial space

Identify the requirements for safe commercial space transportation operations.

2007: Evaluate a sample of human space flight training providers to determine appropriate recommendations for formulating human space flight training requirements. (Commercial Space Transportation)

2007: Determine an appropriate duty and rest periods for space flight crew, flight controllers, maintenance personnel, and other safety critical personnel. (Commercial Space Transportation)

Safe Aerospace Vehicles

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

R&D MILESTONES/TARGETS

By 2015, demonstrate damage and fault tolerant vehicle and systems.

METHOD OF VALIDATION

The approach includes: preventing accidents due to engine failures, structural failures and system failures; developing a fireproof cabin; integrating unmanned aircraft into the system; and addressing safety problems specific to general aviation. Validation of the 2015 milestone will include modeling, flight simulation, physical demonstration, prototypes, and initial standards. The results from this goal will contribute to the 2015 milestone to demonstrate a two-thirds reduction in fatalities and significant injuries under the human protection goal.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change.

		2008	2009	2010	2011	2012	Notes
Advanced Materials/Structural Safety	R,E&D	2,713	2,686	2,700	2,747	2,780	100% of total program
Aging Aircraft	R,E&D	14,334	14,096	14,100	14,307	14,412	96% of total program
Aircraft Catastrophic Failure Prevention	R,E&D	2,202	2,158	2,153	2,181	2,192	100% of total program
Atmospheric Hazards/Digital System Safety	R,E&D	2,502	2,498	2,526	2,581	2,624	70% of total program
CAASD	ATO-Cap	537	615	651	825	861	2% of total R&D program
Commercial Space Transportation	S&O	64	64	64	64	64	50% of total program
Fire Research and Safety	R,E&D	1,176	1,177	1,194	1,221	1,244	16% of total program in 2008
Fire Research and Safety	R,E&D	0	1,098	1,085	1,182	1,182	/6 Fireproof cabin
Propulsion and Fuel Systems	R,E&D	4,086	4,050	4,075	4,150	4,201	100% of total program
Unmanned Aircraft Systems Research	R,E&D	2,780	3,560	3,558	3,608	3,631	84% of total program
Total ($000)		30,394	32,002	32,107	32,866	33,192	

R&D ACTIVITIES

Engines

Prevent engine failures.

In-flight icing

2012: Develop methods to validate engines to operate in environments with high ice water content. (Atmospheric Hazards/Digital System Safety)

Engine and component structures

2012: Complete a certification tool[13] that will predict cracks, establish rotor life, and define inspection requirements. (Propulsion and Fuel Systems)

2012: Complete development of damage tolerant design methods for aircraft propellers. (Aging Aircraft)

Uncontained engine failures

2011: Complete requirements for a system that identifies propulsion malfunctions to the flight crew. (Aircraft Catastrophic Failure Prevention Research)

2012: Develop revised guidance for fuselage protection from uncontained engine failure fragments that includes multiple fragments analysis. (Aircraft Catastrophic Failure Prevention Research)

Structures

Prevent accidents due to structural failure.

2010: Develop certification methods for damage tolerance and fatigue of composite airframes. (Advanced Materials/Structural Safety)

2011: Apply damage detection technologies for inspecting remote and inaccessible areas of in-service aircraft with metal structures. (Aging Aircraft)

2012: Define criteria for use of imbedded sensors in fault tolerant structures. (Advanced Materials/Structural Safety)

Systems

Prevent accidents due to system failures.

Avionics

2012: Improve guidelines to expedite the certification of multiple (20 to 30) software packages into a single avionics system. (Atmospheric Hazards/Digital System Safety)

Electrical

2010: Develop guidelines for adequate clearance to prevent arcing in aircraft electrical wiring systems. (Aging Aircraft)

Flight controls

2010: Evaluate the ease of operation and certification of flight control designs. (Aging Aircraft)

Fire

Develop a fire proof cabin.

2011: Evaluate ultra-fire resistant materials during full-scale fire tests. (Fire Research and Safety)

2015: Develop initial standards for fireproof cabin.[/6] (Fire Research and Safety)

Unmanned aircraft

Integrate Unmanned Aircraft System (UAS) into the civil airspace.

2012: Conduct field evaluation of detect, sense, and avoid technology; command, control, and communications technologies; and flight termination procedures. (Unmanned Aircraft Systems Research, CAASD)

General aviation

Reduce general aviation accidents.

2012: Complete validation of certification process for health and usage monitoring systems (HUMS) for operational implementation. (Aging Aircraft)

2012: Develop rotorcraft damage tolerance methods and standards to establish guidance for certification. (Aging Aircraft)

Commercial space

Identify the requirements for safe commercial space transportation vehicles.

2007: Develop and maintain a database of failures and reliability of rocket-powered vehicles to identify the source and cause of failures. (Commercial Space Transportation)

[13] Design Assessment Reliability and Inspection (DARWIN)

Self-separation

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

R&D MILESTONES/TARGETS

By 2015, develop initial standards and procedures for self-separation.

METHOD OF VALIDATION

The approach includes conducting research and development to support the standards, procedures, training, and policy required to implement the NextGen operational improvements leading to self-separation. This goal does not develop technology, but it works with the designated technology developer to prepare for the operational use of the technology according to the JPDO schedule identified below. Validation of the 2015 milestone will include demonstrating that the research and development is sufficient for the initial policy and standards that are required to certify technology, procedures, and training needed to implement the JPDO plan for self-separation.[14]

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change.

		2008	2009	2010	2011	2012		Notes
ATC/Technical Operations Human Factors	R,E&D	0	0	0	0	0		Coordination only
Flightdeck/Maintenance/System Integration HF	R,E&D	0	9,985	8,983	9,679	9,853	/7	Supports standards, procedures, training
JPDO	R,E&D	0	0	0	0	0		Coordination only
Wake Turbulence	R,E&D	0	0	0	0	0		Coordination only
Total ($000)		0	9,985	8,983	9,679	9,853		

[14] Research will be performed by Flightdeck/Maintenance/System Integration Human Factors to support the development of standards, procedures, and training by Flight Standards to implement the JPDO plan for separation. The Air Traffic Control/Technical Operations Human Factors, Wake Turbulence, and CAASD programs support the effort through work conducted under the other goals, but coordinated with this effort.

R&D ACTIVITIES[/7]

Level 1

Surface/runway operations awareness

2010: Model collision risk for surface movement. (JPDO OI# 179)[15]
2011: Display aircraft and ground vehicles in the cockpit to guide surface movement during low visibility conditions. (JPDO IO# 153)
2015: Enable surface movement in zero visibility conditions guided by cockpit display. (JPDO OI#156)

Level 2

Reduced separation

2011: Reduce visual approach minima through avionics-aided separation. (JPDO OI# 152)
2011: Reduce oceanic spacing to 15x15 nm. (JPDO OI# 185)
2011: Reduce longitudinal arrival and departure spacing requirements for dual use runways. (JPDO OI#167)
2012: Reduce lateral separation requirements for converging and parallel runway operations. (JPDO OI #161)
2012: Enable variable touchdown point markings to avoid wake impact. (JPDO OI#168)
2012: Reduce in-trail separation to near VFR levels for single runway departure operations. (JPDO OI# 162)
2012: Reduce in-trail separation to near VFR levels for converging and closely spaced parallel runways. (JPDO OI# 163)
2014: Reduce oceanic spacing to 3 miles. (JPDO OI# 186)
2014: Enable multiple aircraft occupancy for single runway arrivals and single runway departures. (JPDO OI# 174, 175)
2014: Enable dynamic adjustment of longitudinal arrival and departure spacing. (JPDO OI #171)
2015: Further reduce longitudinal arrival and departure spacing. (JPDO OI# 173)
2015: Enable shared separation at non-towered airports. (JPDO OI# 149)
2015: Reduce arrival spacing, with altitude offset, for very closely spaced parallel runways. (JPDO OI# 176)
2015: Reduce arrival spacing, at co-altitude, for very closely spaced parallel runways. (JPDO OI# 177)

Level 3

Shared separation

2010: Enable oceanic pair-wise separation. (JPDO OI# 165)
2011: Enable en route pair-wise separation. (JPDO OI# 160)

Level 4

Self-separation

2015: Enable self-separation in oceanic airspace. (JPDO OI# 166)
2015: Enable self-separation in high density en route corridors. (JPDO OI#164)

[15]Operational Improvement numbers are from the draft JPDO release in June 2006.

Situational Awareness

Common, accurate, and real-time information of aerospace operations, events, crises, obstacles, and weather

R&D MILESTONES/TARGETS

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

METHOD OF VALIDATION

The approach includes supporting development of standards and procedures for weather-in-the-cockpit to provide the flight crew awareness of weather conditions and forecasts; demonstrating wake turbulence technologies to support self-separation; and improving situational awareness at airports. Validation of the 2015 milestone will include pilot-in-the-loop simulations, modeling, tests, physical demonstrations, and initial standards and procedures.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change.

		2008	2009	2010	2011	2012		Notes
Airport Cooperative Research	AIP	2,000	2,000	2,000	2,000	2,000	40%	of Safety component
Airports Technology Research – Safety	AIP	6,373	6,373	6,373	6,373	6,373	65%	of total program
ATC/Technical Operations Human Factors	R,E&D	0	0	0	0	0		Coordination only
CAASD	ATO-Cap	2,496	2,859	3,027	3,834	4,002	11%	of total R&D program
Flightdeck/Maintenance/System Integration HF	R,E&D	0	6,490	5,839	6,291	6,404	/8	Weather-in-the-cockpit procedures
JPDO	R,E&D	0	0	0	0	0		Coordination only
NAS Weather Requirements	ATO-Cap	1,000	1,000	1,000	1,000	1,000	100%	of total program
NextGen Demonstration	ATO-Cap	10,000	0	0	0	0	50%	of total R&D program in 2008 only
Runway Incursion Reduction Program	ATO-Cap	5,000	5,000	5,000	2,000	0	100%	of total program
Safe Flight 21 – Alaska Capstone	ATO-Cap	7,500	10,000	10,000	10,000	6,650	50%	of total program
Wake Turbulence	R,E&D	3,700	3,633	3,582	3,602	3,584	34%	of total program
Weather Program	R,E&D	15,368	14,869	14,689	14,788	14,737	91%	of total program in 2008
Weather Program	R,E&D	0	2,996	3,144	3,388	3,449	/9	Weather-in-the-cockpit
Wind Profiling and Weather Research - Juneau	ATO-Cap	4,000	0	0	0	0	100%	of total program
Total ($000)		57,437	55,220	54,654	53,276	48,199		

R&D ACTIVITIES

Weather

Demonstrate weather-in-the-cockpit.[16]

Weather products

2010: Approve for operational readiness the national ceiling and visibility CONUS forecast. (Weather Program, Flightdeck/Maintenance/System Integration Human Factors)

2013: Approve for operational readiness the in-flight icing oceanic nowcast. (Weather Program, Flightdeck/Maintenance/System Integration Human Factors)

2013: Approve for operational readiness the volcanic ash forecast. (Weather Program, Flightdeck/Maintenance/System Integration Human Factors)

2015: Approve for operational readiness the convective weather (thunderstorm) 2 to 6-hour forecast. (Weather Program, Flightdeck/Maintenance/System Integration Human Factors)

Policy and guidance[/8/9]

2010: Develop design approval guidance for hardware and software standards. (Flightdeck/Maintenance/System Integration Human Factors, Weather Program)

2010: Develop design approval guidance for archiving data. (Flightdeck/Maintenance/System Integration Human Factors, Weather Program)

2010: Develop guidance for airman training and evaluation criteria. (Flightdeck/Maintenance/System Integration Human Factors, Weather Program)

2010: Develop guidance for operational approval of new products and products from non-government vendors. (Flightdeck/Maintenance/System Integration Human Factors, Weather Program)

Requirements and demonstrations

2010: Identify air traffic weather requirements. (NAS Weather Requirements, CAASD)

2012: Conduct physical demonstration of weather-in-the-cockpit. (Safe Flight 21 – Alaska Capstone)

2012: Demonstrate weather displays for air traffic controllers. (Air Traffic Control/ Technical Operations Human Factors)

Airports

Ensure safe airport operations.

2008: Implement Juneau area wind system. (Wind Profiling and Weather Research – Juneau)

2010: Develop system enhancements for runway status lights. (Runway Incursion Reduction)

2010: Develop advisory material to install new visual guidance systems (Airport Technology Research- Safety, Airport Cooperative Research)

2011: Develop a radar-based national bird strike advisory system for airports and their vicinity. (Airport Technology Research- Safety)

2012: Develop guidance material for airport planning to ensure consistency from the operator's perspective from airport to airport. (Airport Technology Research- Safety, Airport Cooperative Research)

Separation Standards

Develop new separation standards.

Performance-based

2008: Develop separation standards that vary according to aircraft capability and pilot training. (NextGen Demonstration)

Wake vortices

2010: Recommend new separation standards and procedures based on aircraft performance. (Wake Turbulence)

2012: Evaluate system-wide safety risk for new separation standards. (Wake Turbulence)

2012: Verify new separation standards maintain or reduce safety risk. (Wake Turbulence)

[16]Weather-in-the-cockpit enables pilots and aircrews to engage in shared situational awareness and shared responsibilities with controllers, dispatchers, Flight Service Station (FSS) specialists, and others, pertaining to safe and efficient preflight, en route, and post flight aviation safety decisions involving weather.

System Knowledge

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

R&D MILESTONES/TARGETS

By 2015, understand economic (including implementation) and operational impact of system alternatives.

METHOD OF VALIDATION

The approach includes developing the information analysis and sharing system to support the FAA and NextGen safety initiatives; generating guidelines to help stakeholders develop their own safety management systems; and modeling activities to help measure progress toward achieving safety, capacity, and environmental goals. Validation of the 2015 milestone will include analysis, modeling, prototypes, and demonstrations. The evaluation efforts under this goal support the interim assessment of progress and validation of the 2015 milestones under the human protection, clean and quiet, and fast, flexible and efficient goals.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change. Programs marked with ATO-Cap* form the R&D component of line item 1A14X

		2008	2009	2010	2011	2012	Notes	
Aging Aircraft	R,E&D	597	587	588	596	601	4%	of total program
Airspace Management Laboratory	ATO-Cap	4,000	4,000	4,000	4,000	0	100%	of total program
Airspace Redesign	ATO-Cap	5,000	3,000	3,000	3,000	3,000	100%	of total program
Aviation Safety Risk Analysis	R,E&D	9,517	8,349	8,334	8,446	8,493	100%	of total program in 2008
Aviation Safety Risk Analysis	ATO-Cap*	0	19,000	19,000	19,700	19,700	/10	Supports JPDO Safety IPT goals
CAASD	ATO-Cap	2,023	2,317	2,453	3,107	3,244	9%	of total R&D program
Environment and Energy	ATO-Cap*	0	5,000	5,000	5,000	5,000	/11	Validation modeling
JPDO	R,E&D	4,296	4,194	4,153	4,188	4,184	30%	of total program
Operations Concept Validation	ATO-Cap	3,000	3,000	3,000	3,000	3,000	100%	of total program in 2008
Operations Concept Validation	ATO-Cap*	0	15,000	15,000	15,000	15,000	/12	Validation modeling
System Capacity Planning and Improvement	ATO-Cap	6,500	6,500	6,500	6,500	6,500	100%	of total program
Unmanned Aircraft Systems Research	R,E&D	530	678	678	687	692	16%	of total program
Total ($000)		35,463	71,625	71,706	73,225	69,412		

R&D ACTIVITIES

Information Analysis and Sharing

Develop an information management system to serve as the foundation for the analysis of data trends and the identification of potential safety hazards before accidents occur.

2009: Evaluate current protection and assurance models and potential conflicts with privacy and consumer advocacy groups. (JPDO OI #69)[17] / (JPDO, Aviation Safety Risk Analysis)[/10]
2012: Validate the Net Enabled Operations (NEO) Architecture proof-of-concept for the sharing of aviation safety information among JPDO member agencies. (JPDO OI #69) / (Aviation Safety Risk Analysis)[/10]
2013: Complete the NGATS Aviation Safety Information Analysis and Sharing (ASIAS) Phase 1 pre-implementation activities, including concept definition. (JPDO OI #69) / (JPDO, Aviation Safety Risk Analysis)[/10]

Develop a system to increase safety of commercial operations.

2011: Develop automated tools to monitor databases for potential safety issues. (Aviation Safety Risk Analysis)
2012: Demonstrate a working prototype of network based integration of information extracted from diverse, distributed sources. (Aviation Safety Risk Analysis)

Safety Management System

Produce guidelines for developing processes and technologies to implement a safety management system.

2011: Develop proof of concept for NextGen including a prototype to implement on a trial basis with selected participants that involve a cross-section of air service providers. (JPDO OI #71, 72, 73) / (Aviation Safety Risk Analysis)[/10]
2011: Complete study of risk-based fleet management for small-airplane continued operational safety. (JPDO OI #68) (Aging Aircraft)
2012: Develop risk management concepts, models, and tools for unmanned aircraft systems. (JPDO OI #68) (Unmanned Aircraft Systems Research)
2012: Develop risk management concepts, models, and tools for transport category airplanes. (JPDO OI #68) (Aviation Safety Risk Analysis)
2014: Demonstrate a National Level System Safety Assessment capability that will proactively identify emerging risk across the NextGen. (JPDO OI #71, 72, 73)/ (JPDO, Aviation Safety Risk Analysis)[/10]

Safety evaluation

Develop method and metrics to measure progress in reducing the rate of fatalities and significant injuries by two-thirds.[18]
(Aviation Safety Risk Analysis)

2010: Demonstrate a one-third reduction in the rate of fatalities and injuries.
2012: Demonstrate a one-half reduction in the rate of fatalities and injuries.
2015: Demonstrate a two-thirds reduction in the rate of fatalities and injuries.

Capacity evaluation

Develop method, metrics, and models to demonstrate that the system can handle growth in demand up to three times current levels.[19]
(JPDO, CAASD, Operations Concept Validation,[/12] System Capacity Planning and Improvement, Airspace Management Laboratory, Airspace Redesign)

2008: Demonstrate capacity increase to 130% current levels.
2010: Demonstrate capacity increase to 166% current levels.
2012: Demonstrate capacity increase to 230% current levels.
2015: Demonstrate capacity increase to 300% current levels.

Environmental evaluation

Develop method, metrics, and models to demonstrate that aviation noise and emissions can be significantly reduced in absolute terms to enable the air traffic system to handle growth in demand up to three times current levels.[20]
(Environment and Energy,[/11] JPDO, CAASD, Operations Concept Validation)

2008: Demonstrate no environmental restrictions at 130% capacity.
2010: Demonstrate no environmental restrictions at 166% capacity.
2012: Demonstrate no environmental restrictions at 230% capacity.
2015: Demonstrate no environmental restrictions at 300% capacity.

[17] Operational Improvement numbers are from the draft JPDO release on June 2006.
[18] This supports demonstration of the 2015 milestone under the human protection goal.
[19] This supports demonstration of the 2015 milestone under the fast, flexible, and efficient goal.
[20] This supports demonstration of the 2015 milestone under the clean and quiet goal as it applies to the 2015 milestone under the fast, flexible, and efficient goal.

World Leadership

A globally recognized leader in aerospace technology, systems, and operations

R&D MILESTONES/TARGETS

By 2015, demonstrate the value of working with international partners to leverage research programs and studies in order to improve safety and promote seamless operations worldwide.

METHOD OF VALIDATION

The approach includes managing research collaborations to increase value, and leveraging research under the existing R&D program to increase value. This goal applies to the R&D program only. Validation of the 2015 milestone will include developing agreements and conducting analysis. The research results listed under activity 2 are generated by the other nine goals in this plan. The purpose of this goal is to help plan the use of these products in international partnering activities to produce the highest value. The method of validation for the individual research results is provided under the respective goal for each result.

FUNDING REQUIREMENTS

The funding levels listed for years 2009 to 2012 are estimates and subject to change. Programs marked with ATO-Cap* form the R&D component of line item 1A14X

		2008	2009	2010	2011	2012		Notes
ATC/Technical Operations Human Factors	ATO-Cap*	0	0	0	0	0		Coordination only
Aviation Safety Risk Analysis	ATO-Cap*	0	0	0	0	0		Coordination only
Environment and Energy	R,E&D	0	0	0	0	0		Coordination only
Fire Research and Safety	ATO-Cap*	0	0	0	0	0		Coordination only
Flightdeck/Maintenance/System Integration HF	R,E&D	0	0	0	0	0		Coordination only
System Planning and Resource Management	R,E&D	1,184	1,148	1,137	1,146	1,145	100%	of total program in 2008
System Planning and Resource Management	R,E&D	0	699	690	690	614	/13	Management
Wake Turbulence	R,E&D	0	0	0	0	0		Coordination only
Weather Program	R,E&D	0	0	0	0	0		Coordination only
Total ($000)		1,184	1,847	1,827	1,836	1,759		

R&D ACTIVITIES

Management

Manage ongoing research.

2008: Manage R&D portfolio, conduct advisory committee reviews of R&D, and publish the NARP. (System Planning and Resource Management)

Manage research collaborations. [/13]

2009: Determine measures for the exchange of research information. (System Planning and Resource Management)
2010: Develop a strategic mapping for international collaboration. (System Planning and Resource Management)
2010: Identify a process to measure quality, timeliness, and value of collaboration. (System Planning and Resource Management)
2015: Determine final value of collaboration. (System Planning and Resource Management).

Products

Leverage research results.

2008: Modify procedures to allow use of closely spaced parallel runways for arrival operations during non-visual conditions. (Wake Turbulence)
2010: Deploy an Aviation Environmental Design Tool that quantifies and assesses interrelationships among noise and emissions at the local and global levels. (Environment and Energy)
2010: Develop certification methods for damage tolerance and fatigue of composite airframes. (Advanced Materials/Structural Safety)
2012: Apply gene expression technology to define human response to aerospace stressors. (Aeromedical Research)
2012: Demonstrate weather-in-the-cockpit. (Weather Program/ Flight Deck Human Factors)
2013: Deploy the Aviation Environmental Portfolio Management Tool that will provide the cost/benefit methodology needed to harmonize national aviation policy and environmental policy. (Environment and Energy)
2014: Develop initial standards for a fireproof cabin. (Fire Research and Safety)
2014: Validate the Information Analysis and Sharing System. (JPDO, Aviation Safety and Risk Analysis)
2015: Demonstrate reduced longitudinal separations for arrival and departure operations. (Wake Turbulence)
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 operation, procedures, and information. (Air Traffic Control/ Technical Operations Human Factors)

Table 2.2 – Highlights of Funding Levels in the R&D Goals[21]

	ATC/Technical Operations Human Factors	ATO-Cap*
	ATC/Technical Operations Human Factors	ATO-Cap*
	Aviation Safety Risk Analysis	ATO-Cap*
	Environment and Energy	ATO-Cap*
	Environment and Energy	ATO-Cap*
	New ATM Requirement	ATO-Cap*
	Operations Concept Validation	ATO-Cap*
	Wake Turbulence	ATO-Cap*
1A14X	**NextGen System Development**	**ATO-Cap**

A11.a	Fire Research and Safety	R,E&D
A11.g.	Flightdeck/Maintenance/System Integration HF	R,E&D
A11.g.	Flightdeck/Maintenance/System Integration HF	R,E&D
A11.g.	Flightdeck/Maintenance/System Integration HF	R,E&D
A11.k.	Weather Program	R,E&D
A13.a.	Environment and Energy	R,E&D
A14.a.	System Planning and Resource Management	R,E&D
		R,E&D

Key:

Goal
1. Fast, flexible and efficient
2. Clean & quiet
3. Hiqh quality teams and individuals
4. Human-centered design
5. Human protection
6. Safe aerospace vehicle
7. Self-separation
8. Situational awareness
9. System knowledge
10. World leadership

[21]The total R&D program is summarized in Tables 3.1 through 3.4 of Chapter 3 in this report. The funding levels listed for years 2009 to 2012 are estimates and subject to change. Programs marked with ATO-Cap* form the components of line item 1A14X NextGen System Development.

Explanation of R&D Components of ATO-Capital Line Item
1A14X - NextGen System Development

2008	2009	2010	2011	2012	Goal	
0	11,500	11,500	11,500	11,500	3	Controller efficiency
0	7,500	7,500	7,500	7,500	4	Air/ground integration
0	19,000	19,000	19,700	19,700	9	Supports JPDO Safety IPT goals
0	15,000	15,000	15,000	15,000	2	Noise and emission reduction
0	5,000	5,000	5,000	5,000	9	Validation modeling
0	27,000	27,000	29,300	31,000	1	Supports 3 times capacity
0	15,000	15,000	15,000	15,000	9	Validation modeling
0	2,000	2,000	2,000	2,000	1	Technology and standards
0	**102,000**	**102,000**	**105,000**	**106,700**		

Explanation of Increase in
R,E&D Outyear Planning

2008	2009	2010	2011	2012	Goal	
0	1,098	1,085	1,182	1,182	6	Fireproof cabin
0	11,483	12,577	13,551	13,794	4	Air/ground integration & error management
0	9,985	8,983	9,679	9,853	7	Supports standards, procedures, training
0	6,490	5,839	6,291	6,404	8	Weather-in-the-cockpit procedures
0	2,996	3,144	3,388	3,449	8	Weather-in-the-cockpit
0	19,970	19,716	19,700	19,800	2	Noise and emission reduction
0	699	690	690	614	10	Management
0	**52,721**	**52,034**	**54,481**	**55,096**		


HondaJet

Research & Development

Chapter Three

Research & Development

Sponsors

This chapter summarizes the research and development (R&D) program according to the FAA's budget submission. The chapter explains what the FAA is doing (programs), how much it is spending (budget), how it performs its programs (partnerships), and how well it executes its programs (evaluation).

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. Sponsors include Aviation Safety, the Air Traffic Organization, Airports, Commercial Space Transportation, and Aviation Policy, Planning and Environment. The Office of Aviation R&D under Operations Planning in the Air Traffic Organization manages the program for the Agency.

The R&D programs are funded in four appropriation accounts: Research, Engineering and Development (R,E&D); Air Traffic Organization (ATO) Capital; Airport Improvement Program (AIP); and Safety and Operations (S&O).

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.[22] The AIP account generally funds airport improvement grants, including those emphasizing capacity development, and safety and security needs; and funds grants for aircraft noise compatibility planning and programs and low emissions airport equipment.[23] It also funds administrative and technical support costs to support airport programs. The ATO Capital account and the Safety and Operations account are new account designations in the fiscal year (FY) 2008 budget request. They replace the former Facilities and Equipment (F&E) and Operations accounts.

The programs summarized below are in the fiscal year FY 2008 R&D budget request. Appendix A provides detailed information for each program, including intended outcomes, outputs, programmatic structure, partnerships, and a long-range outlook for the program.

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[22]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.

[23]FAA Budget Estimates FY 2007 submitted for use by The Committees on Appropriations, Section 3D. – Grants-In-Aid for Airports, page 3; and Vision 100 – Century of Aviation Reauthorization Act, Public Law 108-176, December 12, 2003.

Programs

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

Fire Research and Safety (A11.a.): The program 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 it improves survivability during post-crash fires.

Propulsion and Fuel Systems (A11.b.): The program 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.): The program 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 and by developing maintenance and repair methods. The program also increases the ability of passengers to survive aviation accidents by improving the crash characteristics of aircraft structures and by modeling crash events.

Atmospheric Hazards/Digital System Safety (A11.d.): The program develops technologies to detect frozen contamination, and ensure safe operations during and after flight in atmospheric icing conditions. It improves aircraft safety by ensuring the safe operation of advanced flight-critical digital (software-based and programmable logic-based) airborne systems technology. It also assesses how this technology may be safely employed in flight-essential and flight-critical systems such as fly-by-wire, augmented manual flight controls, navigation and communication equipment, and autopilots.

Aging Aircraft (A11.e.): The program develops technologies, technical information, procedures, and practices to help ensure the continued airworthiness of aircraft structures, engines, and systems. It assesses the causes and consequences of fatigue damage of aging aircraft; ensures the continued safe operation of aircraft electrical, mechanical, and flight control 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, commuter airplanes, and propeller systems; and develops technologies and guidance to ensure safe operation in hazards resulting from electromagnetic interference, high-intensity radiated fields, and lightning.

Aircraft Catastrophic Failure Prevention Research (A11.f.): The program 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. It also uses historic accident data to investigate turbine engine un-containment events and propulsion malfunctions.

Flightdeck/Maintenance/System Integration Human Factors (A11.g.): The program provides the human factors research for guidelines, handbooks, advisory circulars, rules, and regulations that ensure safe and efficient aircraft operations. It improves task performance and training for aircrew, inspectors, and maintenance technicians; develops and applies error management strategies to flight and maintenance operations; and ensures that human factors are considered in certifying new aircraft and in designing and modifying equipment.

Aviation Safety Risk Analysis (A11.h.): The program 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. It develops an

Programs (continued)

infrastructure that enables the free sharing of de-identified, aggregate safety information from various government and industry sources in a protected, aggregated manner; and conducts research to evaluate proposed new technologies and procedures, which will improve safety by making relevant information available to the pilot during terminal operations.

Air Traffic Control/Technical Operations Human Factors (A11.i.): The program identifies and analyzes trends in air traffic operational errors and technical operations incidents, and develops and implements strategies to mitigate errors and incidents. It manages human error hazards, their consequences, and recovery methods in early stages of system design or procedural development; and assesses concepts and technology to modernize workstations, improve controller performance, and reduce staffing requirements.

Aeromedical Research (A11.j.): The program 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; and defines cabin air quality and analyzes requirements for occupant protection and aircraft decontamination.

Weather Program (A11.k.): The program develops new technologies to provide weather observations, warnings, and forecasts that are accurate, accessible, and efficient. It works to enable flight deck weather information technologies that allow pilots and aircrews to engage in shared situational awareness and shared responsibilities with controllers, dispatchers, Flight Service Station (FSS) specialists, and others, pertaining to safe and efficient preflight, en route, and post flight aviation safety decisions involving weather.

Unmanned Aircraft Systems Research (A11.l): The program ensures safe integration of unmanned aircraft system (UAS) into the nation's aviation system; and 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.): The program 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.): The program provides a better understanding of the swirling air masses, or wakes, trailing downstream from aircraft wingtips; safely reduces separation distances between aircraft; supports the safe use of parallel runways; and allows airports to operate closer to their design capacity.

GPS Civil Requirements (A12.c): The program provides a user fee to DOD for GPS services. The fee supports DOD assessment, development, acquisition, implementation, and operation of upgrades to civil GPS capabilities beyond the second and third civil signals; supports development of the L1C civil signal, which will be compatible with the EU Galileo open service on the GPS III satellites; and supports hardware and software upgrades for global monitoring of all GPS civil signals.

Environment and Energy (A13.a.): The program develops and validates methodologies, models, metrics, and tools to assess and mitigate the effect of aircraft noise and aviation emissions; analyzes and balances the interrelationships between noise and emissions, considers local and global impacts, and determines economic consequences; and reduces scientific uncertainties related to aviation environmental issues to support decision-making.

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

William J. Hughes Technical Center Laboratory Facility (WJHTC) (A14.b.): The program 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.

Air Traffic Organization (ATO) Capital

Runway Incursion Reduction (1A01A): The program minimizes the chance of injury, death, damage, or loss of property caused by runway accidents or incidents. It selects and evaluates technologies; validates technical performance and operational suitability; and develops a business case to support program implementation. It improves pilot situational awareness with airport visual aids such as runway status lights, final approach runway occupancy signals and other enhanced airport lighting technologies.

System Capacity Planning and Improvement (1A01B): The program 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. It also 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): The program conducts modeling and simulation to validate new operational concepts for the next generation of decision support systems for pilots and air traffic controllers. It validates performance requirements and identifies research criteria at the system and subsystem level; and assesses safety and environmental impact, identifies risk, and takes actions necessary to reduce risk.

NAS Requirements (1A01D): The program analyzes mission needs and establishes weather requirements for the ATO to increase operational predictability during weather events. It aligns requirements, priorities, programs, and resources and develops metrics to measure and understand the impact of weather on the system; and evaluates weather-related services and technologies for the ATO.

Airspace Management Laboratory (1A01E): The program 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 environmental impacts. It studies alternatives for airspace redesign that, when combined with new decision support tools and procedures, will optimize the nation's airspace.

Airspace Redesign (1A01F): The program investigates and demonstrates new airspace concepts and procedures to increase national aviation system capacity. It 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.

Programs (continued)

Wind Profiling and Weather Research - Juneau (1A01I): The program funds operations and maintenance of the Juneau Area Wind System operational prototype. It implements an end-state system that consists of operational prototype software algorithms and a hardware infrastructure that is acceptable for use in the NAS.

Wake Turbulence (1A01J): The program evaluates technology prototypes for decision support tools that may reduce wake turbulence departure spacing and increase airport capacity. It develops requirements for validating the tools and displaying the separation information to controllers.

Local Area Augmentation System (LAAS) for GPS (1A01L): The program augments the accuracy, integrity, availability, and continuity of the current Global Positioning System (GPS) services to be used for terminal, non-precision, and Category I/II/III precision approaches. The research and development activity focuses on achieving Category II/III performance.

Safe Flight 21 – Alaska Capstone (1A02A): The program 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.

NextGen Technology Demonstrations (1A13): The program demonstrates and tests concepts related to NextGen including trajectory-based operations and super density operations to mature technologies, support investment decisions, and deploy new capabilities. It identifies early implementation opportunities, refines longer-term objectives, and if results dictate, eliminates certain concepts from further consideration.

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

Airport Improvement Program (AIP)

Airport Cooperative Research – Capacity: The program addresses airport design, including 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 improvements in pavement maintenance and materials.

Airport Cooperative Research – Safety: The program addresses all aspects of improving airport safety, including improvements in lighting and marking, mitigation of wildlife hazards, airport design and geometry, reduction of runway incursions, and improvement of aircraft rescue and firefighting.

Requested as AIP in FY 2008:

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

Airports Technology Research – Safety: The program 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.

Safety and Operations (S&O)

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

Budget

Budget
Budget

This section provides four tables that explain the FAA R&D budget by appropriation, program sponsor, R&D category, and performance goal. It presents the FAA R&D request for the President's budget for FY 2008. The funding levels listed for years 2009 to 2012 are estimates and subject to change.

Appropriation account -- Table 3.1 shows the FAA R&D budget planned for FY 2008, including the five-year plan through 2012, grouped by appropriation account. The previous section on programs defined the four appropriation types. The ATO Capital budget in Table 3.1 includes four line items: Advanced Technology Development and Prototyping (ATD&P) line item number 1A01, Safe Flight 21 (SF-21) line item number 1A02, NextGen Demonstrations (NextGen) line item number 1A13, and the CAASD line item number 4A09. Not all programs in these ATO Capital 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 2008, including the five-year plan through 2012, grouped by sponsoring organization. Sponsoring organizations are Aviation Safety, Air Traffic Organization, Airports, Commercial Space Transportation, and Aviation Policy, Planning and Environment.

R&D category -- The FAA research includes both applied research and development as defined by the Office of Management and Budget Circular A-11[61]. Table 3.3 shows the FAA R&D program according to these categories with the percent of applied research and development for FY 2008 through 2012.

Performance goal -- Table 3.4 shows the FAA R&D budget by performance goal as defined in Exhibit IVof the FAA budget request for FY 2008. 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 2008.

[24] OMB Circular A-11, *Preparation, Submission and Execution of the Budget*, June 2006, section 84, page 8 (www.whitehouse.gov/OMB/circulars).

Table 3.1
FAA R&D Program Budget by Appropriations Account

Project Number	FY 2008 Budget Line Item	Program	Appropriation Account	2007 President's budget ($000)	2008 President's budget ($000)	2009 Planned ($000)	2010 Planned ($000)	2011 Planned ($000)	2012 Planned ($000)	
Research, Engineering and Development (R,E&D)										
061-110	A11.a	Fire Research and Safety	R,E&D	6,638	7,350	8,457	8,546	8,815	8,957	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	4,048	4,086	4,050	4,075	4,150	4,201	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	2,843	2,713	2,686	2,700	2,747	2,780	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	3,848	3,574	3,568	3,608	3,687	3,749	
065-110	A11.e.	Aging Aircraft	R,E&D	18,621	14,931	14,683	14,688	14,903	15,013	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	1,512	2,202	2,158	2,153	2,181	2,192	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	7,999	9,651	37,499	36,967	39,245	39,869	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	5,292	9,517	8,349	8,334	8,446	8,493	
082-110	A11.i.	Air Traffic Control/Technical Operations Human Factors	R,E&D	9,654	10,254	10,323	10,471	10,715	10,919	
086-110	A11.j.	Aeromedical Research	R,E&D	6,962	6,780	6,932	7,149	7,390	7,630	
041-110	A11.k.	Weather Program	R,E&D	19,545	16,888	19,336	19,286	19,638	19,643	
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	1,200	3,310	4,238	4,236	4,295	4,323	
027-110	A12.a.	Joint Planning and Development Office	R,E&D	18,100	14,321	13,979	13,844	13,961	13,945	
041-150	A12.b.	Wake Turbulence	R,E&D	3,066	10,755	10,560	10,412	10,471	10,418	
--	A12.c.	GPS Civil Requirements	R,E&D	0	3,600	3,469	3,416	3,432	3,411	
091-110/111/116	A13.a.	Environment and Energy	R,E&D	16,008	15,469	35,039	34,678	34,811	34,926	
011-130	A14.a.	System Planning and Resource Management	R,E&D	1,234	1,184	1,847	1,827	1,836	1,759	
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	3,430	3,415	3,548	3,644	3,758	3,868	
			TOTAL R,E&D	**130,000**	**140,000**	**190,721**	**190,034**	**194,481**	**196,096**	
Air Traffic Organization (ATO) Capital										
S09.02-00	1A01A	Runway Incursion Reduction	ATO Capital	8,000	5,000	5,000	5,000	2,000	0	
M08.28-00	1A01B	System Capacity, Planning and Improvement	ATO Capital	5,500	6,500	6,500	6,500	6,500	6,500	
M08.29-00	1A01C	Operations Concept Validation	ATO Capital	3,000	3,000	3,000	3,000	3,000	3,000	
M35.01-00	--	General Aviation and Vertical Flight Technology	--	2,000	0	0	0	0	0	
M42.01-00	--	Safer Skies	--	3,600	0	0	0	0	0	
M08.27-00	1A01D	NAS Weather Requirements	ATO Capital	800	1,000	1,000	1,000	1,000	1,000	
M08.28-02	1A01E	Airspace Management Lab	ATO Capital	4,000	4,000	4,000	4,000	4,000	0	
M08.28-04	1A01F	Airspace Redesign	ATO Capital	2,800	5,000	3,000	3,000	3,000	3,000	
W10.01-00	1A01I	Wind Profiling and Weather Research Juneau	ATO Capital	1,100	4,000	0	0	0	0	
M08.36-01	1A01J	Wake Turbulence	ATO Capital	1,000	3,000	1,000	1,000	1,000	1,000	
N12.02-01	1A01L	Local Area Augmentation Sysm (LAAS)	ATO Capital	0	1,000	0	0	0	0	
			Subtotal Line 1A01	31,800	32,500	23,500	23,500	20,500	14,500	/1
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	ATO Capital	16,800	15,000	20,000	20,000	20,000	13,300	
M49.01-01	1A13	NextGen Demonstration	ATO Capital	0	20,000	12,000	12,000	12,000	12,000	/2
M48.01-01	1A14X	NextGen System Development	ATO Capital	0	0	102,000	102,000	105,000	106,700	
M03.02-00	4A09A	Center for Advanced Aviation System Development	ATO Capital	30,100	22,854	26,180	27,720	35,112	36,652	/3
			TOTAL ATO Capital	**78,700**	**90,354**	**183,680**	**185,220**	**192,612**	**183,152**	
Airport Improvement Program (AIP)										
--	--	Airports Technology Research - Capacity	AIP	8,503	8,907	8,907	8,907	8,907	8,907	
--	--	Airports Technology Research - Safety	AIP	9,367	9,805	9,805	9,805	9,805	9,805	
--	--	Airport Cooperative Research Program -- Capacity	AIP	5,000	2,000	5,000	5,000	5,000	5,000	/4
--	--	Airport Cooperative Research Program -- Environment	AIP	0	3,000	5,000	5,000	5,000	5,000	/4
--	--	Airport Cooperative Research Program -- Safety	AIP	5,000	5,000	5,000	5,000	5,000	5,000	/4
			TOTAL AIP	**27,870**	**28,712**	**33,712**	**33,712**	**33,712**	**33,712**	
Safety and Operations (S&O)										
--	--	Commercial Space Transportation Safety	S&O	125	128	128	128	128	128	
			TOTAL S&O	**125**	**128**	**128**	**128**	**128**	**128**	
			GRAND TOTAL	**$236,695**	**$259,194**	**$408,241**	**$409,094**	**$420,933**	**$413,088**	

Notes:
/1 The amount shown for ATD&P reflects only R&D activities: it does not include acquisition, operational testing, or other non-R&D activities.
/2 The amount shown for NextGen Demonstrations includes only the R&D portion of the total line item amount. R&D represents 40% in FY 2008 and beyond.
/3 The amount shown for CAASD includes only the R&D portion of the total CAASD line item amount. R&D represents 43% in FY 2007 and 30.8% in FY 2008 and beyond.
/4 Airport Cooperative Research Program for capacity, environment, and safety are combined into a single white sheet write-up in Appendix A.
/5 The funding levels listed for years 2009 to 2012 are estimates and subject to change.

Table 3.2
FAA R&D Program Budget by Sponsoring Organization

Project Number	FY 2008 Budget Line Item	Program	Appropriation Account	2007 President's budget ($000)	2008 President's budget ($000)	2009 Planned ($000)	2010 Planned ($000)	2011 Planned ($000)	2012 Planned ($000)	
Aviation Safety (AVS)										
061-110	A11.a	Fire Research and Safety	R,E&D	6,638	7,350	8,457	8,546	8,815	8,957	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	4,048	4,086	4,050	4,075	4,150	4,201	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	2,843	2,713	2,686	2,700	2,747	2,780	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	3,848	3,574	3,568	3,608	3,687	3,749	
065-110	A11.e.	Aging Aircraft	R,E&D	18,621	14,931	14,683	14,688	14,903	15,013	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	1,512	2,202	2,158	2,153	2,181	2,192	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	7,999	9,651	37,499	36,967	39,245	39,869	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	5,292	9,517	8,349	8,334	8,446	8,493	
086-110	A11.j.	Aeromedical Research	R,E&D	6,962	6,780	6,932	7,149	7,390	7,630	
041-110	A11.k.	Weather Program	R,E&D	0	16,888	19,336	19,286	19,638	19,643	/1
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	1,200	3,310	4,238	4,236	4,295	4,323	
			Subtotal R,E&D	58,963	81,002	111,956	111,742	115,497	116,850	
M35.01-00	--	General Aviation and Vertical Flight Technology	--	2,000	0	0	0	0	0	
M42.01-00	--	Safer Skies	--	3,600	0	0	0	0	0	
			Subtotal ATO Capital	5,600	0	0	0	0	0	
		***Aviation Safety* Total**		**64,563**	**81,002**	**111,956**	**111,742**	**115,497**	**116,850**	
Air Traffic Organization (ATO)										
082-110	A11.i.	Air Traffic Control/Technical Operations Human Factors	R,E&D	9,654	10,254	10,323	10,471	10,715	10,919	
041-110	A11.k.	Weather Program	R,E&D	19,545	0	0	0	0	0	/1
027-110	A12.a.	Joint Planning and Development Office	R,E&D	18,100	14,321	13,979	13,844	13,961	13,945	
041-150	A12.b.	Wake Turbulence	R,E&D	3,066	10,755	10,560	10,412	10,471	10,418	
--	A12.c.	GPS Civil Requirements	R,E&D	0	3,600	3,469	3,416	3,432	3,411	
011-130	A14.a.	System Planning and Resource Management	R,E&D	1,234	1,184	1,847	1,827	1,836	1,759	
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	3,430	3,415	3,548	3,644	3,758	3,868	
			Subtotal R,E&D	55,029	43,529	43,726	43,614	44,173	44,320	
S09.02-00	1A01A	Runway Incursion Reduction	ATO Capital	8,000	5,000	5,000	5,000	2,000	0	
M08.28-00	1A01B	System Capacity, Planning and Improvement	ATO Capital	5,500	6,500	6,500	6,500	6,500	6,500	
M08.29-00	1A01C	Operations Concept Validation	ATO Capital	3,000	3,000	3,000	3,000	3,000	3,000	
M08.27-00	1A01D	NAS Weather Requirements	ATO Capital	800	1,000	1,000	1,000	1,000	1,000	
M08.28-02	1A01E	Airspace Management Lab	ATO Capital	4,000	4,000	4,000	4,000	4,000	0	
M08.28-04	1A01F	Airspace Redesign	ATO Capital	2,800	5,000	3,000	3,000	3,000	3,000	
W10.01-00	1A01I	Wind Profiling and Weather Research Juneau	ATO Capital	1,100	4,000	0	0	0	0	
M08.36-01	1A01J	Wake Turbulence	ATO Capital	1,000	3,000	1,000	1,000	1,000	1,000	
N12.02-01	1A01L	Local Area Augmentation Sysm (LAAS)	ATO Capital	0	1,000	0	0	0	0	
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	ATO Capital	16,800	15,000	20,000	20,000	20,000	13,300	
M49.01-01	1A13	NextGen Demonstration	ATO Capital	0	20,000	12,000	12,000	12,000	12,000	/2
M48.01-01	1A14X	NextGen System Development	ATO Capital	0	0	102,000	102,000	105,000	106,700	
M03.02-00	4A09A	Center for Advanced Aviation System Development	ATO Capital	30,100	22,854	26,180	27,720	35,112	36,652	/3
			Subtotal ATO Capital	73,100	90,354	183,680	185,220	192,612	183,152	
		***Air Traffice Organization* Total**		**128,129**	**133,883**	**227,406**	**228,834**	**236,785**	**227,472**	
Airports (ARP)										
--	--	Airports Technology Research - Capacity	AIP	8,503	8,907	8,907	8,907	8,907	8,907	
--	--	Airports Technology Research - Safety	AIP	9,367	9,805	9,805	9,805	9,805	9,805	
--	--	Airport Cooperative Research Program -- Capacity	AIP	5,000	2,000	5,000	5,000	5,000	5,000	
--	--	Airport Cooperative Research Program -- Environment	AIP	0	3,000	5,000	5,000	5,000	5,000	
--	--	Airport Cooperative Research Program -- Safety	AIP	5,000	5,000	5,000	5,000	5,000	5,000	
		***Airports* Total**		**27,870**	**28,712**	**33,712**	**33,712**	**33,712**	**33,712**	
Aviation Policy, Planning and Environment (AEP)										
091-110/111/116	A13.a.	Environment and Energy	R,E&D	16,008	15,469	35,039	34,678	34,811	34,926	
		***Aviation Policy, Planning and Environment* Total**		**16,008**	**15,469**	**35,039**	**34,678**	**34,811**	**34,926**	
Commercial Space Transportation (AST)										
--	--	Commercial Space Transportation Safety	S&O	125	128	128	128	128	128	
		***Commercial Space Transportation* Total**		**125**	**128**	**128**	**128**	**128**	**128**	
		TOTAL		**$236,695**	**$259,194**	**$408,241**	**$409,094**	**$420,933**	**$413,088**	

Notes:
/1 The ATO sponsors the Weather Program (R,E&D line item A11.k) until FY 2007, but sponsorship transfers to AVS in FY 2008 and beyond.
/2 The amount shown for NextGen Demonstrations includes only the R&D portion of the total line item amount. R&D represents 40% in FY 2008 and beyond.
/3 The amount shown for CAASD includes only the R&D portion of the total CAASD line item amount. R&D represents 43% in FY 2007 and 30.8% in FY 2008 and beyond.
/4 The funding levels listed for years 2009 to 2012 are estimates and subject to change.

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

Project Number	FY 2008 Budget Line Item	Program	Appropriation Account	2007 President's budget ($000)	2008 President's budget ($000)	2009 Planned ($000)	2010 Planned ($000)	2011 Planned ($000)	2012 Planned ($000)	
Applied Research										
061-110	A11.a	Fire Research and Safety	R,E&D	6,638	7,350	8,457	8,546	8,815	8,957	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	4,048	4,086	4,050	4,075	4,150	4,201	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	2,843	2,713	2,686	2,700	2,747	2,780	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	3,848	3,574	3,568	3,608	3,687	3,749	
065-110	A11.e.	Aging Aircraft	R,E&D	18,621	14,931	14,683	14,688	14,903	15,013	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	1,512	2,202	2,158	2,153	2,181	2,192	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	7,999	9,651	37,499	36,967	39,245	39,869	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	5,292	9,517	8,349	8,334	8,446	8,493	
082-110	A11.i.	Air Traffic Control/Technical Operations Human Factors	R,E&D	9,654	10,254	10,323	10,471	10,715	10,919	
086-110	A11.j.	Aeromedical Research	R,E&D	6,962	6,780	6,932	7,149	7,390	7,630	
041-110	A11.k.	Weather Program	R,E&D	19,545	16,888	19,336	19,286	19,638	19,643	
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	1,200	3,310	4,238	4,236	4,295	4,323	
027-110	A12.a.	Joint Planning and Development Office	R,E&D	18,100	14,321	13,979	13,844	13,961	13,945	
041-150	A12.b.	Wake Turbulence	R,E&D	3,066	10,755	10,560	10,412	10,471	10,418	
091-110/111/116	A13.a.	Environment and Energy	R,E&D	16,008	15,469	35,039	34,678	34,811	34,926	
011-130	A14.a.	System Planning and Resource Management	R,E&D	1,234	1,184	1,847	1,827	1,836	1,759	
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	3,430	3,415	3,548	3,644	3,758	3,868	
		Subtotal	**R,E&D**	130,000	136,400	187,252	186,618	191,049	192,685	
M03.02-00	4A09A	Center for Advanced Aviation System Development	ATO Capital	30,100	22,854	26,180	27,720	35,112	36,652	/1
		Subtotal	**ATO Capital**	30,100	22,854	26,180	27,720	35,112	36,652	
--	--	Airport Cooperative Research Program -- Capacity	AIP	5,000	2,000	5,000	5,000	5,000	5,000	
--	--	Airport Cooperative Research Program -- Environment	AIP	0	3,000	5,000	5,000	5,000	5,000	
--	--	Airport Cooperative Research Program -- Safety	AIP	5,000	5,000	5,000	5,000	5,000	5,000	
		Subtotal	**AIP**	10,000	10,000	15,000	15,000	15,000	15,000	
--	--	Commercial Space Transportation Safety	S&O	63	64	64	64	64	64	/2
		Subtotal	**S&O**	63	64	64	64	64	64	
		Applied Research		**170,163**	**169,318**	**228,496**	**229,402**	**241,225**	**244,401**	
		Percent *Applied Research*		**71.9%**	**65.3%**	**56.0%**	**56.1%**	**57.3%**	**59.2%**	
Development										
--	A12.c.	GPS Civil Requirements	R,E&D	0	3,600	3,469	3,416	3,432	3,411	
		Subtotal	**R,E&D**	0	3,600	3,469	3,416	3,432	3,411	
S09.02-00	1A01A	Runway Incursion Reduction	ATO Capital	8,000	5,000	5,000	5,000	2,000	0	
M08.28-00	1A01B	System Capacity, Planning and Improvement	ATO Capital	5,500	6,500	6,500	6,500	6,500	6,500	
M08.29-00	1A01C	Operations Concept Validation	ATO Capital	3,000	3,000	3,000	3,000	3,000	3,000	
M35.01-00	--	General Aviation and Vertical Flight Technology	--	2,000	0	0	0	0	0	
M42.01-00	--	Safer Skies	--	3,600	0	0	0	0	0	
M08.27-00	1A01D	NAS Weather Requirements	ATO Capital	800	1,000	1,000	1,000	1,000	1,000	
M08.28-02	1A01E	Airspace Management Lab	ATO Capital	4,000	4,000	4,000	4,000	4,000	0	
M08.28-04	1A01F	Airspace Redesign	ATO Capital	2,800	5,000	3,000	3,000	3,000	3,000	
W10.01-00	1A01I	Wind Profiling and Weather Research Juneau	ATO Capital	1,100	4,000	0	0	0	0	
M08.36-01	1A01J	Wake Turbulence	ATO Capital	1,000	3,000	1,000	1,000	1,000	1,000	
N12.02-01	1A01L	Local Area Augmentation Sysm (LAAS)	ATO Capital	0	1,000	0	0	0	0	
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	ATO Capital	16,800	15,000	20,000	20,000	20,000	13,300	
M49.01-01	1A13	NextGen Demonstration	ATO Capital	0	20,000	12,000	12,000	12,000	12,000	/3
M48.01-01	1A14X	NextGen System Development	ATO Capital	0	0	102,000	102,000	105,000	106,700	
		Subtotal	**ATO Capital**	48,600	67,500	157,500	157,500	157,500	146,500	
--	--	Airports Technology Research - Capacity	AIP	8,503	8,907	8,907	8,907	8,907	8,907	
--	--	Airports Technology Research - Safety	AIP	9,367	9,805	9,805	9,805	9,805	9,805	
		Subtotal	**AIP**	17,870	18,712	18,712	18,712	18,712	18,712	
--	--	Commercial Space Transportation Safety	S&O	63	64	64	64	64	64	/2
		Subtotal	**S&O**	63	64	64	64	64	64	
		Development		**66,533**	**89,876**	**179,745**	**179,692**	**179,708**	**168,687**	
		Percent *Development*		**28.1%**	**34.7%**	**44.0%**	**43.9%**	**42.7%**	**40.8%**	
		TOTAL		**$236,695**	**$259,194**	**$408,241**	**$409,094**	**$420,933**	**$413,088**	

Notes:
/1 The amount shown for CAASD includes only the R&D portion of the total CAASD line item amount. R&D represents 43% in FY 2007 and 30.8% in FY 2008 and beyond.
/2 The Commercial Space Transportation Program is 50 percent applied research and 50 percent development, which is $62.5K rounded to $63K for FY 2007.
/3 The amount shown for NextGen Demonstrations includes only the R&D portion of the total line item amount. R&D represents 40% in FY 2008 and beyond.
/4 The funding levels listed for years 2009 to 2012 are estimates and subject to change.

Table 3.4

FAA R&D Program Budget by **Performance Goals**

(Organized According to Exhibit IV of the FAA FY 2008 Budget Request)

Project Number	FY 2008 Budget Line Item	Program	Appropriation Account	FY 2008 Contract Costs ($000)	FY 2008 Personnel Costs ($000)	FY 2008 Other In-house Costs ($000)	FY 2008 Total Planned ($000)	
1. SAFETY								
a. Reduce Commercial Air Carrier Fatal Accident Rate								
061-110	A11.a	Fire Research and Safety	R,E&D	3,355	3,650	345	7,350	
063-110	A11.b.	Propulsion and Fuel Systems	R,E&D	2,463	1,476	147	4,086	
062-110/111	A11.c.	Advanced Materials/Structural Safety	R,E&D	1,684	945	84	2,713	
064-110/111	A11.d.	Atmospheric Hazards/Digital System Safety	R,E&D	1,789	1,653	132	3,574	
065-110	A11.e.	Aging Aircraft	R,E&D	10,665	3,946	320	14,931	
066-110	A11.f.	Aircraft Catastrophic Failure Prevention Research	R,E&D	1,684	482	36	2,202	
081-110	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	R,E&D	6,408	3,066	177	9,651	
060-110	A11.h.	Aviation Safety Risk Analysis	R,E&D	6,402	2,892	223	9,517	
082-110	A11.i.	Air Traffic Control/Technical Operations Human Factors	R,E&D	4,587	5,443	224	10,254	
086-110	A11.j.	Aeromedical Research	R,E&D	732	5,893	155	6,780	
041-110	A11.k.	Weather Program	R,E&D	15,936	863	89	16,888	
069-110	A11.l.	Unmanned Aircraft Systems Research	R,E&D	3,158	136	16	3,310	
011-130	A14.a.	System Planning and Resource Management	R,E&D	725	25	49	798	/1
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	450	1,781	71	2,302	/1
		Subtotal	**R,E&D**	60,037	32,251	2,068	94,356	/2
S09.02-00	1A01A	Runway Incursion Reduction	ATO Capital	5,000	0	0	5,000	
W10.01-00	1A01I	Wind Profiling and Weather Research Juneau	ATO Capital	4,000	0	0	4,000	
		Subtotal	**ATO Capital**	9,000	0	0	9,000	
--	--	Airports Technology Research - Safety	AIP	8,091	1,318	0	9,409	/3
--	--	Airport Cooperative Research Program -- Safety	AIP	4,933	67	0	5,000	
		Subtotal	**AIP**	13,024	1,385	0	14,409	
		Reduce the Commercial Air Carrier Fatal Accident Rate		**82,061**	**33,636**	**2,068**	**117,765**	
b. Reduce the Number of General Aviation Fatal Accidents								
M36.01-00	1A02A	Safe Flight 21 - Alaska Capstone	ATO Capital	15,000	0	0	15,000	
--	--	Airports Technology Research - Safety	AIP	396	0	0	396	/3
		Reduce the Number of General Aviation Fatal Accidents		**15,396**	**0**	**0**	**15,396**	
c. Maintain Zero Commercial Space Transportation Accidents								
--	--	Commercial Space Transportation Safety	S&O	97	31	0	128	
		Maintain Zero Commercial Space Transportation Accidents		**97**	**31**	**0**	**128**	
		TOTAL SAFETY		**97,554**	**33,667**	**2,068**	**133,289**	
2. MOBILITY								
a. Increase Percent of On-time Arrivals								
027-110	A12.a.	Joint Planning and Development Office	R,E&D	12,910	1,256	155	14,321	
041-150	A12.b.	Wake Turbulence	R,E&D	10,485	251	19	10,755	
--	A12.c.	GPS Civil Requirements	R,E&D	3,600	0	0	3,600	
011-130	A14.a.	System Planning and Resource Management	R,E&D	228	8	15	251	/1
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	141	560	22	723	/1
		Subtotal	**R,E&D**	27,364	2,074	212	29,650	/2
M08.28-00	1A01B	System Capacity, Planning and Improvement	ATO Capital	6,500	0	0	6,500	
M08.29-00	1A01C	Operations Concept Validation	ATO Capital	3,000	0	0	3,000	
M08.27-00	1A01D	NAS Weather Requirements	ATO Capital	1,000	0	0	1,000	
M08.28-02	1A01E	Airspace Management Lab	ATO Capital	4,000	0	0	4,000	
M08.28-04	1A01F	Airspace Redesign	ATO Capital	5,000	0	0	5,000	
M08.36-01	1A01J	Wake Turbulence	ATO Capital	3,000	0	0	3,000	
N12.02-01	1A01L	Local Area Augmentation Sysm (LAAS)	ATO Capital	1,000	0	0	1,000	
M49.01-01	1A13	NextGen Demonstration	ATO Capital	20,000	0	0	20,000	/4
M03.02-00	4A09A	Center for Advanced Aviation System Development	ATO Capital	22,854	0	0	22,854	/5
		Subtotal	**ATO Capital**	66,354	0	0	66,354	
--	--	Airports Technology Research - Capacity	AIP	7,589	1,318	0	8,907	
--	--	Airport Cooperative Research Program -- Capacity	AIP	2,000	0	0	2,000	
		Subtotal	**AIP**	9,589	1,318	0	10,907	
		Increase Percent of On-time Arrivals		**103,307**	**3,392**	**212**	**106,911**	
		TOTAL MOBILITY		**103,307**	**3,392**	**212**	**106,911**	
4. ENVIRONMENT								
091-110/111/116	A13.a.	Environment and Energy	R,E&D	13,172	2,036	261	15,469	
011-130	A14.a.	System Planning and Resource Management	R,E&D	123	4	8	135	/1
011-140	A14.b.	William J. Hughes Technical Center Laboratory Facility	R,E&D	76	302	12	390	/1
		Subtotal	**R,E&D**	13,371	2,342	281	15,994	/2
--	--	Airport Cooperative Research Program -- Environment	AIP	3,000	0	0	3,000	
		TOTAL ENVIRONMENT		**16,371**	**2,342**	**281**	**18,994**	
		GRAND TOTAL		**217,232**	**39,401**	**2,561**	**259,194**	

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 67.4 percent; Mobility at 21.2 percent; and Environment at 11.4 percent.

/2 Personnel for R,E&D measured in full time equivalents is as follows: 264 for Safety; 16 for Mobility; and 18 for Environment.

/3 The Airport Technology Research - Safety program total budget request is divided between reducing the commercial air carrier fatal accident rate ($9,409K) and reducing the number of general aviation fatal accidents ($396K).

/4 The amount shown for NextGen Demonstrations includes only the R&D portion of the total line item amount. R&D represents 40% in FY 2008 and beyond.

/5 The budget request amount shown for CAASD is only the R&D program portion of the total CAASD line item amount (30.8% of the total CAASD line item).

/6 Many R&D programs apply to more than one goal area; however, for budgeting purposes most programs are included in only one goal area.

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 to ensure the FAA attains its R&D 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 uses 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 shows how government can 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 research 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 research and is used to implement a broader MOU. Appendix B provides the FAA MOUs/MOAs with the National Aeronautics and Space Administration (NASA) and the Department of Defense.

Field Offices

The FAA has field offices at two NASA research centers to foster and provide technical coordination of research that contributes to modernization efforts and safety enhancements of the air transportation system. The first field office opened in 1971 at NASA Ames Research Center located in Moffett Field, California, and the second office opened in 1978 at NASA Langley Research Center in Hampton, Virginia. Both offices report directly to the FAA headquarters. For more information, see 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 and 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, 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 across a wide range of related climate and global change issues. The research addresses 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*[25] provides the research areas and questions that the program addresses. The FAA helps by identifying the impact of aviation on the environment, particularly the troposphere. For more information, see http://www.climatescience.gov.

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[25] *Strategic Plan for the Climate Change Science Program*, report by the Climate Change Science Program and the Subcommittee on Climate Change Research, July 2003 (http://www.climatescience.gov).

Global Earth Observation System of Systems
The Global Earth Observation System of Systems (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 including those pertaining to aviation. These include enhanced weather observation, modeling and forecasting, air and water quality monitoring, and emissions. Under GEOSS, the FAA works with the Environmental Protection Agency to address air quality and emissions issues facing aviation. For more information, see http://www.epa.gov/geoss.

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 sector. The FAA does this through the following mechanisms.

Cooperative Research and Development Agreements
The CRDA is collaborative in nature and allows the FAA to share facilities, equipment, services, intellectual property, personnel resources, and other resources with private industry, academia, or state and local government agencies. For more information on using CRDAs, see http://www.tc.faa.gov/technologytransfer/.

Contracts
The FAA awards contracts to conduct applied research studies, and to develop, prototype, demonstrate, and test new hardware and software. The FAA also awards contracts to small businesses in compliance with the terms of the Small Business Innovation Research (SBIR) Program. Appendix B provides additional detail on the use of SBIR. For more information, see http://www.asu.faa.gov/faaco/kenproj.htm.

Intellectual Property/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. Appendix B provides a current list of the FAA's patents

Government and Academia

The FAA 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. The universities 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. For more information, see http://research.faa.gov/research_links.

Aviation Research Grants
All colleges, universities, and legally incorporated non-profit research institutions qualify for research grants. Research grants may use any scientific methodology deemed appropriate by the grantee. At the FAA, the evaluation criteria for grant proposals include the potential application of research results to the FAA's long-term goals for civil aviation technology. Appendix B provides a summary of grants issued in 2006. For more information, see http://www.tc.faa.gov/logistics/grants.

Partnerships (continued)

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. Appendix B provides a summary of the COEs. For more information, see http://www.coe.faa.gov.

Aerospace Vehicle Systems Institute
The Aerospace Vehicle Systems Institute is a cooperative industry, government, and academia venture for investigation and standardization of aerospace vehicle systems to reduce life-cycle cost and accelerate development of systems, architectures, tools, and processes. For more information, see http://avsi-tees.tamu.edu.

International

The FAA uses cooperative agreements with European and North American aviation organizations to participate in air traffic management modernization programs and to leverage research activities that harmonize operations and promote a seamless air transportation system worldwide.

EUROCONTROL
The European Organization for the Safety of Air Navigation (EUROCONTROL) is a civil and military organization with the goal 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 and will continue to study air quality at Canadian airports to develop and implement practices that reduce air pollution from airports. Canada, as a member state of the International Civil Aviation Organization, is working to reduce smog-forming pollutants from the aviation sector and participates in the COE partnership to advance the state of knowledge in many key areas.

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. Instead, evaluation of R&D requires consideration of quality, relevance, and performance. Today, the FAA accomplishes evaluation through both formal and informal reviews performed by internal and external groups.

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. The iCMM® provides a single model of best practice for enterprise-wide improvement. As a result of an internal review, the FAA created processes to improve its management of the R&D program. These processes received maturity ratings of 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 R&D sponsors of the FAA. 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.

External Program Reviews

The FAA R&D program receives continuous external review from advisory committees to ensure that it meets customer needs and is technically sound. The FAA also seeks feedback from the National Academies and through user surveys and discussion groups. Researchers present progress reports at public forums and science reviews, publish and present technical paper, obtain formal peer validation of science, train specific users on product usage, and maintain and share lessons learned.

Evaluation

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 research activities with other government agencies and industry. The committee considers aviation research needs in the six areas of air traffic services, airport technology, aircraft safety, aviation security, human factors, and environment and energy.[26] A maximum of 30 members serve on the committee and represent corporations, universities, associations, consumers and government agencies. For more information, see http://research.faa.gov/redac.

During 2006, the REDAC held two committee meetings and 11 subcommittee meetings and produced six reports: *Guidance for FAA Fiscal Year 2008 R&D*, November 8, 2005; *Transitioning Air Traffic Management Research into Operational Capabilities*, November 8, 2005 (final report); *Review of Skills Training and Needs of the Next Generation Controller Workforce*, November 8, 2005; *Financing the Next Generation Air Transportation System*, June 8, 2006; *Review of FAA Fiscal Year 2008 R&D Program Plans*, June 20, 2006; and *Separations Standards Working Group Final Report*, September 20, 2006. Appendix C provides the recommendations from these reports and Agency responses.

Commercial Space Transportation Advisory Committee
Established in 1984, the Commercial Space Transportation Advisory Committee (COMSTAC) provides information, advice, and recommendations to the Administrator on matters relating to the U.S. commercial space transportation industry, including research and development (R&D) activities. A maximum of 25 members serve on the committee. Each member is recommended by the Administrator and appointed by the Secretary of Transportation for a two-year term. Members represent the commercial space transportation industry, academia, state and local government, and space advocacy groups. The COMSTAC provides annual recommendations for commercial space transportation R&D projects and periodically reviews the FAA R&D reports and activities. For more information, see http://www.faa.gov/about/office_org/headquarters_offices/ast/industry/advisory_committee/

During 2006, the COMSTAC held two committee meetings and seven working group meetings and produced one report, *The 2006 Commercial Space Transportation Forecasts*, dated May 2006.

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. The board 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. The board's primary sponsor is NASA, but it also performs studies for other agencies.

During 2006, the ASEB conducted a *Decadal Survey of Civil Aeronautics* to identify a ten-year strategy for the federal government's involvement in civil aeronautics, with particular emphasis of NASA's research portfolio.[27] The report identifies research challenges

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[26]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.
[27]http://www.nationalacademies.org/aseb

and prioritizes these challenges relative to their ability to improve the nation's air transportation system. For more information, see: http://www.nationalacademies.org/aseb.

Transportation Research Board

The National Research Council established the Transportation Research Board (TRB) in 1920 as an advisory board for highway research. In 1974 it was renamed TRB to reflect its expanded services to all modes of transportation. The TRB mission is to promote innovation and progress in transportation through research. It fulfills this mission through the work of its standing committees and task forces. The TRB manages the Airport Cooperative Research Program (ACRP) for the FAA with program oversight and governance provided by representatives of airport operating agencies.

During 2006, the ACRP officially started when a Memorandum of Agreement was executed by the cooperating parties, in October 2005, and the FAA provided funds to begin the program and to carry out research projects. The ACRP Governing Board was appointed by Secretary of Transportation Norman Mineta and held its first meeting in January 2006 to establish operating procedures and to prioritize research needs. For more information, see: http://www.trb.org/crp/acrp/acrp.asp

Abbreviations & Acronyms

AEP	[FAA – Staff Office] Aviation Policy, Planning and Environment
AIP	[FAA Budget Appropriation] Airport Improvement Program
ARP	[FAA – Line of Business] Airports
ASEB	National Academy Aeronautics and Space Engineering Board
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
ATO Capital	[FAA-Budget Appropriation]
ATOP	Advanced Technologies and Oceanic Procedures
AVS	[FAA – Line of Business] Aviation Safety
CAASD	[MITRE] Center for Advanced Aviation System Development
CDA	Continuous-descent Approach
CDTI	Cockpit Display of Traffic Information
COE	Center of Excellence
COMSTAC	Commercial Space Transportation Advisory Committee
CRDA	Cooperative Research and Development Agreement
DARWIN™	Design Assessment Reliability and Inspection
DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOT	Department of Transportation
EA	Enterprise Architecture
EUROCONTROL	European Organization for the Safety of Air Navigation
FAA	Federal Aviation Administration
FY	Fiscal Year
GA	General Aviation
GEOSS	Global Earth Observation System of Systems
GPS	Global Positioning System
HAP	Hazardous Air Pollutants
HUMS	Health and Usage Monitoring Systems
iCMM®	Integrated Capability Maturity Model
IPT	Integrated Product Team
JPDO	Joint Planning and Development Office
JRC	[FAA] Joint Resources Council
LAAS	Local-Area Augmentation System
MOA	Memorandum of Agreement
MoC	Memorandum of Cooperation
MOU	Memorandum of Understanding
NARP	National Aviation Research Plan

NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NextGen	Next Generation Air Transportation System
NOx	Oxides of nitrogen
OEP	Operational Evolution Partnership
OI	Operational Improvement
OMB	Office of Management and Budget
OSTP	[Executive Office of the President] Office of Science and Technology Policy
PARTNER	Partnership for AiR Transportation Noise and Emissions Reduction
PM	Particulate Matter
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
RNAV	Area Navigation
RNP	Required Navigation Performance
SBIR	Small Business Innovation Research
SF	Safe Flight
S&O	[FAA Budget Appropriation] Safety and Operations
TCAS	Traffic Collision Avoidance System
TMA	Traffic Management Advisor
UAS	Unmanned Aircraft Systems
VFR	Visual Flight Rules
WJHTC	William J. Hughes Technical Center