A REVIEW OF AERONAUTICS R&D AT FAA AND NASA

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE AND AERONAUTICS

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

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A REVIEW OF AERONAUTICS R&D AT FAA AND NASA

THURSDAY, MARCH 6, 2003

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE AND AERONAUTICS,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:08 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Dana Rohrabacher [Chairman of the Subcommittee] presiding.

HEARING CHARTER

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

A Review of Aeronautics R&D at FAA and NASA

THURSDAY, MARCH 6, 2003
10:00 A.M.–12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose of Hearing

On Thursday, March 6, 2003, at 10:00 a.m., in room 2318 Rayburn House Office Building, the Subcommittee on Space and Aeronautics will hold a hearing on the Fiscal Year 2004 budget request for aeronautics research and development programs at the Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA). The hearing will explore each agency's strategic plan for aeronautics research, how well their plans align with their budget request and industry needs, and the coordination of research activities between FAA and NASA.

2. Major Issues

Decline in aeronautics research and development spending in the face of looming industry challenges. Between FY 1998 and FY 2003, NASA cut aeronautics research by half. Even though the FY 2004 NASA budget request reflects a one percent increase in aeronautics technology funding compared to FY 2003, over the next five years, funding will be reduced by four percent (without accounting for inflation). FAA funding has also been reduced. The FY 2004 request is $279.0 million, about a five percent reduction from the previous year.

U.S. aerospace industries are highly reliant on technologies enabled by NASA—and to a lesser extent by FAA—research. Aerospace business markets today make it difficult for companies to invest huge sums in high-risk, long-term R&D activities. The consequences of insufficient research and development investment are already being felt in several ways. Key issues include the following:

- **Aviation Gridlock.** Beginning in the late 1990s, and especially during the summer of 2000, our nation's air traffic control infrastructure was unable to accommodate growth in traffic demand. As a result, commercial air carriers routinely suffered from system delays caused by congestion along busy airway corridors and lack of capacity at many of the larger hub airports to land or takeoff. Traffic declined following the September 2001 terror attacks, but is expected to resume an annual growth rate of 3.8 percent.
- **Eroding U.S. Share in International Aerospace Markets.** Our country's sole domestic producer of large civil aircraft (Boeing) faces fierce competition from the European manufacturer, Airbus, for sales of large civil aircraft. For the first time ever, Airbus won 50 percent of new aircraft orders during 2002.
- **Elimination of Rotorcraft R&D.** Rotorcraft continue to serve many important civil and military markets here and abroad, yet much research remains to be done to make them quieter, more robust, and more efficient. In FY 2003, NASA proposed elimination of rotorcraft research and did so again in the FY 2004.
- **Noise and Emissions Reduction.** The future success of commercial civil aerospace products will rely heavily on developing quieter and less polluting aircraft. International standards setting organizations, and particularly some European countries, are proposing noise and emissions reductions requirements to meet environmental concerns. NASA proposes augmenting its Quiet Aircraft Technology program in the FY 2004 budget to meet this challenge. The goal is to accelerate the development and transfer of technologies to reduce perceived noise by half by 2007 compared to a 1997 baseline.

FAA's Research and Development Funding Structure. FAA's R&D is principally funded through its Research, Engineering and Development (R,E&D) account. Over the last several years, however, FAA has migrated a number of R,E&D activities into other operational accounts, making it difficult to get clear insight into FAA's aeronautics research and development programs.

FAA/NASA Collaborations—Joint Program Office. FAA and NASA are increasingly collaborating on research and development for next-generation airspace management and vehicle systems technologies. They are in the formative stages of creating a Joint Program Office (JPO)[1] to design and develop technologies to enhance capacity, safety, and efficiency of our National Airspace System. While the creation of the JPO is a clear sign that these issues are receiving greater attention, the cultures and missions of FAA and NASA are very different, so it will require significant and sustained commitment from all involved for it to succeed. Specifically, FAA is an operational agency primarily focused on safely and efficiently directing aircraft. In contrast, NASA is a research and development agency that—with respect to aeronautics—is not burdened by the same urgency confronting FAA to constantly maintain safe operations. NASA scientists and engineers perform remarkable research, but it may take them years to develop an operationally suitable technology for FAA to evaluate. Bridging these two divides has—in the past—proven difficult.

Effects of Full Cost Accounting at NASA. For the first time, NASA submitted its budget in full cost accounting. This means that all direct and indirect costs, such as institutional support, are in the same budget line, giving the appearance that its aeronautics budget nearly doubled over last year. NASA's aeronautics program is actually increased by only $10 million or one percent, and is projected to shrink by four percent over the next five years. While full cost accounting may reflect the true cost of programs, concerns have been raised that implementation of full cost accounting for NASA-owned facilities such as wind tunnels and engine test stands may result in much higher rental fees to outside researchers. If costs are too high, researchers may choose to use wind tunnels in other countries, jeopardizing the security of their research findings.

3. Background

Since the late 1940's, aerospace has been a major source of high paying jobs that has created and sustained a variety of other high technologies. Aerospace is the largest source of exports (measured by dollars) for the United States. Over the last two decades market forces, international competition, and industry consolidations have reduced the number of domestic large civil airframe manufacturers[2] to just one: the Boeing Company. The number of domestic manufacturers of turbine power plants has been reduced to two: (Pratt and Whitney; General Electric). There is no domestic manufacturer of regional jets, the largest growth segment in our domestic commercial aviation system today.

On November 18, 2002, the Congressionally-chartered *Commission on the Future of the United States Aerospace Industry* produced its final report.[3] The Commission raised a number of issues about the ability of domestic companies to maintain primacy in aerospace markets worldwide. Specifically, the Commission is concerned that the decline in federal aeronautics research spending, and the lack of coordination among executive and legislative entities that control investment strategy, will undermine U.S. dominance in the aerospace industry.

The Commission also cited growing efforts by foreign governments to develop aerospace capabilities through subsidization of product development and sales costs. In particular, the Commission highlighted the European Union's "Aeronautics 2020" program that seeks to coordinate the research and manufacture of European-produced aerospace products among its member states. The program also sets specific market-share targets for European-produced civil and military aerospace products in world markets, and the development of a European designed and manufactured air traffic management system.

4. Federal Aviation Administration Research and Development

FAA's overall mission is to provide ". . .a safe, secure, and efficient global aerospace system that contributes to national security and the promotion of U.S. aerospace safety." It achieves these goals by regulating the design, development and operation of aircraft flown in U.S. airspace, and by managing the National Airspace

[1] FAA and NASA have invited DOD, DOT, the Department of Homeland Security, and the Department of Commerce to join this effort.

[2] While Boeing is the only domestic supplier of large civil aircraft, there are multiple domestic suppliers for military and general aviation aircraft.

[3] The full Science Committee has scheduled a hearing on the Commission's Final Report for Wednesday, March 12, at 2:00 p.m. The Report can be found at *www.aerospacecommission.gov/*.

System (NAS) through a nationwide network of air traffic control facilities. For FY 2004, FAA proposes to spend just over $14 billion to perform these missions.

FAA proposes to spend $279.0 million on research and development, about two percent of the agency's $14 billion budget. R&D supports three strategic goals:

- **Safety:** By 2007, reduce U.S. aviation fatal accident rates by 80 percent from 1996 levels.
- **System Efficiency:** Provide an aerospace transportation system that meets the needs of users and is efficient in the application of FAA and aerospace resources.
- **Environment:** Prevent, minimize and mitigate environmental impacts, which may represent the single greatest challenge to the continued growth and prosperity of civil aerospace.

FAA funds R&D to achieve these goals in three accounts: Research, Engineering and Development; Airport Improvement Program; and the Facilities and Equipment Program.

FAA Research and Development Funding - FY04 Budget Request
($=Thousands)

Program	FY03 Request	FY04 Request	FY05 Runout	FY06 Runout	FY07 Runout	FY08 Runout	TOTAL FY04-FY08
Research & Development - TOTAL	$295,511	$279,317	$290,392	$290,893	$301,045	$292,227	$1,453,849
Airport Improvement Program	14,106	17,417	17,592	17,793	17,646	17,766	88,349
Facilities & Equipment Program*	154,569	161,900	170,800	168,100	176,400	164,400	841,300
Research, Engineering & Development	126,836	100,000	102,000	105,000	106,999	110,061	524,060

* FAA's Federally Funded Reseach and Development Center is included in the F&E account.

FAA's national research laboratories are located at the William J. Hughes Technical Center, Atlantic City, NJ.

5. National Aeronautics and Space Administration—Aeronautics R&D

NASA's Aeronautics Technology Research and Development program is funded through the Office of Aerospace Technology account. The mission of this program is to perform R&D to enable a safer, more secure, environmentally friendly and efficient air transportation system, increase the performance of military aircraft, and develop new uses for science for commercial missions. Through partnerships with the Defense Department and FAA, NASA conducts research to enhance the security of the National Airspace System. Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive controls, advanced vehicle designs, and collaborative design and development tools. As indicated earlier, NASA is collaborating with FAA in a Joint Program Office to address air traffic management technologies.

Aeronautics R&D funding has been cut by one-half since FY 1998. The FY 2004 budget request essentially flat-funds the program for this year and projects a four percent decrease over five years. As reflected in the budget table in the appendix, the Aeronautics Technology budget has three major R&D activities. They are:

- **Aviation Safety and Security:** Aviation Safety and Security is aimed at research and technologies that will improve vehicle safety, weather forecasting and display tools, system safety technologies, and aviation security technologies. Examples include developing "refuse to crash" aircraft; synthetic vision; and improving human/machine integration in design, operations, and maintenance.
- **Airspace Systems:** Airspace Systems is focused on developing system and software tools to enable major increases in the capacity and mobility of the air transportation system for operations and vehicle systems. Examples include the Small Air Transportation Systems (SATS) program to permit all-weather operations by non-commercial aircraft at untowered fields; the Virtual Airspace and Modeling Simulation (VAMS) program to give researchers a computer-generated "virtual" environment to test new air traffic control concepts and procedures; and a new initiative for FY 2004, the NASA Exploratory Technologies for the National Airspace System (NExTNAS), to conduct assessments of distributed air/ground traffic management concepts.

- **Vehicle Systems:** Vehicle Systems research focuses on developing technologies for future aircraft and air vehicles that, if implemented, will reduce NO_X emission to reduce pollution near airports and in the lower atmospheric zone, reduce emissions of the greenhouse gas CO_2, and reduce aircraft noise. NASA also conducts longer-term research on technologies for next generation vehicles through this activity.

NASA - Aeronautics Technology FY04 Budget Request
($=Thousands)

Program	FY03 Request*	FY04 Request	FY05 Runout	FY06 Runout	FY07 Runout	FY08 Runout
Aeronautics Technology - TOTAL	$949.2	$959.1	$932.2	$938.7	$933.8	$916.4
Aviation Safety & Security	156.2	168.5	188.4	175.2	178.2	170.9
Vehicle Systems	604.6	573.5	585.8	591.4	571.7	569.5
Airspace Systems	188.4	217.1	158.0	172.1	183.9	176.0

*Reflects Full Cost Accounting.

New Initiatives—NASA Aeronautics:

NASA's FY 2004 budget request includes three new initiatives within Aeronautics Technology. They are:

- **Aviation Security:** NASA proposes to spend $21 million for FY 2004; $225 million over five years (funded through the Aviation Safety and Security Program) to help reduce the vulnerability of aviation to terrorist and criminal acts.
- **National Airspace System Transition:** NASA proposes to spend $27 million for FY 2004; $100 million over five years (funded through the Airspace Systems Program) on technologies for a next-generation National Airspace System.
- **Quiet Aircraft Technology:** NASA proposes an augmentation to an existing program for quiet aircraft. NASA proposes to spend an additional $15 million in FY 2004, and an additional $100 million over five years. In total, this program will receive $271.6 million over five years (funded through the Vehicle Systems Program). The goal is to accelerate development and transfer of technologies to reduce perceived noise by half by 2007 compared to a 1997 baseline.

NASA Aeronautics research is conducted primarily at the Langley Research Center (VA); Ames Research Center (CA); Dryden Flight Research Center; and the Glenn Research Center (OH).

6. Legislation

Both the FAA and NASA are due to be re-authorized this year.

Rep. John Larson, a Member of the Science Committee, introduced legislation earlier this year to increase federal investment in aeronautics R&D. H.R. 586, the Aeronautics Research and Development Revitalization Act of 2003, seeks to double NASA's and FAA's aeronautics research budgets, and authorizes research activities for rotorcraft, noise and emissions reduction.

7. Witnesses

Dr. Jeremiah Creedon, Associate Administrator for Aerospace Technology, NASA. Dr. Creedon has been asked to address the following questions: How does NASA's aeronautics research and development program balance between serving near-term industry needs and the pursuit of long-term, high-risk, revolutionary projects? What is NASA's vision for meeting projected traffic levels in the year 2020 for the National Airspace System? What is NASA's assessment of the conclusions and recommendations put forth in the *Final Report of the Commission on the Future of the United States Aerospace Industry* that address air traffic management and aerospace research and development? What changes, if any, will outside customers at NASA's aeronautics research centers and associated facilities experience as a result of implementing full cost accounting?

Mr. Charlie Keegan, Associate Administrator for Research and Acquisitions, FAA. Mr. Keegan has been asked to address the following questions: What is the rationale for spreading the agency's research and development activities across several accounts? Is the level of investment in research and development adequate to meet future agency needs, especially in the areas of aircraft safety certification and modernization of air traffic management? From a management perspective, what distinctions, if any, result from funding a research and development project in an operational account? How are requirements, proposed research projects, and technology handoffs for joint programs passed between FAA and NASA?

Dr. R. John Hansman, Professor of Aeronautics and Astronautics, MIT. Dr. Hansman has been asked to address the following questions: How relevant is federal aeronautics R&D conducted by NASA and FAA to the demands that commercial and general aviation users are expected to impose on our National Airspace System in the future? How do the NASA and FAA aeronautics research portfolios distinguish themselves from R&D conducted by our foreign competitors? How have university-based researchers dealt with funding and programmatic changes in federally-sponsored aeronautics research programs? Do you believe our aerospace manufacturing capabilities are at risk of a long and protracted retrenchment?

Mr. Mac Armstrong, Senior Vice President—Operations & Safety, Air Transport Association. Mr. Armstrong has been asked to address the following questions: What is your assessment of FAA's and NASA's investment strategies and level-of-effort for civil aeronautics research and development, and the usefulness of the resulting technologies to builders and users of commercial aircraft? What is your assessment on the future of our national airspace system and the potential for current investments to meet this challenge? How satisfied is the air carrier industry with R&D investment in emissions and noise reduction technologies?

Appendix A

FAA Research and Development Funding - FY04 Budget Request
($/Thousands)

Program / Project	FY03 Request	FY04 Request	FY05 Runout	FY06 Runout	FY07 Runout	FY08 Runout	TOTAL FY04-FY08
Research & Development - TOTAL	[illegible]	$279,317	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Airport Improvement Program	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Airports Technology - Efficiency	6,506	7,750	7,636	7,306	7,965	8,865	39,234
Airports Technology - Safety	7,600	9,957	9,764	9,892	9,901	9,797	48,713
Facilities and Equipment Program	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Airspace Management Laboratory	4,600	7,000	9,000	9,500	10,200	12,000	47,700
Aviation System Capacity Improvement	5,200	6,500	8,100	8,700	9,300	10,000	42,600
Center for Advanced Aviation Systems Development	81,264	80,000	99,400	100,000	105,000	110,300	501,600
Cyber Security for NAS Development	2,820	1,700	3,700	2,000	3,000	3,000	11,400
Domestic Reduced Vertical Separation Minima (DRVSM)	2,100	1,800	*	*	*	*	1,800
Free Flight - Phase 2	7,000	0	2,200	0	&	0	2,200
General Aviation and Vertical Flight Technology	1,000	1,400	1,500	1,500	2,000	2,000	8,400
NAS Requirements Development	3,000	3,000	3,000	3,000	3,600	3,100	15,700
NAS Safety Assessments	0	1,000	&	&	&	&	1,000
Navigation - LAAS	2600	0	&	0	&	0	2,600
Navigation - WAAS	3100	0	&	0	&	0	3,100
Operations Concept Validation	2,500	2,700	5,000	5,000	6,200	8,000	27,500
Required Navigation Performance	0	2,000	*	*	*	*	2,000
Runway Incursion Reduction	8,700	8,200	8,200	9,100	6,300	4,900	36,700
Safe Flight 21 - Alaska Capstone	15,000	21,400	19,100	14,500	16,600	0	71,600
Safe Flight 21 - Ohio River Valley	11,400	6,000	10,800	6,000	5,400	0	28,200
Safer Skies	3,000	3,400	3,000	3,000	3,000	3,000	15,400
Separation Standards	2,200	2,500	2,500	3,100	3,700	5,000	16,800
Software Engineering R&D	1,000	1,500	1,100	2,100	3,100	3,100	10,900
Research, Engineering and Development	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Advanced Materials/Structural Safety	3,050	2,700	2,835	2,926	3,000	3,066	14,525
Aeromedical Research	6,006	6,262	6,659	6,939	7,288	7,692	34,859
Aging Aircraft	20,211	17,000	18,212	18,752	18,860	19,658	93,272
Air Traffic Control/Airway Facilities Human Factors	10,211	9,099	9,100	9,043	9,860	10,221	47,726
Aircraft Catastrophic Failure Prevention Research	1,520	792	796	815	847	872	4,078
Aviation Weather - Efficiency	9,099	0	0	0	0	0	0
Aviation Safety Risk Analysis	6,013	7,096	8,036	8,208	8,307	8,600	40,919
Environment and Energy	7,696	7,873	8,085	8,289	8,386	8,683	41,321
Fire Research and Safety	6,429	7,526	7,902	8,149	8,330	8,682	40,689
Flight Deck/Maintenance/System Integration Human Factors	10,411	8,394	8,588	8,809	9,068	9,333	44,202
Flight Safety/Atmospheric Hazards Research	4,430	4,086	4,696	4,837	4,508	4,062	24,186
Propulsion and Fuel Systems	8,711	1,148	1,186	1,354	1,312	1,373	6,364
Strategic Partnerships	610	0	0	0	0	0	610
System Planning and Resource Management	1,489	1,261	1,270	1,296	1,302	1,326	6,455
Weather Program - Safety	19,406	20,852	21,200	21,463	21,813	22,024	107,352
William J. Hughes Technical Center Laboratory	6,495	3,425	3,541	3,679	3,500	3,646	18,398

* Funding requests are under review
& Program schedule under development

Appendix B

National Aeronautics and Space Administration
Aeronautics Technology
($ Millions)

	Business as Usual	FULL COST					
Program	President's FY03 Request	Est. President's Req. FY03	FY04	FY05	FY06	FY07	FY08
Aeronautics Technology	**$541.4**	**$949.2**	**$959.1**	**$932.2**	**$930.7**	**$933.8**	**$916.4**
Aviation Safety & Security	**95.0**	**156.2**	**168.5**	**188.4**	**175.2**	**178.2**	**170.9**
Vehicle Safety Technologies	46.8	83.9	74.5	81.5	-	-	-
System Safety Technologies	24.3	31.6	31.3	20.7	-	-	-
Weather Safety Technologies	28.9	40.7	42.3	42.5	-	-	-
Integrated Intelligent & Intuitive Sys.	-	-	-	-	117.5	119.8	126.2
Aviation Security Technologies	-	-	20.6	43.7	57.7	58.4	44.7
Vehicle Systems	**321.3**	**684.6**	**593.9**	**555.9**	**591.4**	**571.7**	**568.5**
Quiet Aircraft Technology (QAT)	20.0	41.4	60.2	71.0	74.0	25.0	
21st Century Aircraft Technology (TCAT)	29.0	46.0	42.0	42.5	42.1	-	-
Flight Research	58.9	91.4	85.4	43.3	10.5	-	-
ERAST	(20.0)						
Advanced Vehicle Concepts	34.7	72.5	41.2	40.7	-	-	-
Hyper-X	(21.0)						
Breakthrough Vehicle Technologies	61.9	124.2	119.5	115.9	143.1	-	-
Ultra Efficient Engine Technologies	50.0	87.8	90.0	88.1	91.0	-	-
Propulsion and Power	66.8	141.3	139.6	125.1	31.0	-	-
Clean Adaptive Vehicle Systems	-	-	-	50.2	199.7	546.7	568.5
Airspace Systems	**125.1**	**188.4**	**217.0**	**158.6**	**172.1**	**183.9**	**176.0**
Adv. Air Transportation Technology (AATT)	71.6	103.5	109.6	-	-	-	-
Small Aircraft Transportation System (SATS)	20.0	29.2	30.6	9.9	-	-	-
Virtual Airspace Modeling & Simulation (VAMS)	23.0	35.5	33.3	33.0	35.0	34.0	-
Aviation Operations Systems	10.5	28.4	20.6	19.3	12.5	-	-
NASA Exploratory Technologies - NAS (NExTNAS)	-	-	21.0	95.8	124.8	149.9	176.0

Chairman ROHRABACHER. I hereby call this meeting of the Space and Aeronautics Subcommittee to order. Without objection, the Chair will be granted the authority to recess this committee just in case we have votes. At today's hearing we will explore plans for aeronautics research and development at the FAA and NASA. This year, of course, marks the 100th anniversary of the Wright brothers' first flight. What was the date?

Dr. CREEDON. December 17.

Chairman ROHRABACHER. All right. December 17.

Dr. CREEDON. 1903.

Chairman ROHRABACHER. And that is going to be quite a day. I am looking forward to it and I am very grateful that I will have the opportunity of being the Chairman of this particular Subcommittee on that date. So I believe that an appropriate way to honor these pioneers of aviation is to continue the remarkable trend of technological advancement that they began and that we have witnessed this incredible moving forward, moving up, over this last 100 years.

Unfortunately, the budgets for NASA and the FAA clearly reflect a somewhat lackluster commitment to our future in aeronautics if that is the way our commitment to the future of aeronautics is to be judged. In fact, NASA cut funding for aeronautics research in half over the last 10 years and now spends only $1 out of every $16 on aeronautics. This year, NASA proposes to cut the program by an additional five percent over the next five years. Meanwhile, the FAA proposed only a modest increase in its program over the next five years. However, we must not simply look at budget proposals. As I say, we must also clearly examine whether these programs are properly focused and whether they are relevant to our national goals and objectives. Preserving our aerospace industry's edge over fierce international competition, however, will require a greater emphasis and attention to these goals.

Given the recommendations of the Commission on the Future of the United States Aerospace Industry, what is the rationale for continuing to cut aeronautics R&D—something we need to know. How should the Government help stop the erosion of the U.S. market share in international aerospace sales? Finally, what can be done to accelerate the transition of new technologies that are being developed in the United States and throughout the world into operational use and what kind of problem is that? Where do we have technologies that are waiting to be used or being kept off the market for some reason, and perhaps that is more important than spending more money.

Today's discussion will address these and other critical issues. And during the past 100 years, our nation's commitment to aviation and aeronautics propelled our nation's industries and our economy. If we are to be the world leader in terms of the economic well being of our people and the competitiveness of our industries, we must be the world's number one aerospace nation as well. So we can expect nothing less because they are so intertwined with our economic well being and whether or not we are number one in space and whether our aeronautics is able to outcompete those overseas.

I would be recommending—saying that we are going to go to Bart Gordon now, but he is not here. But when he arrives, we will make sure he gets—Mr. Wu, would you like to say a few words in the meantime?

[The prepared statement of Chairman Rohrabacher follows:]

PREPARED STATEMENT OF CHAIRMAN DANA ROHRABACHER

Today's hearing will explore plans for aeronautics research and development at the FAA and NASA. This year marks the 100th anniversary of the Wright brothers' first powered flight. I know of no better way to honor the pioneers of aviation than to continue the remarkable trend in technological advancement witnessed over the last one hundred years.

Unfortunately, the budgets for NASA and the FAA clearly reflect a lackluster commitment to our future in aeronautics. In fact, NASA has cut funding for aeronautics research in half over the last ten years and now spends only one dollar out of every sixteen dollars on aeronautics. This year, NASA proposes to cut the program by an additional five percent over the next five years. Meanwhile, FAA proposes only a modest increase in its program over the next five years. However, we must not simply look at the budget proposals to judge these programs, we must also closely examine whether these programs are properly focused and relevant to national goals and objectives. Preserving our aerospace industry's edge against fierce international competition will require greater emphasis and attention to these goals.

Given the recommendations of *The Commission on the Future of the United States Aerospace Industry,* what is NASA's rationale for continuing to cut its aeronautics R&D program? How should the government help stop the erosion of U.S. market share in aerospace? Finally, what can be done to accelerate the transition of new technologies to operational use? Today's discussion will address these and other critical issues.

During the past one hundred years, our nation's commitment to powered flight propelled the aviation industry. We can expect nothing less for the future.

Mr. WU. Thank you very much, Mr. Chairman. I believe that Mr. Gordon will be making an opening statement when he arrives. Since you all represent so much of American aeronautics and astronautics research, I just want to relay to you all a conversation I had with a professor of aeronautics and astronautics a few weeks ago. Not wanting to disturb the folks at NASA who are obviously focused on immediate challenges on February 1, I began a series of conversations with academicians about our current state of space programs, but the example which I found striking was that one of these individuals stated, you know, say that we first started using jet engines, prevailing use of jet engines, around 1950 or so. At that point, we had to tear them down after about 100 hours of use. And 50 years later, say around the year 2000, we get, roughly, 20,000 hours out of the engines that you ride on in a 747 before you have to tear the jet engine down. From 100 hours to 20,000 hours.

We have been in space for almost the same period of time, say, roughly, 1960 to the year 2000, and yet, the dependability, the safety of space flight, has not increased along the same curve that this jet engine dependability has, and there are sound reasons why those two scenarios are slightly different, but the difference is really quite striking. And I think that our aerospace community has further work to do in this arena and Congress has responsibilities in this arena to make sure that we do our best to bring these curves together as best we can. They will never be the same curve, but the striking difference between jet engines going from 100 hours between maintenance to 20,000 hours, and space flight right now going at the failure rate of one every fifty-seven missions, that

that is something that we do not want to tolerate going forward into the future.

Thank you for the time, Mr. Chairman.

Chairman ROHRABACHER. Okay. Thank you, Mr. Wu, and we will permit Mr. Gordon a short opening statement when he arrives. Apparently, there has been a personal family situation there. So without objection, the opening statements of other Members will be put into the written record so we can get right to the testimony. Hearing no objection, so ordered. I also ask unanimous consent to insert in the appropriate place in the record the background memorandum prepared by the Majority Staff for this hearing. Hearing no objection, so ordered.

And we do have today some distinguished witnesses, and we want to thank each and every one of you for being with us, but we would also like you to summarize your statement in fact. Usually, I ask for five-minute summaries. If you can do it in any less than that, Curt Weldon, who is one of the more aggressive members of both the DOD Committee and this committee, has asked for time to get at you. He won't be able to get at you if you are using all the time up, so we would like it very much if you could just summarize your statements and then we would want to focus on the questions and answers and a dialogue between us.

So with that said, our first witness is Dr. Jeremiah Creedon, who is NASA's Associate Administrator for Aerospace Technology, and Dr. Creedon, you may proceed.

STATEMENT OF JEREMIAH F. CREEDON, ASSOCIATE ADMINISTRATOR FOR AEROSPACE TECHNOLOGY, NASA

Dr. CREEDON. Thank you, Mr. Chairman. I want to thank all the Members of the Committee for the opportunity to summarize my written submission, and I will try to be brief. I would like to recognize my colleagues at the table here and acknowledge that the partnerships that we at NASA have as we try to execute our research and technology development are very important and vital to us, and we are very proud to be working with them on the future and trying to realize a bright future for aviation.

That future is based on technology and innovation. The Commission on the Future of Aerospace Industry in the United States was asked to study what needed to be done to ensure a bright aerospace industry future. They made a number of recommendations; in fact, a total of nine. Five of those recommendations had to do with technology. The Commission clearly stated that research and technology is the foundation for the future of the aerospace industry, and I would like to quote very briefly from the report. "Aerospace is a technology driven industry. Long-term research and innovation are the fuel for technology. U.S. aerospace leadership is a direct result of our preeminence in research and innovation."

The Commission recommended a number of investments. We feel that NASA's programs are investments of the type that the Commission recommended. We also feel that our current and planned efforts are well in alignment with the Commission's recommendation. In response to what we feel are the national needs, we have proposed a number of changes in the aeronautics technology program for Fiscal Year 2004, and I would like to briefly describe a few of these changes.

First of all, we proposed an increase in the funding for quiet aircraft technology. Our goal in this area is to take the objectionable noise from airplanes and contain it within the airport boundary. And Mr. Chairman, in your opening remarks, you talked about the transfer of the technology to people that will actually implement it. This increase that we have put into the program is an attempt to more quickly accelerate those technologies to the point where the aerospace industry can consider implementing them.

In the aftermath of September 11, the President's 2004 budget request includes funds for a new NASA effort in aviation security. That effort will be focused on protecting aircraft in the national aerospace system from criminal and terrorist attacks, as well as improving the efficiency of the security measures that the country has undertaken. We have also requested $8 million for getting more routine operations of unmanned air vehicles in the national airspace system. These vehicles have potential applications not only in the area of Homeland Security, but in communications and monitoring the earth's resources.

I want to talk a few minutes about the extremely important area of the national airspace system. The current system is suffering from the combined effects of September 11, but the aviation system will, in fact, recover. But as it recovers, it may recover in some different format, in some different methods of operation than was existing prior to September 11. In particular, we may see more use of secondary airports. Accordingly, we are going to continue our work on our SATS, or small aircraft transportation system, because we believe that holds the promise of bringing much improved air access and much improved mobility to the population by making better use of secondary airports.

We also intend to continue working with the FAA on two things. First, working with them as we have been on their implementation of the OEP. But also, we are going to be working with them on defining and realizing a future air transportation system. We have proposed investing $27 million starting in 2004 for a national airspace system transition initiative. Research within this program, which we will do jointly with the FAA and others, will focus on what a future system might look like and what we would have to do to enable such a future system. Any future system must have the flexibility to move, and expand, and adapt to be responsive to the demands on the transportation system. And even if it is revolutionary, it must still allow continuous safe operations to occur even in the face of unpredicted events.

NASA and the FAA have a long and very productive relationship in aviation. The relationship is based on common objectives in unique and complimentary roles. NASA's role in the aerospace system is both on near-term and far-term research, while the FAA is more focused on research and development required to promote implementation of changes in the airspace system operations. We share the same objectives to increase the capacity and efficiency of the airspace system, to increase safety, to reduce the deleterious effects of emissions, and we have a number of ways that we coordinate with the FAA. We have inter-agency integrated product teams, where we share joint roadmaps for our work in this area and also in the work of safety.

In summary, NASA is proud of its continuing critical contribution to aeronautics. In this centennial year of the first powered flight by the Wright brothers, we look forward to a bright future of flight and working with our colleagues in bringing about that future. I would like to thank you for the opportunity to speak before you today, and I would be happy to try to answer your questions.

[The prepared statement of Dr. Creedon follows:]

PREPARED STATEMENT OF JEREMIAH F. CREEDON

Mr. Chairman and Members of the Subcommittee:

Thank you for this opportunity to testify on aeronautics research and technology (R&T) at NASA. I would also like to recognize my colleagues, Mr. Charles Keegan from the Federal Aviation Administration (FAA), Mr. Mac Armstrong from Air Transport Association, and Dr. John Hansman from the Massachusetts Institute of Technology, and. NASA considers our partnerships to be vital, and we are proud to work with them on the future of aviation.

That future is based on technology and innovation. NASA plays a critical role in supplying the aeronautics technology base for the Nation and has an extremely productive aeronautics R&T program—as recent accomplishments and applications of NASA technologies demonstrate. We have seen applications of technologies to improve safety, reduce environmental impact and improve the efficiency of aviation operations. For example, in aviation safety new weather information systems based on NASA technology developments are reaching the market place. Synthetic vision systems, which will allow clear-day views of terrain and air craft in all-visibility conditions, are in the commercialization phase and more safety technologies are on their way.

In the environmental area, we have seen the recent commercialization of a jet engine combustor that resulted from a NASA-sponsored demonstration to reduce NO_X emissions by 50 percent compared to ICAO regulatory standards, and we have recently completed sector testing of a combustor concept that reduces NO_X by 67 percent. We have also seen the commercialization of noise reduction technologies, like serrated nozzles that reduce jet noise by three decibels, equivalent to half the sound energy. Overall, we have demonstrated five decibels of integrated noise reductions compared with the 1997 state-of-the-art and have identified technologies for five decibels of additional reductions.

We are making significant progress on more breakthrough technologies. We recently demonstrated key processes and methods for the development of nanotube reinforced polymer composites that would provide revolutionary improvements in structural strength-to-weight ratios. We've also demonstrated advanced aerodynamics flow control techniques that would allow highly efficient and simpler vehicle controls and high-lift systems. Significant progress continues in the areas of autonomy and intelligent, reconfigurable flight controls. All of these technologies represent steps on the path to a new generation of safe, smart, environmentally benign aircraft.

A Balanced Portfolio

NASA invests in long-term, high-risk, high-payoff research in pre-commercial technologies in which industry cannot invest and in both nearer term and longer-term research focused on public good issues such as environmental compatibility, safety, and air traffic management.

Provision of air service is also a public good. Since airline deregulation, the U.S. has mainly relied on market forces to ensure that the most efficient level of air service is provided to communities. However, it is in the public good to technologically enable better air service to more communities. Therefore, we seek partnerships, such as our Small Aircraft Transportation System (SATS) project, that enable greater mobility for more of the Nation. In addition, there is a large government role in the provision of air traffic management services. NASA works closely with the FAA to enable future improvements to the system to improve capacity, efficiency and safety in response to market demand for growth and change.

An entirely new level of performance can be achieved through the integration of many breakthrough vehicle and airspace capabilities. This requires a broad-based investment in basic research and technology. Technologies with application horizons many years in the future are chosen by evaluating the most promising technology pathways in the highest leverage areas. As technologies mature, we evaluate them to ensure adequate progress is being made and their performance potential remains worthy of investment. We continuously seek technology pull opportunities to bring focus and opportunities to demonstrate technology. For example, unmanned aerial vehicles, from a technology viewpoint, provide not only unique applications, such as remote sensing, but also can be technology pathfinders for other commercial or military aviation applications.

The Aerospace Commission

The Aerospace Commission made nine recommendations to ensure the health of the U.S. aerospace industry. Five of which have a strong focus on research and technology. The Commission clearly stated that research and technology is the foundation for the future of the aerospace industry. Quoting directly from Chapter 9 of the report, "Aerospace is a technology-driven industry. Long-term research and innovation are the fuel for technology. U.S. aerospace leadership is a direct result of our preeminence in research and innovation."

The Commission recommends investments in this country's future. NASA's programs are the type of investment that the Commission recommends, and we believe NASA's current and planned efforts are in alignment with the thrust and intent of the Commission's findings and recommendations.

As discussed, we are investing in technologies to support the transformation of the National Airspace System as recommended in Chapter 2 of the report. In fact, through prioritization of activities within our budget, we propose to expand our investment in this area and we are working in partnership with the FAA on this critical issue.

As Chapter 2 of the Commission's report also notes, security is a key requirement of the future airspace system. We certainly agree and have been working since 9/11 to develop a responsive program that reflects NASA's unique strengths. We also propose to initiate an aviation security project that seeks to enable long-term, high-leverage solutions to eliminate key vulnerabilities within the aviation system.

Many of our efforts address the specific recommendations on breakthrough aerospace capabilities in Chapter 9 of the report. We have investments in all of the areas addressed: increased safety, reduced emissions, reduced noise, increased capacity and reduced trip time. Our FY 2004 budget request reflects adjustments to strengthen technology development in these key areas. Additionally, the Commission is justifiably concerned about the time it takes to transition research into products. At NASA, we measure our success in technology by the extent to which our results are transferred, and are applied. In recent years, we have transferred and seen the application of noise and emission reduction technologies, decision support tools for air traffic management, aviation safety technologies and more.

As it has in the past, NASA will continue to work closely and partner with the Department of Defense (DOD), the Department of Transportation (DOT), the Federal Aviation Administration (FAA), Department of Homeland Security, academia, and industry to ensure that the research that NASA pursues is deliberately and methodically integrated into useful and timely products and processes.

Significant Changes for FY 2004

NASA is proposing a number of key changes to the Aeronautics Technology program for FY 2004 in response to national needs and the role we play as outlined above. Our request for Aeronautics Technology is $959.1 million. I am pleased to report that through reprioritization within the President's FY 2004 budget, we have increased funding for the development of technology in several key areas.

Due to significant demand from the FAA and industry that we increase our investment in noise reduction to ensure rapid technology development and transfer, I am pleased to be able to inform you that the President's FY 2004 budget has increased the funding to address this critical aviation issue. NASA's *Quiet Aircraft Technology* project includes an increase of $15 million in FY 2004 for this work.

NASA is developing technologies that can directly change the noise produced by jet engines. Through an understanding of the basic physics of noise production we are able to interfere with the way that sound is produced, creating quieter aircraft for future travelers. We have also determined that a large part of the objectionable noise comes from parts of the aircraft other than the engines when the aircraft are approaching the runway. NASA is developing concepts for landing gear and wing configurations to reduce this objectionable noise. Physics-based tools to study noise propagation allow us to test the benefits of new flight profiles to bring the aircraft noise closer to the airport while maintaining flight safety.

In partnership with the engine and aircraft manufacturers and based on the results discussed earlier, we will be able to bring additional noise reduction technology to new aircraft more quickly than had been otherwise planned. We are expecting to demonstrate an additional five-decibel reduction in perceived noise by the end of FY 2007, leading to a total of ten-decibel reduction in comparison to the 1997 state of the art.

In the aftermath of September 11th, heightened, but efficient, security of the aviation system is a critical, long-term requirement. Therefore, I am pleased to report that as part of the President's FY 2004 Budget Request, NASA will begin a new effort in Aviation Security. We will invest $21 million in FY 2004 for this initiative. Research in this program will focus on concepts and technologies that can protect aircraft and the airspace system from criminal and terrorist attacks while dramatically improving the efficiency of security. In the near-term, NASA will develop and demonstrate decision support technologies for ground-based air traffic management systems that detect and assist in the management of threatening situations. Other areas include technologies to reconfigure the aircraft to fly safely in the event of damage, and flight controls technology that would prevent the aircraft from being purposefully crashed. Additionally, we are investigating how NASA research in information and sensor technology may be applied to this area.

We will invest $27 million in FY 2004 for the new *National Airspace System Transition* initiative. The major challenges are to accommodate the projected growth in air traffic while preserving and enhancing safety; provide all airspace system users more flexibility, efficiency and access in the use of airports, airspace and aircraft; enable new modes of operation that support the FAA commitment to "Free Flight" and the Operational Evolution Plan (OEP); and develop technology to enable transition to a next generation National Airspace System beyond the OEP horizon. The research within this program will be focused on developing a more flexible and efficient operational approach to air traffic management. For example, together with the FAA, NASA will investigate and solve the technical challenges of increasing runway capacity in inclement weather to eliminate the biggest source of delays—poor visibility. We will also develop totally new concepts that allow the system to scale with increasing traffic levels. We are developing sophisticated new modeling capabilities of the Nation's air traffic system so we can test out our tools and concepts.

Unmanned aerial vehicles (UAVs) have potential applications of benefit to the U.S., including homeland security, telecommunications and monitoring the earth's resources. Their ability to fly autonomously for boring or hazardous applications and their ability to fly at high altitudes allowing them to cover large areas make UAVs suitable for these types of jobs. However, UAVs are restricted from routine operations in the National Airspace System (NAS). To address this issue, NASA has included $8 million in its FY 2004 budget request for *UAYs in the NAS*. NASA, DOD and the FAA are working with the UAV industry and have developed a plan for cooperatively developing and demonstrating this technology.

Enabling a Healthy Future for Aviation

While the current aviation system is suffering from the combined effects of 9/11 and the economic downturn, aviation remains critical to our society and economy. Aviation will certainly recover, but it is likely that significant changes will occur. We are already seeing more utilization of secondary airports, driven by low-cost, point-to-point carriers; the "de-peaking" of hub airports; continued growth in regional jets to smaller communities; continued growth in on-demand aviation, such as executive jet, and the promise of jet air taxi service. In fact, the current system structure, where most passengers and cargo are carried by tens of air carriers through tens of airports, must be revised to permit the continued long-term growth of the system. The thousands of airports distributed across this country are a true national asset that can be tapped with the right technology and the right Air Traffic Management (ATM) system. Also, "airspace," one of the Nation's most valuable national resources, is significantly underutilized due to the way it is managed and allocated. Therefore, the airspace architecture of the future must increase the capacity of the Nation's major airports, fully tie together all of our nation's airports into a more distributed system, and create the freedom to fly in a safe, secure controlled environment throughout all of the airspace.

One thing that will remain constant is that free market forces will drive the air transportation system. Therefore, the future system architecture must be flexible to respond to various transportation system possibilities and robust against unexpected threats. The airline industry must have the flexibility to move and expand operations to be responsive to transportation demands. This is the highest level guiding principle for the future ATM system. The next tier of system requirements are robustness (a system that can safely tolerate equipment failures and events such as severe weather and unexpected attacks) and scalability (the ATM system automatically scales with the traffic volume). One possibility for achieving scalability would be achieved by building large portions of the ATM system into the aircraft, so that as aircraft are added to the fleet the ATM system would automatically scale to accommodate them. This decentralized architecture and increased vehicle capability to automatically avoid protected airspace is also an effective means of limiting the potential damage of a terrorist attack.

The system will be built on global systems, such as GPS, to allow precision approach to every runway in the Nation without reliance on installing expensive ground-based equipment, such as Instrument Landing Systems (ILS) at every airport. However, the robustness of the global communication, navigation and surveillance (CNS) systems must be such that the system can tolerate multiple failures and potential security threats and still be safe. This is a significant challenge on which the new architecture depends.

If we are successful at meeting the challenge of a robust global CNS, then with precise knowledge of position and trajectory known for every aircraft, it will no longer be necessary to restrict flying along predetermined "corridors." Optimal flight paths will be determined in advance and adjusted along the way for weather and other aircraft traffic. This fundamental shift will allow entirely new transportation models to occur. For example, with precision approach to every airport in the U.S. and a new generation of smart, efficient small aircraft, the current trend of small jet aircraft serving small communities in a point-to-point mode could be greatly extended.

The future system will truly be "revolutionary" in scope and performance, but it must also be implemented in a mode that allows continuous safe operations to occur, even in the face of unpredicted events. In designing the future airspace system, a systems engineering approach must be used to define requirements, formulate total operational concepts, evaluate these operational concepts, and then launch goal-oriented technology activities to meet requirements and support the operational concept. NASA's role is to be a full participant in this national process and to lead the long-term technology effort that supports it. NASA and the FAA are developing an approach right now to implement such a process.

The NASA–FAA Relationship

Finally, I will address the critical relationship between NASA and the FAA. NASA and the FAA have a long and productive relationship in aviation. The relationship is based on common objectives, and unique and complimentary roles. NASA's role is long-term research and technology development. FAA is much more focused on comparatively short-term research and development to support certification, rule-making, requirements generation and acceptance testing. In addition to our complimentary roles, we share many of the same objectives—to increase the capacity and efficiency of the NAS, to increase aviation safety, and to reduce environmental impacts. With ATM, the FAA is the user of NASA technology. With safety and environment, industry is the primary technology user, but FAA benefits from a rule making and certification perspective. In this light, NASA and the FAA maintain several mechanisms for coordination and integration. For example, in the area of aviation safety, NASA and FAA have an active working group that develops and tracks joint technical roadmaps. In air traffic management, there is a interagency integrated product team that develops joint plans for integrated ATM R&D. And we are actively planning a more integrated, long-term approach to cooperation in air traffic management to ensure a common vision and set of national requirements and that the research and technologies that are developed out of NASA have a pathway into FAA operations.

Conclusion

In conclusion, NASA is proud of its continuing critical contribution to aeronautics. In the centennial year of the first powered flight by the Wright Brothers, we look forward to the future of flight. New technologies on the horizon will make the next 100 years as exciting, eventful, and in many ways as unpredictable, as the first 100 years.

Chairman ROHRABACHER. Thank you very much. I am sure that we have got some questions for you. Curt Weldon is just anxious to ask those questions, but not yet. I am just preparing them for you, Curt. Okay. Next witness is Mr. Charlie Keegan, Associate Administrator for Research and Acquisitions at the FAA. And this is Mr. Keegan's first appearance before any Congressional committee. Let me note that Mr. Keegan started off as an air traffic controller, and he was on the hot seat then and he is in a hot seat today. So we welcome you and look forward to your testimony.

STATEMENT OF CHARLIE KEEGAN, ASSOCIATE ADMINISTRATOR FOR RESEARCH AND ACQUISITIONS, FAA

Mr. KEEGAN. Thank you, Mr. Chairman and Members of the Committee. Good morning. I appreciate the opportunity to appear before you to discuss the FAA's investment in civil aeronautics research, engineering, and development, as reflected across our R&D program and the President's budget for the Fiscal Year 2004.

I have three points to make. The first one will be about our request amount of $100 million. We believe that this is a well-balanced approach toward the FAA's overall budget request of somewhere near $14 billion and in accordance with the FAA's mission. It is a well focused program for Fiscal Year 2004, focusing on aircraft safety as well as noise and emissions. I would like to emphasize that although this request is less than what we requested in 2003, the key to the success of this program will be the leveraging of resources with our other Government partners as well as industry and academia.

An example of this is the work that we are doing now in unleaded aviation fuels. Aviation fuels, as I am sure you are aware, are leaded today and present an emissions issue. In the future we hope to use unleaded fuels for aircraft. The key is their safety. Next week, we will take delivery from Exxon of 4,000 gallons of unleaded fuel to be tested, and we expect to test that through the rest of this year and through 2004 to, hopefully, make progress in this area for unleaded fuels for general aviation aircraft.

I would like to move to our relationship with NASA. Our relationship with NASA has been outstanding, and I believe it will continue to mature over the next several years. I bring personal experience to this relationship of bringing NASA technology called the Traffic Management Advisor, part of the center TRACON automation system from the research house at NASA Ames into operation that today is delivering tangible and sizeable benefits to the American public every single day, and we want to continue to do that piece by piece. And those elements are outlined in our Operational Evolution Plan, which is our outlook for capacity over the next 10 years.

Mr. Chairman, if I may, I would like to go to a couple props that I brought with me today that represent some of the incredible research that is going on at our technical center in Atlantic City, New Jersey. The first is important safety elements regarding fuel inerting. We have had several, a handful of, explosions in aircraft fuel tanks without a known source of ignition. Since we can't find the ignition source, to be safe, we want to eliminate the possibility of that event. This device is actually strands of polyester. Forcing air in one end, and out the other, bleeds off—through a hole that is right here, bleeds off the oxygen, putting more nitrogen in the fuel tank instead of oxygen that would be able to burn. This rather simple device weighs approximately 160 pounds and prevents the ability of a center fuel tank in a Boeing 747 to explode. We have tested this on the ground and will begin flight testing soon, and we have had much interest from Airbus, as well as Boeing, and will be able to continue to do that work which we think is just absolutely incredible—simple strategies toward preventing catastrophic events.

The next thing is what we call soft soil. It looks like a piece of sand that is held together. It is actually oxygenated concrete. This device is in response to an event where a DC–10 at JFK Airport New York ran off the end of the runway, where about a dozen people were injured and causing major damage to the aircraft. We have implemented this and we need to make it more cost effective so we can implement it more, and that is what our research is going onto now. These are pictures, which I will be glad to pass around, of the Saab 340 that ran into this material post event, after we had implemented it. No one was injured, there was very little damage to the aircraft, and we think that is positive for the ability for us to maintain airport safety as well.

And that really concludes my comments. I would like to submit my testimony for the record, and I am ready to answer any questions that you may have. Thank you.

[The prepared statement of Mr. Keegan follows:]

PREPARED STATEMENT OF CHARLES KEEGAN

Chairman Rohrabacher and Members of the Subcommittee:

I appreciate the opportunity to appear before you, to discuss the Federal Aviation Administration's (FAA) investment in civil aeronautics research, engineering and development (R,E&D), as reflected across our R,E&D program and in the President's budget request for Fiscal Year 2004.

This is a particularly important year for aviation innovation as we approach the centennial of flight. Since the Wright Brothers' first flight, we have seen remarkable improvements in navigational tools and critical safety technologies through the diligent work of aviation researchers. Today, that legacy of success continues as FAA's researchers and scientists lay the groundwork for free flight operations and develop the technologies, tools, and procedures so that FAA may strengthen its critical mission—improving aviation safety. These improvements are reducing fatalities, injuries, and aircraft losses; creating better aircraft and airport designs; and improving maintenance and inspection procedures.

Today, I will provide a brief overview of the President's FY04 aviation R,E&D budget proposal, discuss some of our R,E&D priorities and accomplishments, and provide examples of how our collaborative work with NASA, the Department of Defense (DOD), industry, and academia contributes to making our aviation system safer and more efficient.

The President's budget request supports the FAA's major research and development activities presented in the National Aviation Research Plan (NARP), which describes these research activities in detail and how they relate to the agency's mission. The NARP covers the research needed to achieve the FAA's safety, capacity and environmental goals including: aircraft airworthiness, runway safety, aviation weather, human performance and aerospace medicine, as well as efficiency research projects that support increasing the capacity of the National Airspace System (NAS).

For FY04, we have requested $100 million for R,E&D. Based on this request, we have developed a comprehensive program that focuses resources on our highest priority activities. The President's budget presents our request in performance-based terms to better focus on the critical areas our R,E&D projects. Of the total requested:

- $66.487 million is for aircraft technology safety programs, which include research related to fire safety, aging aircraft, human factors, and flight safety;
- $20.852 million is for programs associated with improving safety through weather research;
- $7.975 million is for environmental research, which includes research related to aircraft and rotorcraft noise reduction technologies and aircraft noise and emissions models; and
- $4.686 million provides general mission support.

Although the FY04 budget request for the R,E&D account has decreased by $24 million from the FY03 request, the overall budget includes $73.1 million from the Facilities and Equipment (F&E) account for applied research activities under the Advanced Technology Development Prototyping and Safe Flight 21 programs. These programs focus on the evaluation of methods to prevent runway incursions, reduce separation standards, and provide surveillance coverage in non-radar areas. Our budget also includes a separate request for $17.417 million under the Airport Improvement Program for airport technology research to develop standards and guidelines for planning, designing, constructing, operating and maintaining the Nation's airports.

As our budget shows, safety research is the main priority of our R,E&D program. Research efforts are critical to the reduction of fatal accident rates. We know that accidents can be prevented by establishing and maintaining a broad framework of regulations and standards, developing a better understanding of accident causes and countermeasures, and participating in cooperative programs with the global aviation community.

The aircraft safety research programs are producing great dividends for the aviation community. For example, last year we made significant progress in developing an inerting system to prevent fuel tank explosions. The tragic TWA Flight 800 disaster, in 1996, focused national attention on the critical need to improve fuel tank safety. Building on previous research on ground-based inerting, FAA's researchers developed a relatively simple, but effective, design for generating nitrogen-enriched air in flight. Our researchers installed an onboard inerting system in the FAA's 747SP test aircraft. Flight tests are planned in FY03, based on the combination of modeling predictions, $\frac{1}{4}$ scale tests, and demonstrations of the prototype system.

Additionally, we are working with NASA and DOD to enhance safety of the aging aircraft fleet. Over the past several years we have developed new structural inspection techniques that help maintenance personnel locate structural problems before they become serious safety concerns. We are also focusing major efforts on gaining a better understanding of the effects of aging non-structural aircraft systems such as wiring. Civilian and military aircraft contain hundreds of miles of wire, much of it inaccessible once the aircraft is assembled. When the protective sheath of insulation on a wire is damaged and the conductor is exposed, the potential for a short circuit or arc exists. In fact, the FAA, the National Transportation Safety Board, and the Transportation Safety Board of Canada investigations cited electrical systems arcing as one likely cause of the cabin fire and crash of Swissair Flight 111.

The FAA, in cooperation with DOD and industry, has developed a new form of circuit protection technology that is capable of sensing an electrical arc along a wire and opening the circuit, greatly reducing the threat of an electrical arc fire. This technology will not require the redesign of aircraft circuitry. Successful flight tests have been completed and now we are developing common performance specifications.

Although it is easy to be captivated by the new technology that has resulted from our R,E&D, I want to emphasize that aviation safety is also human-centered and dependent on human performance. The FAA requires that human factors be systematically integrated at each critical step in the design, development, and testing of advanced technologies introduced into the NAS. For example, last year FAA researchers and certification specialists began testing a new computerized decision support tool to ensure that aircraft flight deck technologies are user friendly. This decision tool assists certification and design personnel in identifying, assessing, and resolving potential design-induced human performance errors that could contribute to aviation incidents and accidents.

Weather continues to be a major safety factor for all types of aircraft. A recent estimate by the FAA identified weather as being responsible for 70 percent of flight delays and approximately 40 percent of accidents. To mitigate the effects of weather, the FAA's Aviation Weather Research Program conducts applied research in partnership with a broad spectrum of the weather research and user communities with a goal of transitioning advanced weather detection technologies into operational use.

In FY02, a weather safety product, known as the Current Icing Potential, became fully operational at the National Weather Service Aviation Weather Center in Kansas City, Missouri. This product, which generates around-the-clock support, provides information on current in-flight icing conditions and is used for flight planning, determining route changes, and altitude selection. With FAA funding, the National Center for Atmospheric Research in Boulder, Colorado, developed this system using radar and satellite data, surface observations, numerical models and pilot reports. Users can access this information on the Internet via the Aviation Digital Data Service web site at http://adds.aviationweather.gov/projects/adds/.

I am pleased to report that FAA's weather research program was awarded the 2002 National Weather Association's Aviation Meteorology Award in recognition of developing and implementing the Current Icing Potential, as well as the National Convective Weather Forecast, the Forecast Icing Potential products, and the Rapid Update Cycle #20—all new products designed to enhance aviation safety and efficiency by allowing pilots to avoid hazardous flight conditions while improving airspace use.

The FAA understands that while we are responsible for operating a safe and efficient NAS, we must also monitor and mitigate the effects of aviation on our environment. FAA will use research funding to continue to develop and validate new and enhanced methodologies to estimate aviation-related emissions that impact local air quality and global emissions. This will allow FAA to more accurately assess aviation-related emissions impacts and tailor measures to mitigate any impact on communities resulting from airline operations and airport development programs and increased efficiency in showing compliance with provisions under the Clean Air Act and National Environmental Policy Act.

Currently, to understand the environmental effects of aircraft and airport operations, the FAA's environment and energy research program is developing superior decision support tools and providing strategies that both protect the environment while allowing aviation to grow. For example, the Environmental Protection Agency has accepted, as a "Preferred Guideline," the FAA model that assesses the air quality impacts of airport emission sources. This model incorporates enhancements resulting from a landmark aircraft plume study conducted last year. This work was accomplished in coordination with the Department of Transportation's Volpe National Transportation System Center, the University of Central Florida, and the National Oceanic and Atmospheric Administration. Further, the noise model developed by the FAA, the Integrated Noise Model (INM), today has over 700 users in 42 countries and has become the de facto world standard in noise modeling.

The FAA's collaboration with NASA spans across our R,E&D goals. We are working with our colleagues at NASA to make overall improvements to the NAS. In accordance with industry recommendations, the FAA's Free Flight Program has deployed a number of surface and airspace management tools, developed jointly with NASA, such as the Traffic Management Advisor and Surface Movement Advisor, which help air traffic controllers and system users make the system more efficient in the air and on the ground.

We believe in our complimentary working relationship with NASA and we are proud of the accomplishments we have achieved together. Looking at the big picture of aviation research, NASA focuses its efforts on developing technology with the potential for long- and short-term NAS improvement while FAA prepares the technology for introduction into the NAS. Indeed, we are collaborating with NASA, DOD, and the Transportation Security Administration to assure a strong and vibrant NAS for future generations. As Administrator Blakey has said, we are developing "a shared national vision for the aviation system of the future and to coordinate our research activities with that in mind."

As I have described throughout my statement, our commitment to and success in improving aviation safety and efficiency has involved extensive collaboration with our partners the aviation community. One of our most valuable partnerships is that with the Research, Engineering and Development Committee (REDAC). This group, composed of representatives from government, industry, and academia, contributes to FAA's R,E&D by providing guidance on our ongoing work, reviewing our proposed R&D investments, and evaluating our programs during execution. The REDAC provides this support through five standing committees—Air Traffic Services, Aircraft Safety, Airports, Environment and Energy, and Human Factors—comprised of REDAC members and additional topical experts from industry and academia.

With the support of our partners, the FAA can provide world leadership in the conduct of high-priority research and the development of innovative technologies.

In conclusion, on behalf of Administrator Blakey, I would like to express the FAA's appreciation for the support we have received from this Subcommittee and we look forward to working with you in addressing the many critical needs in aviation through the FAA's R,E&D program. This concludes my prepared remarks. I would be pleased to answer any questions that you may have at this time.

Chairman ROHRABACHER. Congratulations on your first testimony before Congress. You came in with, actually, one minute to spare, and you had props and everything like that. This guy has got a future, I am telling you. And we are willing to support a major increase in your budget. All right. Thank you very much, Mr.

Keegan. Our next witness is Dr. John Hansman, Professor of Aeronautics and Astronautics at MIT. Doctor, you may proceed with your testimony.

STATEMENT OF R. JOHN HANSMAN, JR., PROFESSOR OF AERONAUTICS AND ASTRONAUTICS; DIRECTOR, MIT INTERNATIONAL CENTER FOR AIR TRANSPORTATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. HANSMAN. Okay. Thank you, Chairman Rohrabacher. As you noted, this is the 100th year of the Wright brothers, the anniversary of the Wright brothers. And the Wright brothers have always been a hero to me in terms of the way that they conducted research. They, basically, discovered all of the fundamental technologies of aeronautics on their own, and this is just an example of their work, where they went and looked at birds, they developed the testing methods, they developed the quantitative data in order to get to their work.

In terms of questions, very quickly, how relevant is the Federal Aeronautics R&D to demands that the commercial and general aviation users are expected to impose on the NAS? Relevant, but inadequate. Are the R&D programs dedicated to ATM and associated funding levels sufficient? No. This is just a picture of the air traffic density over the U.S. This is November 14. You can see the heavy concentration in the U.S., and you can see the structure, and the system was saturating due to the growth in air travel before September 11. There has been a recession in air travel demand, briefly, but it will recover. You can see these are fundamental trends. You can see the delay data in the NAS. You have probably seen this data before. It was growing, we were going into nonlinear delays, particularly, in the summers before September 11. We pulled back from the edge, but as soon as the economy recovers and demand comes back, we are going to be there again. There is just a limit of the capacity limit factors in our system, the airports, the airspace, the demand structure, and the environmental limits that Jerry mentioned.

Question 2: How do NASA and FAA Aeronautics R&D Portfolio distinguish themselves from foreign competitors? It is difficult to say very quickly. There are differences in national research strategies. You also have to note that in many developing nations, aerospace is looked at as a leveraging technology for job and skill development, so it is perceived as a national investment. Generally, more support of national industries directly. We can talk if you have questions about specific things. I will point to airframes in a minute or two.

Question 3: This is, you know, my parochial view that how the university-based researchers dealt with the funding shifts. In my view, my professional history, we have seen a shift from fundamental research to program based research, for good reasons but it has had some adverse consequences. We see these episodic programs. There is some challenge where we are going to solve the problem in three years and, you know, get there, and a focus on sort of large program centers of excellence. Grants are now seen by the agencies as welfare instead of high risk-high payoff research, so grants is almost a four-letter word in some places. The universities and agencies, and we will take some hit on this, too, in the aerospace domain, have been slow to move their intellectual focus to the future needs. Now, I will just add an anecdote. When we did a strategic plan in our department 10 years ago, we realized 50 percent of our faculty were aerodynamicists. Aerodynamics is an important technology but it is not the technology that is going to pace the future vehicle, so we started the shift, and we need to do that.

I would also note that it is very difficult for junior faculty and students to break into the research program. As you know, we are talking about the 2004–2005 budget here. The planning cycles for research are longer than the career of a student. It is very hard for someone to have an innovative new idea and break it into the system because we can't tell you what the innovative new ideas are going to be in 2004 today. So we need to think about that, and it tends to suppress what I think our young people are most creative groups. So I really commend a sort of shift back there.

Question 4: Are we at risk? This is just an example I will give you. This is the growth in regional jets. This is registered data in the U.S. You will see this is the fastest growing component of the aerospace industry in the U.S. in terms of counts. None of these airplanes are produced in the U.S. Okay? This is just a——

Chairman ROHRABACHER. What kind of jets are...

Dr. HANSMAN. Regional jets. They are jets 60 to 70 seat and smaller scale. So these are the Embraer, the Canadair Challengers, and there are some British Aerospace airplanes in there. If you look, this is just data from December 19. On that date, this is the non-U.S. produced commercial jet traffic over flights in the U.S. They were 37 percent of the overflights.

One other thing I just need to say, it is very important to understand how our research components, both in terms of vehicle capacity and air traffic capacity, influence our air transportation system and also influence the economy. It turns out nobody really understands—the economists don't understand what we would call the economic enabling effects, which are how does the air transportation system support the health and well being of the economy. I will stop there.

[The prepared statement of Dr. Hansman follows:]

PREPARED STATEMENT OF R. JOHN HANSMAN, JR.

Chairman Rohrabacher and Members of the Subcommittee:

Thank you for the opportunity to comment on the federal investment strategy in aeronautics research. This year we will celebrate the 100th anniversary of the success of one of the greatest research programs in human history. I have always been awed by the Wright Brothers and their fundamental and systematic approach to discovery as well as how they addressed the key barriers to their vision of powered flight.

For most of the past century, the U.S. has led the world in "pushing the edge of the aeronautics envelope" based, in part, on a strong national aeronautics research strategy. This has resulted in a vibrant aerospace industry and an unsurpassed air transportation system which has contributed materially to the Nation's economic development, geographic structure and quality of life.

There are, however, indications that the U.S. preeminence in aerospace has declined. In part this is due to increased investment and capability in other countries which see aeronautics as a critical leveraging technology area. This can be positive if we work towards mutual goals of safety, efficiency, environmental impact and capability. More disturbing, however, is the perception that the U.S. has not kept pace and is under-invested in fundamental and high risk research to develop the disciplines and people to shape aeronautics in the future.

I will comment below on the specific questions which you have asked me to address.

How relevant is federal aeronautics R&D conducted by NASA and FAA to the demands that commercial and general aviation users are expected to impose on our National Airspace System in the future? Are R&D programs dedicated to air traffic management—and associated funding levels in the proposed FAA and NASA budgets—sufficient to meet projected growth?

The NASA and FAA research programs dedicated to the National Airspace System (NAS) are clearly *relevant* but also clearly *inadequate* to meet the expected demand.

Due to resource limitations and urgent short-term needs, the current national research portfolio generally focuses on localized improvements to the current operating paradigm based on existing technologies. While these are important in the short-term they will only achieve a marginal gains and will not meet the long-term demand in air traffic growth.

The current system is on the edge of a capacity crisis as seen by the delay experience of 2000 and 2001 (Fig. 1). When the economy strengthens the pre-September 11, 2001 growth pattern will re-emerge (Fig 2) and the performance of the National Airspace System will degrade.

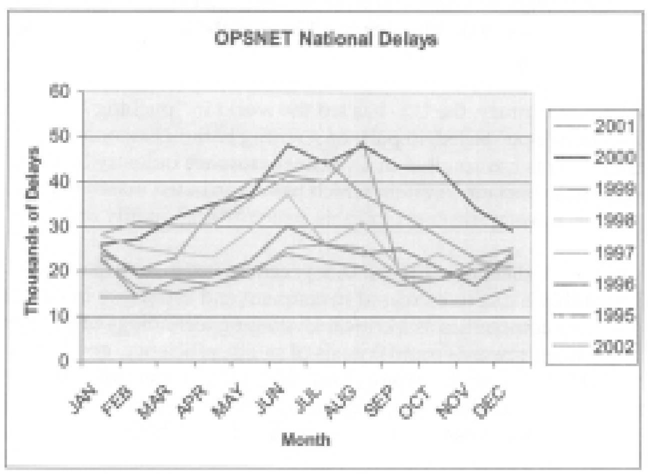


Figure 1 Total System Delays (source FAA Opsnet data analyzed by Jim Evans, MIT Lincoln laboratory

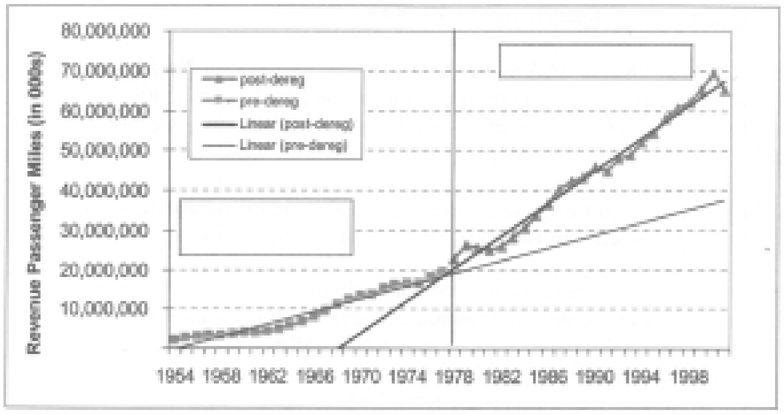


Figure 2 Historical Passenger Traffic Growth in Revenue Passenger Miles (source BTS and BEA)

It should be noted that meeting the future demand is an extraordinary challenge. The National Airspace System (NAS) is an extremely complex dynamic system which has evolved over the past 60 years. It must operate safely on a 24/7 basis. The simplest mechanism to improve system capacity is to increase airport capacity (i.e., runways and gates) at critical locations. However these are exactly the locations where local communities oppose airport expansion due to noise, traffic and environmental impact. The trend is to maximize utilization of existing facilities and to use regional airport systems. This tends to increase pressure on the airspace system.

We have historically had a very poor record at making paradigm shifting changes that the system will require due to the complex competing interested of the many stakeholders in the system. While we have been doing research on the technologies, it is not clear we have done sufficient research on the processes of system transition or on the work which would support difficult decisions to compel changes which would have long-term benefit to the public. In addition we need a stronger base research program in fundamental aspects of Air Traffic Management.

We need a stronger national commitment to the long-term evolution of the NAS with the appropriate funding levels and coordination between the various agencies involved. This commitment must recognize the long time constants (10–20 years) required to effect change in the NAS.

As to funding levels, the FAA and NASA research budgets for National Airspace Systems efforts have been level or declining for the past 5 years. This does not seem adequate in a period of increasing awareness of the emerging limitations of the NAS.

How do the NASA and FAA aeronautics research portfolios distinguish themselves from R&D conducted by our foreign competitors?

It is difficult to make general statements since there are so many technical aspects and styles in the various national research programs. It appears that research portfolios are driven by national agendas and technology investment strategies. It is important to note that many countries, with less mature capabilities, view aeronautics as a key strategic area in technology, education and workforce development. Where agendas are similar the portfolios overlap and we often collaborate. My impression is also that many foreign research programs are more comfortable directly supporting national industries then we are in the U.S.

What technologies differentiate U.S. manufactured products from foreign-produced sources?

For purposes of this discussion I will simply cover; civil aircraft, avionics, propulsion, and complex information systems.

In the area of civil aircraft the technologies are quite similar with differences due more to corporate strategy than technical capability. Several foreign competitors (notably the Europe, Brazil and Canada) have been very successful in the U.S. market. Fig. 3 shows that Regional Jets produced in Brazil, Canada and Great Britain have been the fastest growing segment of the U.S. civil aircraft fleet in recent years. Fig. 4 shows the commercial jet flight trajectories on December 19, 2002 over the U.S. with 37 percent of the flights being in foreign produced aircraft.

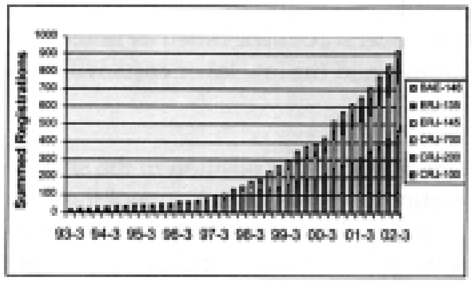


Figure 3 Increase in Regional Jets (source FAA registration data)

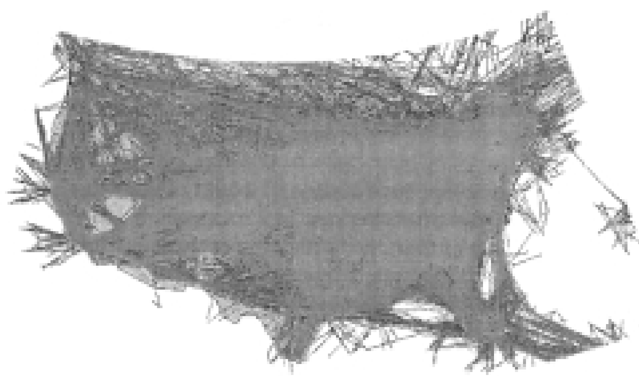


Figure 4 Commercial Jet Flight Trajectories Over the United States on 8/7/02. (U.S. produced aircraft are in blue, foreign produced aircraft are in red)

Part of the reason that international competitors have been able to successfully compete in the civil aircraft market is due to national leveraging strategies, labor costs and certification standards. Certification standards, instituted for safety reasons, tend to normalize out technical differences and make it difficult to hold a consistent technical advantage for those competitors who can meet the standard. Because much of the technical capability to produce mid to small size aircraft are accessible in developing countries aircraft production has been used as a leveraging capability in several countries such as Brazil, Indonesia and Israel. This trend will continue and the low labor costs will make these aircraft attractive for some markets.

The U.S. does have a potential leadership position in the small 4–8 passenger jet market with several interesting aircraft in development including the Eclipse and Cessna Mustang. It is interesting that these efforts appear to be traceable to the propulsion component of the NASA Advanced General Aviation Experiment.

I would note that the competitive domain is different for large Civil Air Transport aircraft due to the very large capital investments required for aircraft development. In this domain there are really only two competitors, Boeing and Airbus. The vulnerability here is that if either were to exit the commercial aircraft business for any reason then there would be a monopoly in this domain until some other producer in the U.S. or abroad developed the capability.

Looking onboard the aircraft at the Avionics systems. U.S manufactured products have a clear technical advantage over many foreign competitors. This is due, in part to good systems engineering but also leveraging from military and space applications (e.g., GPS, estimation techniques, etc.) as well as leveraging from information technology investments. I would note several adverse trends including the difficulty of certifying new avionics systems, the closing of industrial research laboratories, the weakening of the U.S. information technology sector and the growth in offshore information technology capability in low labor cost developing regions such as India.

In the propulsion area there is general technical parity between the U.S. and Europe in large turbofan engines although there some European engines are reported to have lower emissions, albeit lower reliability, than comparable U.S. engines. In the turboprop and small turbofan domain the U.S. and Canada appear to have technical parity. It is, however, interesting that the new Eclipse and Mustang jets have ended up selecting Canadian engines even though the conceptualization of this class of aircraft was driven by expected U.S. engine development. In the piston engine domain Japan and Germany have developed advanced engines for aircraft applications.

In complex information systems such as cockpit interfaces, Command and Control systems, Air Traffic Control systems, Computer Reservation Systems, etc. the U.S. appears to have the intellectual lead but often falls behind due to implementation challenges.

How have university-based researchers dealt with funding and programmatic changes in federally-sponsored aeronautics research programs? How is fundamental research faring in the current environment?

This can be better. The relationship between the federal research agencies in aeronautics and the university-based researchers is not as strong and effective as it should be. There are both content and structural issues and the relationship must be worked on from both sides.

First the content issues. Many of the university-based research organizations have been slow to shift their intellectual focus and disciplines from their traditional expertise to those areas which will be critical for the future of aeronautics. This has kept them out of many of the focused programmatic thrusts. In simplistic terms, the key technical issues in the 50's, 60's and 70's when many of our university based research organizations were developed are quite different from the key technical issues for the future. I would note that both NASA and the FAA have similar challenges in intellectual renewal.

As an example, in my own department we had a strategic planning exercise over a decade ago where we looked at the key technical issues for the future and at our own core competency. At that time, almost half of the faculty in the Department of Aeronautics & Astronautics at MIT had backgrounds in aerodynamics and fluid mechanics which was totally out of balance with our assessment of key future technologies. Since that time we have reshaped our department to emphasize strategic areas in information technology, automation, systems engineering, critical software validation, materials, propulsion, and human factors while still maintaining capability in the more traditional aeronautics disciplines. It should be noted that, as a relatively large faculty, we have more flexibility to diversify to forward looking areas than smaller departments.

From the structural standpoint. There has been a significant shift over the past decade away from small single investigator grants or contracts to large-scale episodic programs or multi-investigator centers of excellence. This has been driven, in part, by a shift away from a core competency base research structure to a more problem focused research structure as a mechanism to maintain research relevance and the management efficiency of consolidating funding into larger blocks.

From the perspective of someone who advises junior faculty and bright doctoral students I believe that these trends have made it difficult for universities to be effective and for our young people to get their innovative ideas funded. I also believe that it has had the effect of reducing the technical engagement of the federal research personnel who must focus more of their energy on management and do not have the time to work on technical aspects.

I would encourage NASA and the FAA to identify and develop key strategic core competencies while re-establishing a strong network of small scale (single investigator-single student) university-based research collaborations. A small investment in building core strategic competency in our agencies, our universities and our students will yield many near- and long-term dividends.

What are your views on the findings and conclusions contained in the *Final Report of the Commission on the Future of the United States Aerospace Industry?* Do you believe our aerospace manufacturing capabilities are at risk of a long and protracted retrenchment? What are your near-term and far-term assessments on the ability of domestic aerospace manufacturers to successfully compete in international markets?

I agree with and support the findings in the commission report.

I believe that we do not fully appreciate the importance and dependence of air transportation to economic health and quality of life both in the U.S. and throughout the world. Fig. 5 presents a simple conceptual model which we have been using to understand to interaction between air transportation and economic development. Traditional economic measures do not fully value the enabling effect of air transportation and we have a very weak understanding of the social impact. It should also be noted that the role of air transportation is quite different in mature and developing economies.

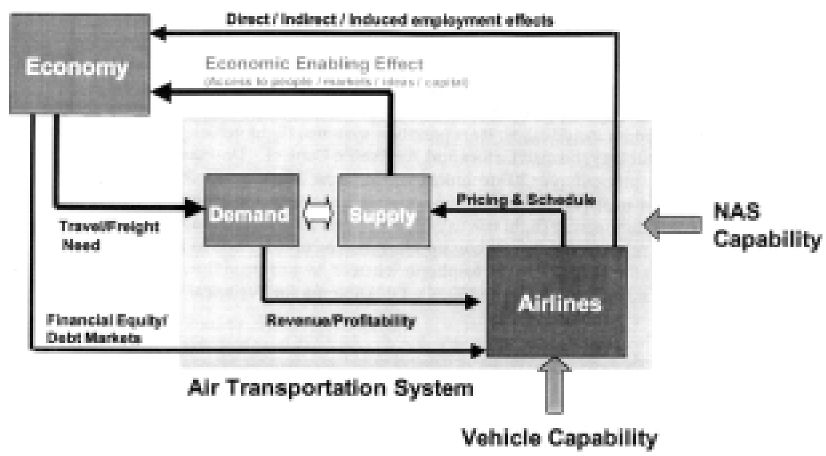


Figure 5 Simple Conceptual Model of the Interaction Between Air Transportation and Economic Development

I think that there is some chance of a protracted retrenchment in the aerospace industry if we simply assume that our past capability will guarantee future success. We must work to have the best products. It is important to note that the growth market for aerospace is outside the U.S. and we need to put more effort into understanding the requirements of these markets.

I hope that the impact of the commission report will to strengthen our commitment to aerospace so we can strongly compete in the global market and to strengthen our resolve to contribute to global objectives such as improving the safety and efficiency of flight operations, connecting economies and people and minimizing adverse environmental impacts worldwide.

Chairman ROHRABACHER. Thank you very much. It is interesting to note that an air traffic controller was able to get his testimony out with one minute to spare, but it did take a Ph.D. talk 30 seconds longer.

Dr. HANSMAN. University professors, you turn them on and they go for an hour.

Chairman ROHRABACHER. Until the bell rings. Right? All right. Our final witness today is Mr. Mac Armstrong, Senior Vice President of Operations and Safety for the Air Transport Association of America. We welcome your testimony and hear what the industry has to say about these things. You may proceed.

STATEMENT OF MALCOLM B. ARMSTRONG, SENIOR VICE PRESIDENT, AVIATION OPERATIONS AND SAFETY, AIR TRANSPORT ASSOCIATION OF AMERICA, INC.

Mr. ARMSTRONG. Good morning, Mr. Chairman, and thank you for inviting me. Our members fly 95 percent of all the passengers and cargo in this country, and as you know, they are in perilous financial condition. We have two major airlines, a number of smaller airlines, well over 20 percent of the industry in bankruptcy. And over the last two years, passenger carriers have lost $18 billion.

Chairman ROHRABACHER. Would you repeat those figures again as soon as these buzzers stop buzzing so we can hear that, because I think that is an important thing for us to know.

Mr. ARMSTRONG. A number of small airlines, two major airlines are in bankruptcy, amounting to well over 20 percent of the industry. And over the last two years, passenger carriers have lost about $18 billion, and recovery is not in sight. So we have been focused on surviving today. It is pretty difficult to think much about R&D in the future. Nonetheless, having said that, healthy R&D programs at NASA and FAA will be critical to ensuring that we can cope with tomorrow. So in that regard, first, we have to address the right issues. And second, we have to make sure that the funding is there to achieve the results that we need.

As to the right issues, safety is our predominant goal, and I must say that we are achieving spectacular success in that arena. Last year, scheduled airlines achieved their best safety record since 1946. We had zero fatalities. So safety should remain a key focus of R&D, just as it is the top priority of the airlines. Nevertheless, we know that the air traffic delays of 2000 will return with a vengeance if we don't plan for the future, and that is why this hearing today is important to us and your desire for action is important.

The FAA's Operational Evolution Plan will add 30 percent to the capacity of the current air traffic system, but that doesn't keep pace with the demand that is projected. The greatest proportion of the improvements in the OEP appropriately at the airports, but we in the FAA all know that we also need to improve the en route sections of the air traffic system beyond the current plans. FAA and NASA need to be working now on the big ideas that will be in the future, and that should be a broad based Government funded initiative to develop that next generation air traffic management system beyond the OEP. We believe it has to be highly automated, where routes are as close to direct trajectory as possible, they avoid weather, they automatically separate aircraft, and they seldom require intervention from the ground. Now, that is a tough challenge.

Equally important is equipment additions to airplanes, and as you can imagine, having airlines spend money right now on that is not in the cards. However, the Aerospace Commission recently had a recommendation that the FAA should motivate operators to equip through some form of Government funding or credits, and we agree.

We are also concerned about decreasing funding in aeronautics R&D and NASA. Aeronautics now represents only five percent of NASA's overall budget, and NASA has a history of cutting aeronautics programs to cover space program overruns. Such fund diversion is a tremendous threat to aviation R&D, and without that, we are unlikely to develop the next generation of airplanes, thereby, threatening the global competitiveness of the U.S. aviation sector. The European Union has already stated their intent to seek world leadership in aviation, and they have committed the R&D funds to do so.

In closing, Mr. Chairman, we need your help in providing NASA and FAA with a sense of priority and the resources to begin working immediately on the next generation air traffic management system, to help FAA find ways to fund airborne equipment, and to be good stewards of the environment, and to see that NASA and FAA have the means to help ensure that the United States remains the world leader in aeronautics. I look forward to your questions.

[The prepared statement of Mr. Armstrong follows:]

PREPARED STATEMENT OF MALCOLM B. ARMSTRONG

Good morning, Mr. Chairman. My name is Mac Armstrong and I am Senior Vice President of Operations and Safety for the Air Transport Association of America (ATA). ATA represents the airlines that fly 95 percent of all passengers and cargo in the U.S. I thank you for inviting me here today to discuss NASA and FAA aeronautics research and development investments.

The airlines are in perilous financial condition. Immediately following 9/11, Congress issued grants of $5 billion, for which we are truly grateful. But, that $5 billion only offset losses from the four-day shutdown and re-start of the industry during the month of September 2001. Since then, multiple small airlines and two major airlines, representing more than twenty percent of the industry, have declared bankruptcy. Over the last two years, passenger carriers have lost about $18 billion. They are borrowing just to operate. Industry debt now exceeds $100 billion, while the passenger carrier's $15 billion total market capitalization continues to decline. Their ability to borrow to support continuing losses is evaporating. The few airlines that have been able to achieve a profit see razor thin margins—and with the prospect of war on the horizon, the overall picture is bleak.

The reasons for the imperiled condition of the industry are clear. Revenue was already soft in 2001 from a weak economy. It further declined sharply following the 9/11 attacks on America. And demand is now still further suppressed by concerns for an impending war with Iraq. Although airlines have embarked on an unprecedented program of self-help to address this "perfect storm" of adversity, stubbornly high fuel prices and escalating security and insurance costs, have been added to the mix with devastating effect.

The industry has already achieved annual savings of over $10 billion in capital and operating expenses, and efforts are well underway to remove billions more in costs. Airlines have cut unprofitable routes, parked hundreds of airplanes and laid off nearly 100,000 people. But the "perfect economic storm" plus skyrocketing costs for fuel, security, and insurance are proving beyond our ability to battle alone.

Analysts predict the industry will lose another $4 to 6 billion this year, meaning that airlines are on target to lose some $25 billion over the three years 2001 to 2003. Given this dismal backdrop, it has been difficult for the industry to focus on aeronautics research programs that might yield benefits in five years or more in the future. We have understandably been focused on surviving today!

Having said that—while we must focus on survival today, maintaining and augmenting the R&D programs will be critical to ensuring that there will be a tomorrow. And that is where I will focus the remainder of my remarks—on key things we must do to ensure a robust aviation R&D program here in the U.S.

First, we must address the right issues in the smartest ways possible. Second, we must make sure the funding is there to achieve the results we need.

I turn first to the right issues. Of course, safety remains our predominant goal—and we are achieving spectacular success. Last year, scheduled airlines achieved their lowest number of accidents since we became a major industry after World War II, and we had ZERO fatalities! Safety should remain a key focus of R&D, just as it always is the top priority for the airlines in their operations.

Nevertheless, we know that the air traffic delays of 1999 and 2000 will return with a vengeance if we do nothing to plan for the future. That is why today's hearing and the interest of the Committee in taking action are so important.

The FAA's Operational Evolution Plan is an important step in increasing capacity in the ATC system. The Plan will only add 30 percent improvement in capacity by 2012, while the number of flights are predicted to increase by 50 percent. The greatest proportion of these improvements will be at airports, with little capacity being added to en route airspace. Both we, and the FAA, know that work must be done to improve the en route segment of the ATC Operation beyond current plans.

FAA and NASA need to begin work now on the next BIG idea—a broad-based, government funded initiative beyond the OEP to deal with predicted traffic increases beyond 2010.

Today, the U.S. ATC system is human centered and human constrained. FAA has been augmenting controller tasks with new tools, but they provide only incremental improvement. These tools are NOT enough to cope with predicted traffic.

What we believe must be done is to develop a system that is HIGHLY automated where routes are assigned that: are as close to direct trajectory as possible, avoid weather, automatically separate aircraft, and seldom require intervention from the ground.

A human intensive ATC system, coping with increasing traffic demands, that relies on a continuing subdivision of airspace (as we do today), requiring additional controllers, will, or may have already reached a point of diminishing returns.

Something must be done now!

Equally important is equipage, such as data link additions, which will be necessary by airlines to gain certain capacity benefits. As you can imagine, having airlines spend enormous amounts of money for avionics, given our current plight, is *not* likely to happen.

The President's Commission on the Future of the U.S. Aerospace Industry recently made a recommendation that addresses this problem. They said that airborne equipment needed for safe, secure, and efficient system-wide operations should be deemed part of the national aviation infrastructure, and FAA should be encouraged to support and motivate operator equipage by any of the following: full federal funding for system-critical airborne equipment, partial funding (through some form of voucher or tax incentives), or auctioned investment credits.

We suggest that the FAA fully examine these alternatives with airspace users to determine viable methods to achieve needed airborne equipage.

With regard to the proposed joint program office linking FAA, NASA, DOD and Homeland Security, we know very few details, but we are concerned with what we do know. Certainly the notion of sharing technology and research to improve National Airspace System (NAS) capacity is a goal worthy of the combined efforts and resources of those agencies. But, a process that does *not* involve the *user* of the system will *not* succeed. We are concerned that there is no formal coordination with Airspace users about NASA activities dealing with future improvements to the FAA's Air Traffic Management system. Since NASA appears to be responsible for more and more of the FAA air traffic capacity research, this has become an important issue for us.

While getting the right issues into focus is a serious challenge, ensuring adequate funding to do the job is equally important. We are greatly concerned about decreasing levels of funding dedicated to aeronautics R&D. As you know, the NASA budget includes R&D funding for both aeronautics and space. However, in recent years, the space related projects have taken priority.

In fact, aeronautics represents only about 5 percent of NASA's budget, and NASA has a history of cutting from its aeronautics programs to cover space program overruns. Such fund diversion is a tremendous threat to aviation R&D—programs that are critical to the next generation of aircraft.

I do not mean to suggest that the space program is not important. It is. But, we must not shortchange the future of aircraft innovation as we look farther and farther into space. The NASA and FAA aeronautics R&D programs should be restored to full funding and funding increases should be also be considered.

An example of a "right" issue that is under-funded is the R&D budget for environmental innovation in noise and emissions. Although budget requests for FY04 have been increased for NASA's Ultra-Efficient Engine Technology (UEET) program to reduce emissions, and the Quiet Aircraft Technology (QAT) program to reduce noise, actual budget *authority* for these two programs has been less than half of what has been needed over the past few years. These diminished funds result in diminished opportunities to make significant advances in noise and emissions technology. As you know, R&D funds are used by NASA and its partners to fund the earliest stages of noise and emissions technology development. Once such technology is developed to a certain Technology Readiness Level, industry funding has been used to further test and develop the most promising technologies. It was this public/private partnership, and a significant NASA investment in the 1980s Energy Efficient Engine program, that developed the base technology in today's modern engines. Without a similar level of investment in R&D funding and support from NASA and FAA, it is *unlikely* that we will develop a new generation of aircraft that are significantly quieter and more environmentally friendly. Such a possibility is all the more sobering given the instability of fuel prices and growing concerns about the impact of aviation on the environment.

Further, we must be concerned about the global competitiveness of the U.S. aviation sector. Cuts in NASA and FAA R&D budgets in the U.S. have been met with increases in the R&D budgets of our competitors. Indeed, while we have been cutting funds from our aeronautics R&D budgets, the European Union has stated their intent to seek world leadership in aviation—and they have committed the R&D funds to do so.

In closing Mr. Chairman, we need your help in providing NASA and FAA with the sense of priority and the resources to begin work immediately on the Air Traffic Management system of the future, to help FAA find ways to fund airborne equipment, and to see that NASA and FAA have the means to help ensure that the United States remains the world leader in aeronautics. I will be happy to answer your questions.

DISCUSSION

Chairman ROHRABACHER. Thank you very much for that input. While I get this cough out of my throat, I am going to ask Curt Weldon if he could start the questions.

Mr. WELDON. Thank you, Mr. Chairman. Let me first of all congratulate you. As a member of the steering committee, I was in when a request came in as to whether or not you should be the Chair of this committee, and you know, without any hesitation, it was unanimous on our side that we needed you in this spot, and you have done a commendable job. You have an interest that is outstanding, and with our very capable Ranking Member, we feel very confident that this subcommittee is a very important subcommittee this session, and will play a leadership role. So I want to applaud you, personally, for your effort.

ROTORCRAFT R&D AT NASA

Mr. Chairman, I come this morning confused and a little bit upset. You know, in a previous capacity, I chaired the Defense R&D Subcommittee for six years, where my job was to oversee about $38 billion a year of defense R&D spending, much of it done in collaboration with other agencies. And during that entire time, I have also sat on this committee, where we oversee over $40 billion of non-defense R&D spending. And our job is to put money on the table into the agencies that can develop the cutting edge technology for the future, and where possible, support the efforts that our military is doing. But in the end, also focus on benefits to the civilian community.

NASA, as I understand it, has the responsibility not just for space, which I have been a total 1,000 percent supporter of in all their budget requests and operations, and in fact, I think Sean O'Keefe is the right guy to be heading NASA right now. But if I am not mistaken, Mr. Chairman, does not NASA also have the responsibility for rotorcraft research? Is that correct?

Chairman ROHRABACHER. Aeronautics.

Mr. WELDON. NASA has responsibility—and let me just say for the record, I now chair a major procurement part of defense budgets for the Congress. One of our largest areas of spending money for the military is in rotorcraft. The two newest programs that we are developing, one for the Army and for Marines and Special Forces Command are the Comanche and the V–22. They are sucking up billions of dollars a year of our defense budget—billions of dollars. Special Forces Command thinks that these aircraft will revolutionize the way they do their job, and our Marines have consistently held the V–22 is their key technology for the future. In spite of two accidents we had, one caused by a software glitch and the other by a lack of fully understanding the impact of vortex ring state on the training of our pilots, we are over that. In fact, Pete Aldrich just said when he visited the program, he is confident that we are now ready to move forward. We are into producing over—we have produced over 50 aircraft already and that program is now back in testing for a final decision this year.

Rotorcraft offers tremendous advantages for us from the standpoint of civilian transportation. In fact, we have had studies that show that with the terrible problems of noise, and the problems of the inability to grow our airports, rotorcraft technology could be a great way to solve those challenges. And in fact, coming from the mid Atlantic region, I can tell you it is very difficult to expand existing airports to take care of bigger and bigger jets, which pose additional problems both in terms of landing them, taking them off, and dealing with the problems of neighbors.

Rotorcraft is being seen around the world as a major growth area. In fact, Eurocopter and companies like Augusta are doing very well, while our industrial base in this country shrinks, and shrinks, and shrinks. The American Helicopter Society, headed by Rhett Flater, it said they are in dire straits, as we once had four major manufacturers, now have three, and we will probably end up with two. So again, we are seeing perhaps that technology go offshore.

Now, does this mean there is no more research? Well, I have talked to all the experts. I talked to the provost at Penn State, where they have an excellent rotorcraft engineering program. I have talked to the dean of University of Maryland, where they have one of the best rotorcraft engineering programs in the country, and I have talked to the president and provost of Georgia Tech, and they all said the same thing—Congressman, there is tremendous opportunities for us to do research in rotorcraft, tremendous. We can help the military because we can build pilotless aircraft that are rotorcraft in nature that can help us solve problems, but they also can support us in the whole issue of Homeland Security. And as a member of the Homeland Security Committee—in fact, we have already discussed the idea of perhaps rotorcraft helping us not on the defense side, but helping us in terms of the civilian aspects of maintaining our quality of life, whether it be for surveillance, or whether it be for the Coast Guard missions of environmental monitoring, or other issues, domestically, or over in search and rescue, whatever they would be; but not defense strategies or not defense needs.

So I say all of these things, and then I ask the question, Dr. Creedon, how much did you request for rotorcraft research in the 2003 and 2004 budgets?

Dr. CREEDON. In the——

Mr. WELDON. How much?

Dr. CREEDON. In 2003 budget, the original request was for zero, however.

Mr. WELDON. No. I asked a question. The 2004 budget, how much?

Dr. CREEDON. The 2004 budget, the request as it now stands is in that budget is $15 million.

Mr. WELDON. Did the staff give me bad information? I was told it was—we have a disagreement here, so let me ask the staff. How much do you understand is in the budget for 2004? Do you not have your facts together or are you misquoting what your request is? Staff tells us you are requesting 2003 and 2004, zero. How much is it?

Dr. CREEDON. Our request in 2003 was zero. Our request in 2004 has contained in that request $15 million, but the staff is not misleading you. It is in our Vehicle Systems Program and is not specifically identified as rotorcraft, so that is probably why you are getting that information from staff.

Mr. WELDON. Do you concur with that? You have to. Well, let me tell you something, Doctor. Maybe you have some adequate justification, but I am going to tell you, as one member of this committee—and I am not just speaking for myself, you will hear this from other Members, a supporter of NASA—you better do some explaining for us about where your priorities are. If you don't want the responsibility for rotorcraft research, say so on the record and we will take it away from you. But NASA is not going to play games with this industrial base. We have tremendous technology opportunities and your mission is not just in terms of space. There are other aeronautics research needs that this nation has. Our rotorcraft industry, consistently, our academic community, consistently, has said there are opportunities where they can provide new cutting edge research, yet, you have requested zero dollars. Why?

Dr. CREEDON. If you would like me to try to answer that, I would be happy to.

Mr. WELDON. I would absolutely like you to try to.

Chairman ROHRABACHER. We will hear the answer and then we have to move on to the next question.

Dr. CREEDON. Okay, fine. One of the things that the administrator has definitely tried to instill throughout the agency is that our budgets are responsible and credible. Specifically, when we propose to do something, we have adequately addressed what the budget needs of that item would be. There are difficult choices that one needs to make when one is putting together any budget. I have explained in my written and oral testimony that we have taken within the runout budget that we have and tried to start a number of things that we thought were important and vital to the country. I have mentioned security, I have mentioned the national airspace system needs, I mentioned the noise. When you do these things within a fixed budget, there are difficult choices that must be made. And we made the choice to discontinue in 2003 the rotorcraft funding, however, we have had the occasion—I have talked to Mr. Flater himself and many others to reconsider that judgment. And in fact, in both Fiscal Year 2003 and in Fiscal Year 2004, in discussions that I have had with Dr. Michael Andrews, I believe one of his titles is Chief Scientist of the Army. We have agreed to put aside $15 million in both of those years, even though our original request for 2003 was zero. They are going to put in at least a matching amount, and we will be working together on some of these high priority research activities that you discussed.

Mr. WELDON. Just a quick follow-up.

Dr. CREEDON. I should add one thing. It is not our desire to have the responsibility for rotorcraft research to be removed from NASA.

Chairman ROHRABACHER. Mr. Weldon, one very quick.

Mr. WELDON. I would just say, well, your actions don't reflect that statement that you just made, and I am going to hold you accountable. But let me just say, Mr. Chairman, I invite you and the other members to come to a hearing next week on March the 12th, where the leading rotorcraft leaders of the country will come in and testify before my Committee, and we will ask them the same question, and Dr. Creedon, we will see what their response is. $15 million from the Army is a pittance compared to what we are spending in our defense budget, and I am ashamed that you at NASA, and Sean O'Keefe at NASA, have not seen fit for one of the key technology growth areas for this nation and the world, and you have said you don't have enough money to put anything in the budget. Only as a second thought have you decided that perhaps maybe you can find $15 million. Maybe we should take it out of the operation of your budget that you, yourself, handle with your staff. In the end, perhaps I would feel more comfortable with that.

Dr. CREEDON. Just two quick things. That is where we are taking the money from.

Chairman ROHRABACHER. Let me note that it is the policy of this Chairman always to allow the witness to have the last word in these type of exchanges, whether it is with the Chairman or any other member. So Dr. Creedon, you may have the last word on this.

Dr. CREEDON. Well, I just want—the money did come out of the budget that I am responsible for, the money we are putting in, and perhaps I misspoke. I said we are putting in $15 million; the Army will be putting in more than that amount.

Chairman ROHRABACHER. Thank you very much, Dr. Creedon. Let me note that it is this type of creative tension—let me describe it as creative tension—between the legislative branch and the executive branch that helps us make the right decisions in a democratic society, and we are very happy to have people who both have expertise and passion about what they believe in on both sides. So thank you very much, both of you, for that exchange. It was necessary.

Now we turn to—and was that a vote, by the way? Okay. We now turn to Mr. Wu because Bart Gordon is not here yet.

CONSTRAINTS IN THE NATIONAL AIRSPACE SYSTEM

Mr. WU. Thank you, Mr. Chairman. Let me ask a couple of questions with perhaps slightly less creative tension involved. Dr. Hansman, you put up a slide that seemed to show that gates, runways, utilization of airspace, that those are a chokepoint phenomena for more efficient use at higher capacity for our national air transport system. And looking past this period of pain for both passengers and airlines to, hopefully, a more prosperous future where there is much fuller utilization, I would invite you, Dr. Hansman, Mr. Armstrong, Mr. Keegan, to address the issue of which of those do you think are the real gating phenomena, pardon the term, or the tightest chokepoints, and are there others that you would try to address in order to create more capacity, which I am confident we will need in the future?

Dr. HANSMAN. Let me start. I am sure Charlie will have something, but the number one constraint in the U.S. right now, when it reemerges, will, in fact, be runways. We have a finite safe limit on what we can do in operating runways and where people want to go turns out to be centralized. So if you looked at the data—actually, it is interesting. The delay data in 2000, you will notice that it went up in the summer, didn't come down in the fall. That was due to a single airport, LaGuardia, being scheduled way past its capacity, and it is such a nonlinear system that the delays propagated through the system. So that is number one, and we are working on it. Unfortunately, the OEP, while it is a great plan, isn't adding runway capacity in some of the key places because of the environmental and other constraints that come in the system.

Number two will be airspace, and in fact, we think that the airspace will emerge as a greater problem because the traffic will tend to divert to other airports, so you will get airspace. But let me just close and say that the fundamental problem is our current operating paradigm has limits so we can't control traffic the way we currently do and get more than—we can argue about it, but something like a factor of two increase in capacity and key points in the system. So we will be constrained by that and the cost will go up, so we really have to look forward, way in the future, to come up with operating paradigms and figure out ways to transition.

Mr. WU. Mr. Armstrong, I want to give you a chance to comment, if you wish, but before I do that, Dr. Hansman, could you further explain—you just mentioned this operating paradigm that gives us a problem. I would like you to unpack that for us a little bit.

EN ROUTE SECTORS

Dr. HANSMAN. One way you can look at it now is we provide great service, air traffic service, today to aircraft, but it is, essentially, a very labor intensive hand carrying product. So every aircraft that is flown is being looked at by a number of people. And the fundamental problem on expanding the system is one controller has a limit, and depending on the type of airspace, it may be 15 or 20 airplanes. The way we deal with the limit is if it gets to be too much traffic, we cut the sector. Okay. But you can't do that forever because there are interface costs. I have to hand the airplanes off. So at some point, you get to diminishing returns, and you fundamentally can't expand the system that way. You have to look at a different way of doing it. I don't know if that was clear.

Mr. WU. Okay . Mr. Armstrong.

Mr. ARMSTRONG. Thank you, sir. We would agree with everything that Dr. Hansman has said. The difficulties, or the limitations, rather, are runways at airports, and the en route system. The good news is that the Operational Evolution Plan does have a number of runways in it. We support those that are there. We don't have all the ones that we would like, but environmental limitations prevent that, though, we strongly support the ones that are in there. Because of that 30 percent capacity increase that I talked about, 70 percent of that comes from runway construction, as a matter of fact, new runways. And so that is a good part of that plan, but as Dr. Hansman has indicated, the en route sector is already going to begin to limit us as soon as we begin to expand back in the demand at all, and that needs to be more highly automated so that those controllers can handle more space, more airplanes with the same——

Mr. WU. Thank you, Mr. Armstrong. I apologize for cutting you off, but I just want to add one more comment based on the comments that you and Dr. Hansman made about additional runway capacity. And that is, whether it is here in Washington, where Chairman Rohrabacher and I share one block not too far from here, we can hear the roar of National Airport, or at home in Oregon, where I happen to live on a hill, and when I hold town meetings in my own neighborhood, there is always some discussion of airline noise. I would commend to you gentlemen that we do aggressive research on quieter engine technology so that as we build this capacity both in the air and on the runways, that none of us have to face a more hostile public as a result of engine noise. Thank you, Mr. Chairman.

Chairman ROHRABACHER. Thank you. The Chairman will now take my five minutes, seeing I have cleared my throat here. Let me note that the roar in my apartment comes from the subway, which is right below us, too.

Mr. WU. We get it from above and below.

RUNWAY CONSTRUCTION

Chairman ROHRABACHER. So we are getting it from both directions there. And I would note that Mr. Keegan did mention that there has been a lot of research on noise from airplanes, which I think is very commendable, and I think that you bringing up the subject is important. I would like to note that when you talk about airport runway space, I mean, people are not willing to permit people to build anymore runways or to build anymore airports it seems. The NIMBY factor in the United States is almost beyond belief now. I mean, you know, just to heck with the rest of the world, to heck with the rest of the country, nobody is going to build anything near my house, you know, not in my backyard. The not in my backyard syndrome has actually been replaced in California with the banana syndrome, which is build absolutely nothing anywhere near anybody.

And so we are not going to be getting, I don't believe, more runway space, although I back—I would be supportive of trying to get new airports and runway space, but I have been beaten back in our own area. El Toro has $2 billion worth of runway infrastructure and airport infrastructure, and yet, the people in my county were able to thwart that because of fear of noise, I might add, which was the basic worry. So perhaps the future does lie in a new type of aviation.

Curt is talking about the V–22 with the possibility of going up and down. Let me note that that is one technology that would permit us a lot more flexibility in dealing with this issue. Dr. Creedon knows there is another—there are several other alternatives of vertical takeoff and landing to the V–22 that are also under development and could well work out. The V–22 might work out, these other technologies might work out. So perhaps vertical takeoff and vertical landing will help us with some of the problems, distribution and changing our system, so that we can take up the slack from an increasing demand.

AIRCRAFT EMISSIONS

Just a thought here, I would like to suggest to you, Mr. Keegan—I highly commend you, as Mr. Wu has commended you for the research on noise, I would also commend you for the research done on pollution as a factor. In the Los Angeles basin, I have to believe that because, again, they focus so much of the takeoff and landing on LAX, rather than distributing that, which the public in Orange County wouldn't permit them to do that, but that means there is an air pollution problem and that we are ending up putting the people in LA County, their health, at great risk. And I think that it is very commendable. Maybe you can tell us a little bit about that, you say that you are trying to take lead out of fuel, but didn't that screw up the engines in our cars?

Mr. KEEGAN. Being in aviation, I am not going to speak to the car part, but we are trying to make sure that unleaded gas in general aviation aircraft is extremely safe. So that is our first and foremost concern. We are quite proud of our community that is dealing with emissions activities and modeling. They have what has been recognized as a world premiere computer modeling that can determine where the pollution is and how we sort of can contain that in arrival routes and on the ground.

Chairman ROHRABACHER. Do you have studies of how much air pollution is caused by aviation?

Mr. KEEGAN. GAO had just completed a study. I believe it is in draft, but what it says is that aviation contributes one-half of one percent to all the pollutants, and it is an extremely low figure, but we are still addressing the issue of our aircraft and where that comes from. The work that——

Chairman ROHRABACHER. And working on whether or not those pollutants might be more dangerous than some of the pollutants coming from elsewhere?

Mr. KEEGAN. Correct, and where they distribute from, and at what particular altitude. And one of the things that we are also working on is the ground equipment and their contribution to the emissions around and at the airport itself, and how they move with wind and the movement of the aircraft. So we have a very strong effort in that area, particularly, in 2004, to move forward and use where we think we have tremendous world leadership and try to drive standards and regulations home from where we think we are the experts.

AERONAUTICS RESEARCH PROJECTS AT FAA & NASA

Chairman ROHRABACHER. Okay. Mr. Armstrong, do you think that the cooperation that private business, that our businessmen who run the major airlines are getting from the FAA and from

NASA in terms of research development, is that cooperation as—well, how would you rate it—A, B, C, D?

Mr. ARMSTRONG. I am not sure I would want to put a grade on it, but I will give you some examples of some successes that we have had——

Chairman ROHRABACHER. All right.

Mr. ARMSTRONG [continuing]. Which highlight why it is important that we continue this research and development. With respect to noise, in 1975, we had seven million people in America who were exposed around airports to noise levels of 65 decibels or greater. That number today is down to 600,000, which is spectacular.

Chairman ROHRABACHER. Would you repeat that figure again for me?

Mr. ARMSTRONG. In 1975, it was seven million; today, it is 600,000, and that is a direct benefit from the engine research——

Chairman ROHRABACHER. Wow, that is tremendous.

Mr. ARMSTRONG [continuing]. That was done at NASA, and then it extended into industry in the 1970's and 1980's so that engines today are much quieter than they were then and we are getting payoff from that.

Chairman ROHRABACHER. And you see how much worse it would be if we wouldn't have had that research.

Mr. ARMSTRONG. I might also add that there is a bill that has been introduced by Senators Allen and Dodd and Congressman Larson that is to help maintain leadership in research and development to help us continue to reduce noise levels, make the engine more efficient, and to reduce pollutants from the engines, and we strongly support that.

Chairman ROHRABACHER. And now, if we can do something to turn something into money for the airlines as well, that might help out. Let me just note that I think NASA—now, we depend a lot on NASA's research, and there is a question about whether or not, you know, how we make our decisions of what the priority is, aeronautics or space. Dr. Creedon, maybe you can talk a little bit about that, where your priorities are and how you make that decision, what direction the money is going to go to in terms of research?

RESEARCH PRIORITIZATION AT NASA

Dr. CREEDON. In the recent past, in the aerospace technology enterprise within NASA, the budget came as an enterprise budget. And we went through what we felt was a good process, involving external input as well as our own deliberative processes, to try to determine how much of the money went to aeronautics and how much of the money went to supporting space science or even space transportation items. In the 2004 budget, for the first time in a long while, aeronautics is its own budget line item, and that will assist us in the future in determining how much money goes into aeronautics, and all of the money that is in that budget line item will be directed toward aeronautics research activities, such as we were talking about emissions just before. One of the things that we are doing in the aeronautics budget is we have just completed tests at the Glenn Research Center on a new engine type that has already demonstrated it can reduce nitrous oxides by 50 percent and we are well on our way to achieving a 70 percent overall goal. So my answer is, in the past, we had an enterprise budget, and we tried to do the best job we could both with internal and external inputs and discussion on dividing it between aeronautics and other activities. Now and in the future, aeronautics is its own budget line item so we can discuss it as a budget line item.

Chairman ROHRABACHER. Well, thank you. We will be paying attention to that bottom line. Let me note that NASA and the Defense Department have demonstrated a keen interest in unmanned aerial vehicles, and remote control, and these type of things that perhaps in the future we may be more heavily involved in. And I, personally, would suggest that NASA take a look at that and become perhaps more focused on remote control research, because that may be something in the future, along with the Department of Defense, would be very important to our competitiveness.

Is that a vote or is that not a vote?

So with that said, we now go to Mr. Larson from Connecticut.

Mr. LARSON. Thank you, Mr. Chairman. Let me also echo the sentiments that were expressed earlier by Mr. Weldon and congratulate you on your chairing of this committee. Let me also associate myself with the remarks of Mr. Weldon, and I would seek unanimous consent to—because I have far more questions than I know I am going to be able to answer to—submit those in writing to the Committee so that they could be answered by Dr. Creedon and——

Chairman ROHRABACHER. With no objection, that, and also, every Member will have the right to submit whatever questions he or she does not get answered today will be submitted to the witnesses.

Mr. LARSON. I want to thank Mr. Armstrong, as well, for mentioning the bill that has been introduced in the Senate by Senator Dodd and Senator Allen, and I also want to commend my colleagues here in the house, most notably, Mr. Forbes and Mr. Weldon, who have a very keen interest in this R&D legislation and have been spearheading this as well. And I would like to submit that to NASA for your perusal and, hopefully, you can find a way to come on board.

AERONAUTICS R&D BUDGET

What is troubling to me, and we had Administrator O'Keefe in here last week, is that we continue to look at a reduction in the aeronautics budget. It seems to me that the mission of NASA is aeronautics. And though I am incredibly supportive of the space program, as Mr. Weldon has pointed out, you place us in a situation by orphaning the aeronautical aspects of NASA's commitment to making funding decisions that detract from the space program, and at a time of crisis, especially, this seems very unfortunate. However, this committee has seen fit to go abroad and do research and meet and discuss the aeronautical challenges that we face around the globe. We know that the European Union is focused on something they call Vision 20/20, where they are out to take this market away from us. And when we look at our own troubled airline industry here, and the testimony that was made by Dr. Hansman, it just seems appalling for us that NASA seems not even to care or focus on this issue while a unified European Union is eating our lunch every single day. This is definitely an area that calls out for your commitment. The job losses that are taking place, the highly skilled, highly trained, critical mass of people in the aerospace industry that are dwindling on the vine as we cede industry to the Europeans is a travesty of mammoth proportions that this committee and NASA has got to address. What are your plans for that?

Dr. CREEDON. First of all, I would like to say that it is not so, that people in NASA do care deeply about the aviation and aeronautics community and in the research in that community.

Mr. LARSON. Well, let us say it is not reflected in your budget.

Dr. CREEDON. That is certainly so. In the budget a week ago, at this very moment, Administrator O'Keefe answered a question about the five percent decline that is projected in the aeronautics budget, that that really should be looked upon as a baseline for the 2004 year, and he said that it did not reflect some of the things that we were considering. And specifically, he mentioned things that we are considering with the FAA in terms of a future generation air transportation system, and he said that he was hopeful that the budget would show increases in the future. One of the things that I would say about the bill, the Larson-Forbes bill, is that NASA certainly shares the intent of the bill on the importance of research and development to the future of aviation and we agree that the areas in the bill are many of the right ones to focus on.

In the past, we have come up with an aeronautics blueprint for the future, and I would say all of the things that are contained in our blueprint are—all the things mentioned in the bill are also contained in our blueprint. And if, in fact, more money is available to us, we will put them against what we think the goals of the aeronautics blueprint are, which are the same goals that are in your bill.

Mr. LARSON. I would just like to reiterate what Mr. Weldon said. If you don't we will.

Chairman ROHRABACHER. It just didn't sound as tough coming from you as it did from Curt. I thank you for that. No one can quite match up to Mr. Weldon's veracity on these issues. Do you have one last question? Okay. Thank you very much.

We now turn to a Member of the Committee who, actually, is probably one of the best educated Members of Congress, who we rely on not just for philosophy, like we all can talk about philosophy. This guy actually understands all these—the physics behind all of these things. And so I now turn you over to Roscoe Bartlett.

TRENDS IN BASIC RESEARCH

Mr. BARTLETT. It would be nice if that were true, wouldn't it, that I understood all the physics involved? Dr. Hansman, you had a visual that showed a shift from basic research to applications focused use of money and resources.

Dr. HANSMAN. Yes.

Mr. BARTLETT. Under that, you noted that grants were now seen as welfare instead of high risk payoff. You saw this shift for basic research as good or bad?

Dr. HANSMAN. I think it is bad. I think—understand, I think the motivation for this—in my experience the most effective and creative, a lot of the most effective and creative work, really comes from unsolicited proposals, single investigator, you know, one faculty member working with a student type ideas. And there has been a shift to these sort of very large scale problem driven programs, and I think those are important, but the portfolio appears to have shifted too much to those programs and not enough to the core research.

And one of the things I would just like to point out, the benefits we have gotten in the noise is really the result of work that was done 10–15 years ago as part of the core research and technology programs within NASA. So if we are not investing in the future at some level, we are going to have problems in the future, you know.

Mr. BARTLETT. In a former life, I was a scientist and spent a number of years in basic research, and what many people didn't understand is that the very productive engineering applications of today are the fruits of basic research of yesterday. And it is very analogous, I think, to the farmer eating his seed corn. If he eats his seed corn and doesn't plant anything in the spring, he will harvest nothing in the fall. And we have had over the past several years a rather dramatic decrease in basic research funding in our country with a shift, just as you indicate on your slide to program based—because when I came here, I was told that we were now going to very wisely support basic research only where it had a societal payoff. And my question was how are you going to do that? I doubt very seriously if Madam Curie had any notion of what the societal applications would be of her early radiation research observations. The question then was, well, what do we then do? Of course, the right answer is you commit an adequate amount of money to support an adequate number of good scientists, and you can be assured that there will be societal payoff. You have no idea from which of those research activities there will be societal payoff, and I am disturbed because we are spending too little of our money on basic research and we have too little appreciation of what basic research is and what it does.

Dr. HANSMAN. I would agree. And also, point to the last bullet that I didn't talk about, which is I think we need to think about what are the strategic core competencies that we need to build in the Nation, in our universities and our industries, and I will just use one example. Mr. Weldon talked about the software problem in the V–22. Software is an example, critical software of a core competency that we have to have in this country, and we are really not adequate right now.

Mr. BARTLETT. We move much of that offshore. India is now doing a great deal. Even for our military, India is now doing a great deal of our programming. You mentioned that grants were seen as welfare. How did that happen?

Dr. HANSMAN. This is my perception of the perception, so I would just qualify that, which is a grant, because it is not directed, is seen as something which isn't controlled by the agencies.

Mr. BARTLETT. Is this because we don't understand the importance of basic research?

Dr. HANSMAN. I think it is just a perception. I think a lot of it has to do with organizational programmatic, you know, issues, that people believe that they can't direct funding or focus the funding from the agencies if it is a grant. And really, the universities want to collaborate, so we need to have structures which allow you the freedom to explore new ideas as they come up, but also allow a collaboration between the universities and the agencies. And I don't know if it is a grant or something else.

Mr. BARTLETT. Grants are usually in support of basic research?

Dr. HANSMAN. They are, generally, in support of basic research, and the fundamental difference of a grant and a contract is that a grant is not explicitly directed in terms of its deliverables. So you don't state up front that I will invent penicillin. You say, I will work in this area and see what comes of it. So it doesn't have the same kind of deliverables.

Mr. BARTLETT. Thank you very much.

Chairman ROHRABACHER. All right. It is the Chair's intent to have one more question, or one more series of questions from our member, and then to recess, and it will probably be about a half-an-hour recess when all of these votes are taken, and then to come back so the rest of our members will have a chance to participate, and if they would like to participate in a second round of questioning as well. We now have Ms. Jackson Lee from Texas, and she has her complete five minutes. And let me just note, she is very active. The people of Texas are very interested in this issue, as well as her very active role in this Subcommittee on Space. So she may proceed.

Ms. JACKSON LEE. Thank you very much, Mr. Chairman. I cannot thank you enough, and the Ranking Member, for having this very pointed and effective hearing. Last week, when the administrator was before this committee, and it was a much larger setting, focusing on NASA's budget collectively but also focusing on the Columbia tragedy just recently, one of the questions I raised was the research on escape or survival of the astronauts, and it tracks my line of questioning to this particular panel, particularly, with the stark news that we have cut the National Aeronautics and Space Administration's aeronautics R&D 50 percent. And I think the Chairman so noted in his opening remarks, astutely, that that appears to be a real problem. As I look at your request for the Fiscal Year 2004 budget, it doesn't seem to remedy that crisis, because it flat funds any requests. And let me say to you that we are not only going to be looking very keenly at this, but my understanding is that this research includes traffic management technologies. If that is the case, this is a very important aspect of NASA's work, advanced vehicle design, adaptive controls, but also, one of the important issues—and Congressman Weldon has gone, but one of the important issues that we will be dealing with in the Homeland Security Select Committee is aviation security. You are asking for $21 million. To me, that seems to be a real stretch on where we are. So let me pose some questions.

First of all, if you could convey back to the administrator that I renew again my request to make the Columbia investigatory team a commission or to request such, but also, to diversify that team. I made the request last week, or was it the week before. There seems to be no diversity of thought and/or position and/or ethnic background. And certainly, there are many races, and creeds, and colors that have participated in NASA, so I raise that.

But let me ask these questions regarding the idea of the loss of dollars.

With respect to Airbus getting now 50 percent of the air industry's request, have you looked into our lack of compliance with the Kyoto protocol and emissions, lack of compliance with emissions concerns of the Europeans as a problem, and are we doing research in fuel efficient engine design? And then we note that there is legislation either passing or already passed that pilots will be able to carry guns into the airport and onto airplanes. Do we have any sophisticated technology research so that we can ensure that those are the only ones that carry guns onto airplanes and that we won't have any tragedies that may occur as relates to airline and airport security, particularly, airline security, I might imagine? And I ask both the good doctor and Mr. Keegan for any responses to that as relates to NASA.

Dr. CREEDON. I will certainly relay your request to the administrator about the membership of the——

Ms. JACKSON LEE. Thank you very much.

Dr. CREEDON. But if I am not mistaken, the makeup of that Board is the result of the decisions of Admiral Gehman himself and is not, in fact—it is his choice as to who is on that Board, but I will relay that back to the administrator.

Ms. JACKSON LEE. Thank you. And I look forward to getting with the Admiral as well. Thank you. I want to point you to the $21 million question.

Dr. CREEDON. Right. Well, first of all, you are asking a question about emissions.

Ms. JACKSON LEE. Yes.

AIRCRAFT EMISSIONS

Dr. CREEDON. And yes, I can answer that within our program and the run-out program, we have concentrated research activities on emissions both CO_2 and nitrous oxides. In fact, I mentioned that we had made very excellent progress this last year on coming up with a new engine type that has the promise of reducing nitrous oxides by 50 percent. As far as your question on the——

Ms. JACKSON LEE. And how much are you requesting in the budget for that continued research?

Dr. CREEDON. I would have to—I could look it up in just a moment. As far as $21 million for security, that is in 2004. We are actually proposing $195 million over the next five years.

Ms. JACKSON LEE. And to be honest with you, that doesn't even seem like a lot. I appreciate your efficiency and fiscal conservatism, but to me, that sounds like a paltry amount. But let me let you finish.

Dr. CREEDON. I understand your concern. With regard to the firearms, there are a number of people throughout the country looking at making efficient sensors for firearms and so forth. What we are doing as part of the money that I indicated that we are putting into aviation security is we are surveying all of the sensors that have been developed within NASA for our science missions and for what we are doing in aircraft, and in space transportation to see if we have some sensors that might be made applicable to the questions that you are raising. As far as the regulations around that, I think I would defer to Charlie to answer those questions.

Mr. KEEGAN. Good morning. I would like to go back to the fuel efficient engines. We are in cooperation with NASA more in a regulatory role than anything else to ensure that the development of such an engine is indeed safe. We could make it very fuel efficient, but it needs to be safe for the same type of cycle times that we are used to now in new production engines that can go for a very long time with an incredibly high safety record, and we want to maintain that safety record.

Chairman ROHRABACHER. We have six minutes before our——

Ms. JACKSON LEE. Mr. Chairman, I just want to thank you very much. I happen to be on Congressman Larson's legislation. I think this committee would do well to support an increase or to get a better focus on R&D research over the 50 percent cut that we have had if we are going to compete internationally with Airbus and others, on behalf of Boeing and others in this country. Thank you.

Chairman ROHRABACHER. Thank you very much, Ms. Jackson Lee. And this committee will be recessed for 20 minutes.

[Recess]

Chairman ROHRABACHER. The Subcommittee is called to order, and we will proceed. I would like to take Chairman's prerogative for a moment before we go to Mr. Forbes, and ask a couple questions of Mr. Keegan. Mr. Keegan, we have now a new air traffic control system that is being—that is evolving into place. Is that right?

Mr. KEEGAN. Yes. We are in a constant state of evolution, sir.

Chairman ROHRABACHER. Okay. But this is sort of a new system as compared to what it was 20 years ago?

Mr. KEEGAN. Well, I think we have a number of initiatives that represent significant change from where we were 20 years ago, yes.

Chairman ROHRABACHER. Okay. So how much money has it cost us to evolve into this system and altogether, what are we talking about?

WIDE AREA AUGMENTATION SYSTEM

Mr. KEEGAN. Well, let me pick one initiative, sir, and that would be the Wide Area Augmentation System, which is really the first transition from a ground based system to an airborne based system—actually, a space-based system, utilizing satellites for navigational purposes and arrival purposes. You know, some of the technology such as GPS satellites, dates back into the mid 1980's. Our efforts really began in 1992, and thus far, our development has been under $1 billion for our portion of this. But this summer, we expect to go operational with a system that will provide accurate and with high integrity navigation between points, as well as near precision approach capability to airports around the country that don't have any other navigational aids available to them. So it provides a tremendous amount of capability for us for what we would consider to be over this period of time a very reasonable investment.

Chairman ROHRABACHER. Okay. That is a $1 billion investment on, of course—that is on top of the fact that we put the satellites up, and they were already up there functioning, etcetera?

Mr. KEEGAN. That is correct, and we still have out-year costs that potentially could range up to $3 billion. I would be more than happy to submit for the record the specific breakdown for the cost of that program.

Chairman ROHRABACHER. Okay. And why is it necessary for us to have this new system? Is it safer or is it more efficient? Why did we do this?

Mr. KEEGAN. Well, today's system is really structured around very specific ground based navigational aids, where you have to fly from one navigational aid to another navigational aid, and so you have a series of roads in the sky. This system allows us to really break that paradigm. You can go wherever you want to go, from your door to the next door, on the route that you choose. And that type of technology has been available to the high end carriers with very specialized equipment, and now it is really available even in your car. WAAS type technology is extremely accurate within a few feet, and that technology has multiple uses, but in aviation—even general aviation, pilots would be able to fly right where they want to go, following winds or——

Chairman ROHRABACHER. Any estimate as to how much more effective that will make our air traffic system?

Mr. KEEGAN. Well, we think it really changes the way that we can manage and develop the system. In the spring of this year, we expect to be able to begin that process by making major changes west of the Mississippi in the upper altitudes by not even designing routes in the sky, but actually just grid points. So we have already begun the process of that transition. We have achieved a 30 percent increase in en route capacity in 15 chokepoint sectors this past year by just redesigning that airspace.

Chairman ROHRABACHER. Say that again now.

Mr. KEEGAN. This past year, we have developed 15 new sectors, just changed the routes. And when we changed those routes between Chicago, New York, Washington, and Atlanta, these 15 sectors opened up enough capacity where we achieved a 30 percent reduction in delay just from those routes. The potential application of this is absolutely astronomical.

Chairman ROHRABACHER. All right. And Mr. Armstrong, would you like to comment on that?

Mr. ARMSTRONG. I think we have some preliminary estimates that we think it will improve something near 10 percent, being able to go direct from where you start to where you end, as opposed to having to follow the highways in the sky.

Chairman ROHRABACHER. So would that be 10 percent reduction in fuel?

Mr. ARMSTRONG. It would be primarily fuel, that is correct, fuel and just operating time.

Chairman ROHRABACHER. That represents $1 billion a year?

Mr. ARMSTRONG. I will have to get back to you on it. I really don't have a number on that.

Chairman ROHRABACHER. It sounds like the investment was worth while. Mr. Hansman—Dr. Hansman.

Dr. HANSMAN. I think the investment was worthwhile in a number of dimensions. One is that it will have a significant safety impact. What WAAS really buys you is vertical guidance on approaches, so it will have a safety impact on the smaller communities in the U.S. It will also have some of the direct routing impact that these guys mentioned. It has had already significant second order benefits to non-aviation communities, so people are now using GPS guided tractors in farm equipment, in things like that. And the last one I would say, the place that will really have benefit, and this is a little bit of my outward looking, is in the developing world, because what WAAS really buys you, if you spread it around the world, is precision approach capability to places that don't have good instrument facilities. And in the U.S. we actually are a rich nation. We have approach facilities in many of the countries, so the marginal benefits are not as strong as they will be in other nations.

Chairman ROHRABACHER. And Dr. Creedon, would you like to add anything there?

Dr. CREEDON. I really don't have anything to answer to the prior——

Chairman ROHRABACHER. Okay. Well, thank you very much. We now turn to Congressman Forbes from Virginia.

RESEARCH INVESTMENT TRENDS

Mr. FORBES. Thank you, Mr. Chairman, and thank all of you for taking time to be here with us today. Dr. Creedon, I am going to address my questions primarily to you just because I have a limit to the amount of time, and I would like to get to some basic policy issues. I think you heard from many Members of the Committee today that they are concerned about funding issues but, particularly, it is just a basic policy issue. It looks like to me, over the last decade, we have had a decrease, a slashing, if you would, in support from both Government and industry in terms of research dollars that have been put in. At the same time, it seems like we have seen ourselves fall further and further behind in our share of global commercial aviation sales, and perhaps, in at least a reduction in our technological edge. And my question for you as a policy matter, is it your personal belief that we can reverse the trends that we see, the reduction in our share of global commercial aviation sales or maintaining our technological edge unless we reverse the funding for research from Government or industry?

Dr. CREEDON. No.

Mr. FORBES. And the second follow-up question I would have is do you have any realistic expectation or anything you could share with us in the Committee that would lead you to conclude that we are going to see a new influx of research dollars from industry in the next several years?

Dr. CREEDON. Of course, I am not really privy to the inside decisions that industry makes, but as I judge the pressures on the industry and pressures that their shareholders and boards put on them, I really, personally, doubt that there will be a large influx of long-term research dollars in the industry into aeronautics research and technology.

AERONAUTICS BLUEPRINT

Mr. FORBES. That seemed to be buttressed by Mr. Armstrong's testimony, I think, today. But the next question I would have is, you know, earlier, in 2002, NASA issued the NASA Aeronautics Blueprint which described a vision of the technology advances that could revolutionize aviation and regain the U.S. in its historic position as a world leader in aeronautical products and services, and I certainly understand that NASA couldn't budget the resources to make the blueprint a reality in 2000 on the Fiscal Year 2003 budget, but I really can't understand why we didn't put it in the 2004 budget, and specifically, we failed to even mention, as I understand it, the Aeronautics Blueprint. Can you just explain to us what happened there?

Dr. CREEDON. The Aeronautics Blueprint was intended to be a longer-term vision of what we could achieve. It wasn't intended to be achieved in any one fiscal year, but rather, it set out a broad vision of what we were trying to accomplish in the future. And in, in fact, our 2004 budget, we increased the fundings in the ways that I mentioned both in my submitted written and my oral testimony in various areas, and those areas are in support of the goals that were outlined in the Blueprint. So I guess the short form of my answer is the Blueprint set out a long-term vision, indicated some of the problems that we saw there were with aviation and aeronautics, and set out a number of goals. And we are working toward those goals over a number of years, and in fact, we did take specific action in our 2004 budget to address some of those goals.

Mr. FORBES. Do you believe we can reach those goals with the current trend of funding that we have?

Dr. CREEDON. We will reach the goals within the funding that we have. The only thing that we are describing is the timing of when we reach them.

MATH & SCIENCE EDUCATION

Mr. FORBES. One of the things that has concerned a lot of us, in fact, right before September 11, we were concerned about two major threats to the United States. One was in terrorism, which proved to be a valid concern. And the other one was a lack of math and science students that we had in the country. How great a threat does the declining student interest in aerospace engineering programs pose to the health of the U.S. aerospace industry? And if you could tell us, what measures, if any, that NASA's aeronautics program is doing to address those problems?

Dr. CREEDON. I would be happy to do that, but if I could go back to your prior question?

Mr. FORBES. Sure.

Dr. CREEDON. As Administrator O'Keefe mentioned just a week ago in his testimony, the Blueprint is an important document considered within NASA, and if more resources were made available, we would put them toward the goals that are contained in the Blueprint, which are also the same as the goals that are in the bill. And so we could actually accelerate our progress along that path. As far as the threat posed by the lack of young people interested in engineering, and mathematics, and just general scientific literacy, I think it is a significant and severe threat, and NASA does as well.

We have under—the Administrator just crafted a new mission and vision statement, and I will quote, "One of the things in the NASA mission is to inspire the next generation of explorers." And we have, in fact, started a whole new enterprise. There were five enterprises within NASA and now there is a sixth, the education enterprise. A specific goal of that enterprise is to work with people such as myself and human space flight enterprise, and the earth and space science enterprises, to take the excitement of the things that we do and our goals and try to infuse that excitement to young people so that they would be more interested in pursuing careers in science and engineering. I think if we do not do this, there will be consequences for the country.

Mr. FORBES. Mr. Chairman, thank you. I see my time has expired.

Chairman ROHRABACHER. Thank you very much. And we now have Mr. Bonner from Alabama.

REGIONAL JETS

Mr. BONNER. Thank you, Mr. Chairman. Thank you very much, panel. Like many Americans, I find myself flying on regional jets a lot more. The airport in Mobile, Alabama is served primarily with regional jets, and yet, I noted that it is creating congestion, especially, at some of the larger hubs. Dr. Hansman, how can we take this growing problem and create opportunities for more people and more places to fly by increasing the use of regional airport systems?

Dr. HANSMAN. We are seeing that trend nationwide. I will just give you my hometown example. In Boston, the airport in Boston is at or near its capacity. Where we have seen the largest growth has actually been in Providence and in Manchester. So what you are seeing is regional airport systems, and in fact, the traffic offerings will vary and the market will re-correct that to some extent. The other benefit of the regional jet-size airplanes, it allows you to match the size of the airplane to the real market, so you get frequency of travel. So I don't know what the flight schedule into Mobile is, but if you had to fly 747's into Mobile, you only get one a day, and I am sure you are getting more than that now, so there is some benefits to airplanes of that scale. And I think one of the future visions is actually to have airplanes that match across the entire scale from the four passenger, six passenger jet, up to the 400 or 500 passenger jet to match the demand to the market to really provide the service.

SMALL AIRCRAFT TRANSPORTATION SYSTEM

Mr. BONNER. Dr. Creedon, how can a program like the Small Aircraft Transportation System help solve this problem? And you said, I think, in your written statement, that the goal is to work to enable better air service to more communities. Is this program a vehicle to actually move in that direction?

Dr. CREEDON. That is our intent, and we think we can achieve that. The Small Aircraft Transportation program is dedicated to providing another means of transportation other than through the hub and spoke system, so that people who may want to go from a smaller airport to another smaller airport can do exactly that. It is dedicated to the proposition that there are, I think, 5,400 public use airports in this country. Right now, the traffic goes into—the vast majority of the traffic goes into about five percentage of these airports, so we are trying to open up the capability of these other airports to the traveling public, and we think that that the SATS program is dedicated to do that.

Another interesting—I don't know the exact number, but I would be happy to get back with it for the record—but there are about 80 percent, I think, of population lives within half-an-hour of one of these 5,400 airports, so that we feel that has great potential in offering a new dimension of mobility to this country.

Mr. BONNER. Your answer—thank you—leads to another question. And again, going back to your written statement where you said that thousands of airports distributed across the country are a true national asset, given that there is a continual growth in regional jet service to smaller communities, do you feel that we are making enough of an investment to the right technology and to ensure that the right air traffic management system is in place?

Dr. CREEDON. I think there are multiple answers to that question. As far as the SATS program itself, it is dedicated to, I believe it is in Fiscal Year 2005, to do a demonstration of the capability, and I think that is proper. We should be able to demonstrate that we are making progress in that area in order to continue beyond. So I think that is a very adequately funded program at this time. But you address, really, a larger issue, and that is the whole air transportation system.

Charlie Keegan and I, and various organizations, we meet quite often, and we are working, really, in two fronts. The first front is on the system that we have, as he does his Operational Evolution Plan and we do some nearer-term research to help that, that is to kind of wring the most capacity without compromising safety that we can get out of the existing system. I think he is well on his way to doing as much of that as we can. But over time, I don't think that we want a country that is constrained by the capacity. So I don't, personally, believe that it is right to just put sanctions on the capacity, that we would really like the capacity to be there for people to travel as they would want to. So we are going to have to, as it really says on the two kind of things carved into the wall here, it may not be true that where there is no vision that people perish, but where there is no air traffic management vision, they will sure travel more slowly than they do now. If we don't leap out ahead and have some vision of what a future air traffic management system could be and start heading toward that, then we will just continue to try to get more and more capacity out of the system that we have. As John said, it is a finite number. Does that answer your question?

Mr. BONNER. Yes, it does. Mr. Chairman, will we be afforded an opportunity to go with a second round of questions?

Chairman ROHRABACHER. If you would—if that is an official request, the Chair will certainly accept that.

Mr. BONNER. Thank you.

Chairman ROHRABACHER. And now we have another freshman with us from Texas, Mr. Bell.

Mr. BELL. Thank you, Mr. Chairman. You didn't have to point out I was a freshman; that would have been clear to everyone after just a few questions, I am sure. I would like to thank the panel for your testimony here today and I apologize for having to be in and out of the room.

Dr. Creedon, I wanted to follow up—I was here when Mr. Larson was talking to you about some of the budgetary concerns, and I share those concerns because the major part of my district is in the Houston area, and obviously, the entire NASA program is extraordinarily important to the region. And a lot of us were hopeful in the wake of the space shuttle tragedy that there could be a silver lining and there would be a recommitment. And I often tell people since the tragedy that the sad thing about NASA is that if everything is going along well, that nobody seems to pay much attention, and it takes a tragedy to refocus attention. But certainly, it gives us an opportunity to have that kind of silver lining and to maybe make a recommitment to the agency.

And so when I see the budget and see that there is an additional five percent, and realizing that since 1998, the R&D budget has been cut by one-half, and now it appears the upright 2004 budget request, essentially, flat funds the program and projects a four percent decrease over the next five years, that is cause for some alarm. And I know that in the wake of the tragedy, people said funding and the funding cuts which NASA has experienced had no impact on safety whatsoever. Those were the reports to us and those were contained in the briefings to us immediately following the Columbia tragedy. And one reporter asked me when I shared that information, that NASA officials are saying it wasn't related to funding in any way, shape, or form, well, how do they know? And we don't know. And we won't know until the investigation is complete. And so my question to you is that in the wake of the tragedy, has there been any conversation and, possibly, an effort on the part of the agency to go back and look at the budget and maybe use this as an attempt to come back and address some of these budgetary concerns?

Dr. CREEDON. There are several aspects to the question. When you were giving the specific percentage declines, I believe those refer to the aeronautics portion of the budget and not the overall NASA budget itself. Is that correct?

Mr. BELL. That is correct.

SHUTTLE ACCIDENT INVESTIGATION

Dr. CREEDON. First of all, the investigation, we at NASA are dedicated to do what we can to determine what the cause of the tragedy was, to fix it, and move on, so that there is no loss of dedication within the agency to that. In doing that, assist Admiral Gehman's investigation board, as much as we can. As far as the dollars and the impact on safety, the culture of safety within the agency is an overriding value, and there is no one within the agency who would ever willingly do anything that they felt would compromise the safety of a shuttle mission or any other mission. I think that safety, as a primary value, is inculcated throughout the agency, and so I don't think that we believe that we would ever willingly do anything that would compromise safety.

As far as rededication and what else we might do differently, while the Admiral Gehman Board is continuing, we within the agency have several activities that are ongoing to determine what we think should be done as a result of this tragedy. We have one group that is looking to what should our response to this be—should we build another orbiter, what kinds of things that we should do. We in the aerospace technology enterprise are looking at can we accelerate the orbital space plane in response to that. But I think before we set forth on any of these plans, we would have to wait until Admiral Gehman's Board finishes its deliberations. Meanwhile, we are not resting. We are actively planning the options that we might do.

Mr. BELL. Why would you have to wait?

Dr. CREEDON. We are not waiting to plan, but I think that we would really like the benefit of finding out what the cause of the tragedy was—was it technical, was it processes, whatever it was, before we move out in implementing a change.

Mr. BELL. Thank you. Thank you, Mr. Chairman.

Chairman ROHRABACHER. Thank you. We have been asked by a Member if he could have another chance at questions, and Mr. Bonner, you may proceed.

Mr. BONNER. Thank you, Mr. Chairman. Two quick questions and then a request. Following up on my interest in, especially, the regional jet service to smaller airports, Mr. Keegan, I believe I am correct that the budget request is for $17 million plus a little change under the Airport Improvement Program to help design, plan, maintain, and all the other things you have to do to improve airports. I guess my question is, if this number is correct, how far will $17 million go, and will it really go to helping improve airports not just at the major hubs but also in some of the smaller communities that we are interested in?

AIRPORT IMPROVEMENT PROGRAM R&D

Mr. KEEGAN. Sir, that $17 million is for research to go into the airports. The Airport Improvement Program budget is significantly larger, it is somewhere near $3 billion, which would be for the overall aspect of improving airports, and it does get spread beyond the fortress hubs that we are familiar with today. That research is broken down into a few areas, including the ability for better fire and response in case of an accident, migration of birds and mitigation of those activities and following that to make sure that that is not an issue at certain places. So it is on a different side of the actual construction and development of the airport infrastructure.

UNMANNED AERIAL VEHICLES

Mr. BONNER. If we could shift gears just for a minute, Dr. Creedon, NASA and the Defense Department have demonstrated that unmanned aerial vehicles can be flown safely, and they have the potential to serve useful civil and emergency service rolls. Many industry experts envision that UAV's will be playing more prominent roles in U.S. aerospace, but currently, FAA requirements—and maybe Mr. Keegan would be a better person to answer this—that FAA requirements to fly them are very complex and they can take weeks or months to gain permission to fly. So a quick question is what is the current state of research on operating UAV's in controlled airspace, and is the FAA working on a concept of operations to permit routing of routine flights of UAV's in controlled airspace?

Mr. KEEGAN. I am not sure of the complete details of UAV's infrastructure and how we are dealing with that, but we do have regulatory activities underway to ensure how they are operating and if they are safe, and today, it is a minimum of a 60-day advance notice on how that works. And from there, the activities have to do with how and where they are going to be used, and they are currently in our operational concept development. They are not a large portion of that; it is still a very small portion of that.

Dr. CREEDON. If I could add to that, as I indicated, we brought a small amount, but I would hope a significant amount, of additional funds into UAV's because we believe they have the same potential that you mentioned. As Charlie mentioned, that is my understanding as well, that right now, UAV's do have access to the airspace, but it is a 60-day apply and approval process. Many members of the industry have come to us because of our cooperative research that we do with the FAA, trying to make the routine access to the national airspace system a quicker thing, reduce the time below 60 days, and perhaps with demonstration of capability that is required on board these UAV's, to get routine access, and there is sort of a series of five goals, and we are putting money into the first two of those goals to try to achieve that result of more routine access. And when we demonstrate that capability in these UAV's, then it would be back over to the regulatory part to acknowledge that and to have new procedures.

Mr. BONNER. My interest stems largely because we have done a lot of the research for that at Marshall Space Flight Center in my home State of Alabama. Finally, I would like to just, again, thanking the Chairman for this additional time, associate my interest and concern with my friend and colleague, Mr. Forbes of Virginia. We have a school for math and science in Mobile, Alabama. We also have an Exploreum IMAX theater where there is a space exhibit ongoing right now. I would sure like to have your help, Dr. Creedon, in getting one of our astronauts, perhaps one of Mobile's own, to come speak to some of the students and encourage them through that presentation to study science and math and to go where man has only dreamed of going.

Dr. CREEDON. It sounds like a very reasonable request.

Mr. BONNER. Thank you very much. Thanks, Mr. Chairman.

Chairman ROHRABACHER. Mr. Forbes, do you have any other questions? Just a few notes. I have made it clear before, and I think that perhaps it deserves repeating, that I think robotics and remote control technologies are technologies that have a lot of promise, and that NASA, in particular, should be deeply involved in that. And I think it will have applications in the private sector, and also, of course, it has applications toward space exploration and utilization. So I would hope to see more of that.

I would also hope, Dr. Creedon, that we see—and Mr. Keegan, as well—that we see evidence in the next few months that this report on the aerospace industry and on the status of aerospace, that it is being taken seriously and that there are some tangible decisions, effects, of that report. I mean, some people spent a lot of time on that, and I agree that either we are going to make some decisions now and start charting a course that will put us on top, or we will be overwhelmed by competition from overseas, not just from Europe, but perhaps even from China. In our great—in a demonstration of great wisdom, we have helped build up an industrial infrastructure in China which now will permit them to compete with us in aerospace in the years ahead. And I say that, obviously, with tongue in cheek, as I think that was lunacy.

So with that said, I would like to thank the witnesses. Thank you all very much. This has been very informative. We take this issue very seriously because the aerospace industry is a very important part of our economy. As we move forward now with this great anniversary, 100th anniversary of human flight—powered flight, I guess it would be, because gliders and balloons before that—let us remember that Americans have always been proud of the fact that we have led the way. We have led the way in freedom and in the way we treat other people. We have led the way in technology and there is a relationship there. There is a relationship between people who believe they can make the condition of humankind better by using their ingenuity and uses of technology and the fact that we respect other people, respect other human beings. And the Wright brothers, perhaps, personified this better than anyone, because they were not Ph.D.s from MIT. They were people who had, basically, self-educated themselves, but they were incredibly intelligent human beings, as we saw in the drawings, paying attention to the shape of the wing, and this wasn't just a—this was not an accident that they stumbled across something. They studied and worked hard, but they were the personification of American values, and today we have been handed that. We have been handed our opportunities by people like the Wright brothers and by those who are active in the Space Program and the development of aerospace over these last 100 years. Now it is up to us, and we will carry the torch, and we will make them proud.

I would like to thank all of you for participating today. Please be advised the Subcommittee Members may request additional information for the record and I ask other Members who are going to submit written questions to do so within one week of this hearing. That concludes the hearing. We are now adjourned.

[Whereupon, at 12:37 p.m., the Subcommittee was adjourned.]

Appendix 1:

ANSWERS TO POST-HEARING QUESTIONS

ANSWERS TO POST-HEARING QUESTIONS

Responses by Jeremiah F. Creedon, Associate Administrator for Aerospace Technology, National Aeronautics and Space Administration (NASA)

Questions submitted by Chairman Dana Rohrabacher

Q1. NASA's aeronautics budget has been restated to reflect personnel and institutional costs, giving the appearance of an almost doubling of the aeronautics program. What effect will full cost accounting have on fees charged to outside customers for use of facilities, such as wind-tunnels and engine test-stands? Please explain any changes in how fees will be assessed.

A1. The adoption of full cost accounting, budgeting, and management practices will have no impact on the pricing policies currently utilized by NASA's aeronautical research and test facilities. In fact, NASA has for some time now been charging external customers the full cost of using such facilities—unless the Agency has a programmatic interest in the research data resulting from a specific test, in which case various forms of cost sharing are employed. We fully expect to continue these practices with respect to outside users.

While the policy of recovering full cost from external users will not change; however, change may occur in both the cost of any given facility and the continued availability of certain facilities. Variability in cost will be the result of variability in the number of users. The maintenance and operation of large research facilities entails a substantial fixed cost. This fixed cost must be spread among the users of facility. The more customers, the lower the cost to each customer to use the facility. The fewer the customers, the higher the cost that will be charged to each customer. Prior to the introduction of full cost accounting, NASA had some flexibility to absorb fixed costs when utilization was low, rather than passing such costs along to external customers. With full cost, that flexibility is now gone. In the extreme, therefore, if an outside customer happens to be the only user of a NASA facility in a given year, that customer will need to pay for the entire cost of the facility for that year—even if the desired test is only weeks in duration. While the policy of charging the entire cost to the customer has not changed, the actual cost to that single remaining customer has changed greatly.

Such economics may also impact the continued availability of certain facilities. If utilization is low in a given facility, the costs of using the facility will grow for the remaining users (both within and outside of NASA). These higher rates may drive away additional customers, further raising the costs to the remaining customers. This "spiral" may ultimately result in a facility that is too expensive for the few last customers, and the facility may eventually have to close due to lack of customers that can afford the cost of the facility. The Office of Aerospace Technology, in concert with the rest of the Agency, is now evaluating management and accounting mechanisms that may need to be applied when short-term utilization of a given facility is low, yet closure of that facility is not in the best long-term interests of the Agency or the Nation.

Q2. FAA and NASA have begun forming a Joint Program Office to coordinate research on a next-generation air traffic management system.

Q2a. What agreements have been made between NASA and FAA to establish a JPO? Please provide a copy of all MOAs, letters, and other documents that describe the goals, roles and responsibilities of participating agencies, a list of the agencies and departments that are taking part, and funding required to staff and support the JPO.

A2a. FAA, NASA, DOD, TSA, and OSTP are participants on an interagency team charged with preparing a plan for the JPO. Letters exchanged between FAA and NASA regarding the interagency planning team and its charge are attached. Also attached is a briefing that describes our proposed strategy for carrying out the transformation and some very early thinking about a possible structure of a JPO. Versions of this briefing have been presented by NASA and FAA to DOD, TSA, and several industry stakeholders.

Q2b. Does the JPO have its ?own spending authority? If so, what is its budget?

A2b. No. The JPO has not been established to date. The team described above does not have spending authority or a budget. The efforts to develop the national plan are funded by FAA and NASA.

Q2c. How will industry provide input to your process? Will there be opportunities for regular industry consultation, including general aviation?

A2c. Clearly, industry needs to be a major player in the transformation of the Air Transportation System. We have briefed industry, including the Air Traffic Services subcommittee of FAA's Research, Engineering, and Development Advisory Committee and The General Aviation Manufacturers Association (GAMA). A number of industry representatives have told us that they would welcome strong federal leadership in carrying out the transformation. The primary purposes of the briefings FAA and NASA have given to industry stakeholders was to get feedback on our transformation strategy and to begin a dialogue on industry participation in the process. Once we reach interagency agreement on how we will work together to carry out the transformation process, we will establish a mechanism for regular industry consultation. General aviation will be a part of this. In fact, one of the industry meetings we have had with GAMA was a briefing to the Government Research Coordinating Subcommittee of the GAMA Flight Operations Policy Committee on the transformation process.

Q3. The goal of NASA's Small Aircraft Transportation System (SATS) is to permit all-weather operations by general aviation aircraft at untowered airfields.

Q3a. What is the status of NASA's Small Aircraft Transportation System Integrated Technology Demonstration? When does NASA plan to complete technology demonstration of SATS?

A3a. The NASA/FAA/National Consortium for Aviation Mobility (NCAM) Alliance has developed and implemented the research and technology plan to develop and evaluate the technologies that will enable an integrated technology demonstration of the four SATS operating capabilities to be completed in late 2005. The plan provides for multiple path approaches for technologies to enable lower landing minima (LLM) and single pilot performance (SPP) with a critical path approach for the higher volume operations (HVO) capability. The en route (ERI) operating capability to/from the controlled airspace will be demonstrated as an element of HVO and will utilize analyses to explore impact on the national airspace.

Site selections for the technology demonstration will be complete in July 2003. Initial flight tests will be conducted in calendar year 2003 to demonstrate HVO, LLM, and SPP operating capabilities at the minimum success criteria. Further flight tests will be conducted in calendar year 2004 to demonstrate HVO, LLM, and SPP operating capabilities at higher levels of technical success. These flight tests will be used to down select those technologies that will be employed in the integrated technology flight experiments of all four operating capabilities in early 2005.

Q3b. How much has been spent to date on SATS?

A3b. Through FY 2003 NASA will have invested $50.8 million on SATS. The NCAM partners will have cost shared over $16 million. For FY 2003, NCAM is matching $7 million of labor by the participating companies, plus $0.9 million of in-kind (e.g., use of equipment and software) contributions.

Q3c. How much will it cost to complete the technology development and demonstration efforts?

A3c. NASA has requested $30.6 million (full cost) in FY 2004 and anticipates requesting $9.9 million (full cost) in FY 2005 to complete the technology development and demonstration. The SATS Alliance partners are expected to cost share approximately another $8 million at about the same ration of labor and in-kind as provided in FY 2003.

Q3d. When will an operational SATS capability be demonstrated? How much will it cost to demonstrate an operational SATS capability?

A3d. Following the integrated flight experiments, the technical and operational feasibility of the four operating capabilities will be demonstrated in late 2005. The costs to demonstrate the capability are included in the funding cited above.

Q3e. What are the technical, policy, and economic issues that need to be resolved to implement SATS? What is NASA's plan to address these issues?

A3e. NASA is conducting a proof-of concept R&T activity to demonstrate the technical and operational feasibility of the higher volume operations, lower landing minima, single pilot performance, and en route integration operating capabilities. These are important operating capabilities necessary to the implementation of SATS; however they are not sufficient for implementation of SATS. Other issues include: insurance considerations, environmental compatibility (noise and emissions), en route operations and weather, aircraft ride quality, safety and security, economic viability, air traffic controller considerations, and the overall financial health of the small aircraft industry. Although the SATS Project is not providing the solutions to these issues, transportation system analyses and assessments of many of these issues are being performed. The results will be provided to the decision makers, stakeholders and others, including the FAA and regional airport authorities.

Q3f. What equipage issues need to be addressed for the general aviation community to exploit SATS?

A3f. SATS research is focused on flight deck and flight path technologies that minimize the equipage required at the Nation's underutilized, non-towered and non-radar airports and runway ends. Equipment required in the aircraft for SATS capability includes an approach-certified instrument flight rules global positioning system receiver, an automatic dependent surveillance-broadcast (ADS–B) transceiver, a communications data link, a cockpit display of traffic information, plus software and display graphics for self-separation and onboard conflict detection and alerting, and self-spacing.

The SATS operational concept includes procedures for suspending HVO operations to accommodate aircraft without the required equipment via procedural separation. These unequipped aircraft would be required to have radios for communication with an air traffic controller.

Q4. NASA has a goal to develop technologies to reduce noise emissions from aircraft by 10 decibels by 2007.

Q4a. Does NASA plan to continue to pursue technologies to reduce noise emissions once the goal is met?

A4a. Yes. Within its Vehicle Systems Program, NASA is currently developing plans to pursue technologies that can further reduce noise emissions, improving upon those goals of the Quiet Aircraft Technology (QAT) Project. Representatives from Government, Industry and Academia are assisting NASA with development of the most appropriate goals and the roadmap from which to achieve those goals.

Furthermore, the FY 2004 request includes an augmentation for the QAT Project to ensure the maturation and transfer of the noise reduction technology. This research would be conducted with aircraft and engine manufacturers as cost sharing partners.

Q4b. Assuming this goal is met as planned, what is a realistic goal to reduce noise emissions further?

A4b. NASA's goal is to contain objectionable noise within the airport boundary. Initial results from an industry, government and academia workshop to develop long-term roadmaps for the Vehicle Systems Program held in April 2003 indicate that there exists a potential to limit average day-night noise level outside of the airport boundary to 55 dBA.

Q4c. Is it feasible to reduce aircraft noise to levels on takeoff and on airport approach and landing to a level that does not exceed ambient noise levels in the absence of flight operations? If so, what technologies would be required? How much would this cost?

A4c. Yes, this is a challenge we believe to be achievable. Roadmapping activities being undertaken by the Vehicle Systems Program are exploring the goal of containing all objectionable noise within airport boundaries. Some examples of technologies expected to be required include: Advanced low noise fan designs, active, intelligent noise suppression, advanced concepts with integrated low-noise features, including noise shielding, distributed propulsion, very low-speed landing, reduced landing gear and landing gear bay/cavity noise, thrust vectoring, unconventional propulsion systems and integration, and application of low-spool noise technologies to the engine core.

At this point in time, many of these concepts are at the embryonic stage of development. Costs estimates for this long-term effort have only just begun to be assembled.

Q5. NASA canceled its High Speed Civil Transport (HSCT) program in 2000.

Q5a. How much did NASA spend on HSCT?

A5a. From 1990 through 1999 NASA spent $1,560.2 million, excluding personnel costs, on the High Speed Research program.

Q5b. Why did NASA cancel the program?

A5b. The High Speed Research (HSR) program was created to explore technologies necessary to enable an industry decision on development of a supersonic commercial aircraft, or "High Speed Civil Transport" (HSCT). The HSR program was dependent on an active partnership between the government and industry. Dramatic technology advances were made against the original HSR program goals. However, planned ramp-ups in industry cost sharing to bring an HSCT to market did not materialize as originally planned. NASA terminated HSR at the end of FY 1999, when the major industry partner in the program dramatically reduced support for the project, shrinking staff devoted to HSR from 300 to 50 and pushing the operational date for a high-speed commercial transport from 2010 to 2020. This industry action was the result of market analysis and technology requirement assessments indicating that the introduction of a commercial HSCT cannot reasonably occur prior to the year 2020 from an economically and environmentally sound perspective. Industry and NASA also questioned whether technologies being pursued today would appropriately address environmental standards and other challenges in 2020. In response, NASA reduced activity in the High Speed Research program to a level commensurate with industry interest.

Q5c. Have any of the factors that led to the program's cancellation changed in such a way that NASA would consider resuming a significant research program in civil supersonic transport? If so, what are the appropriate goals for a supersonic civil transport program?

A5c. NASA is performing research in technologies that have general applicability across many vehicle classes, including supersonics. However, these technologies are directed toward areas that have a direct impact on the public at large, including increasing safety and security, reducing noise and emissions and transforming the National Airspace System to increase its capacity and efficiency. Supersonic technology does not have the wide public impact for it to be a priority given current funding levels.

The challenge in making supersonic transports viable, and hence the goals of a technology effort in this area, included sonic boom mitigation and reduction of noise and emissions.

Questions submitted by Representative Bart Gordon

Q1. FAA and NASA are involved in efforts to establish a unified interagency aviation R&D program (NASA, FAA, DOD, DOC and DHS), including a process for developing a research plan and for providing periodic program reviews.

Q1a. Is OMB part of this planning process?

A1a. While there have been some informal discussions with OMB, they have not been directly involved in this planning process. OMB, however, is highly supportive of this type of interagency cooperation in aviation R&D.

Q1b. What is the current status of the consolidated interagency research plan?

A1b. FAA and NASA have established a working team to begin the development of a first version of a National Plan for the transformation of the Air Transportation System of 2020 and beyond. DOD, TSA, and OSTP are also participating on this team. Our goal is to complete the first draft of this plan by December 2003. This will include an interagency research plan for transforming the National Airspace System.

Q1c. Will we see results of this effort in the President's FY 2005 budget?

A1c. Yes. Development of NASA's FY 2005 budget for air transportation management research and technology is occurring in parallel to and in close coordination with the development of the National plan.

Q2. The 2002 National Research Council (NRC) report, "For Greener Skies: Reducing Environmental Impacts of Aviation," goes on to suggest that federal agencies should realign research goals with funding allocations to avoid raising unrealistic expectations for reducing aviation noise. That is, either relax noise goals or increase R&D funding. For example, the report shows the declining trend in aircraft noise generation from 1960 to 1997 suddenly needing to change sharply downward in order to meet NASA's stated 2007 and 2022 noise goals, while the annual federal noise reduction R&D budget, in constant dollars, is now only about 50 percent of its average level for the past 10 years.

Q2a. What is your reaction to the NRC report's recommendation?

A2a. We agree with the recommendation and propose to increase funding to attain the noise reduction goals. NASA's FY 2004 budget request includes an augmentation to its Quiet Aircraft Technology (QAT) project of $100 million.

Q2b. Do you believe that the NASA noise goals can be reached with the current level of R&D investment, or should the goals be watered down?

A2b. With the additional funding in the FY 2004 budget request, we believe that our goal of developing technology to enable a 10 dB reduction (based on 1997 levels) can be met at a Technology Readiness Level (TRL) of 6, which is the readiness level that is adequate to ensure the transfer of technology out to industry partners. Discussions with industry partners have been initiated to determine what efforts would be required to achieve TRL 6.

Q3. The NRC report recommends that NASA should fund the most promising noise reduction concepts long enough to reduce the technical risk and make it worthwhile for industry to complete development and deploy new technologies in commercial products. This would mean bringing a new technology to NASA's technology readiness level 6.

Q3a. Please respond to this recommendation. What is current NASA policy regarding the technology readiness level for noise technology projects for which funding is provided?

A3a. The Aerospace Technology Enterprise has in its mission statement that "success will be measured by the extent to which our results improve quality of life." To be successful requires technology to be transferred to customers. The FY 2004 Budget request includes an augmentation of $100 million, partly to ensure that the technology is matured and ready to be transferred to industry—the equivalent of technology readiness level 6.

Q3b. Are you concerned that NASA-developed noise reduction technologies may not transition to commercial applications?

A3b. NASA's Vehicle Systems Program has included industry, FAA and academia in the development of long-term planning. Representatives have been participating most recently to identify the most appropriate technology sectors for long-term efforts and have been providing inputs on specific goals and paths to achieve them.

Additionally, the Quiet Aircraft Technology Project held its semi-annual meeting on April 29–30, 2003 to present and discuss with its partners the latest accomplishments and future directions.

Inclusion of industry, FAA, airport representatives and academia in NASA's planning for technology investment sectors and in the road mapping to achieve these technologies substantially improves the applicability of R&D and the potential it will be transitioned into commercial use.

NASA has had a long track record of transitioning noise reduction technologies to applications that industry can use. The cost sharing agreements being negotiated ensure that industry has a vested interest in the technologies, and that they will be transitioned to real aircraft applications.

Q4. The NRC report states that research to reduce oxides of nitrogen and improve engine efficiency has been significantly reduced at NASA and that the research that is supported does not carry the work far enough so that results can be readily adopted by industry. And in general, the report finds that even though large uncertainties remain regarding aviation's effects on the atmosphere, research budgets for examining the issue have been cut by two-thirds in recent years.

Q4a. Do you agree with the report's findings?

A4a. NASA has been examining its aeronautics programs to facilitate adoption of technology. In the area of emission reduction, we have extended the Ultra-Efficient Engine Technology (UEET) project—a major effort to reduce aircraft emissions—through FY 2007 and are working with our industrial partners to ensure that transfer of the technology occurs. We are also working in partnership with the DOD turbine engine program to assure alignment and mutual benefit.

Q4b. Why does aviation emissions research have such a relatively low priority at NASA?

A4b. Aviation emissions research continues to have a high priority at NASA. The Ultra-Efficient Engine Technology Project is a major effort to reduce aircraft emissions. A number of partnerships have been developed through the Ultra-Efficient Engine Technology Project, and we are expanding the scope of this project to include cost-shared technology demonstrations at TRL 6.

Q5. The NRC report notes there is a current trend of lessening industry involvement in NASA-sponsored environmental research and technology development.

Q5a. Why has this occurred? Doesn't this contribute to problems in transitioning technology to commercial applications?

A5a. With the termination of the Advanced Subsonic Technology and High Speed Research programs in 1999, funding directed toward propulsion research declined. From a funding standpoint, that may be viewed as a lessening of industry involvement. However, NASA's Ultra-Efficient Engine Technology Project has continuing partnerships with industry and signed agreements in place for cooperative activities. The emissions reduction effort is a partnership with industry to develop combustors that produce reduced levels of oxides of nitrogen. Partners from engine and airframe manufacturers, academia and government agencies are participating in materials and structures research and activities to optimize the integration of propulsion and airframes. These partnerships ensure that NASA is working on the right problems to facilitate the transfer of the technology.

Q5b. What would you suggest be done?

A5b. A specific long-term plan for technology investments is being developed within the Vehicle Systems Program. This effort has received significant input from industry, academic and government representatives to ensure funding is focused on the critical problems, including emissions. We see a continuing role for industry partnerships and cost-sharing of technology maturation to ensure technology transfer.

Q6. Your aircraft noise R&D budget includes both institutional costs (e.g., facilities, infrastructure, travel, benefits) and actual project procurement funds in the five-year runouts.

Q6a. If we strip away the institutional costs that the budget office has allocated to the Quiet Aircraft Technology program, how much funding is actually being proposed for R&D procurements for Quiet Aircraft Technology in each of the next five years? Is that an increasing or a flat funding profile?

A6a. The FY 2004 request includes an augmentation for the Quiet Aircraft Technology (QAT) project in order to mature noise reduction technology to levels appropriate for transfer to industry. The funding profile for QAT is shown in the table below for both the total funding and the amount planned for direct procurements. This funding is to develop and transfer technology that results in a 10-decibel reduction in aircraft noise by 2007 (based on 1997 production aircraft).

While no final decision has been made on whether to conduct additional noise reduction Research and Technology beyond OAT, plans are being formulated for technology development beyond OAT to bring objectionable noise within airport boundaries.

	FY 2004	FY 2005	FY 2006	FY 2007
Total (full cost) $M	60.2	71.0	74.0	25.0
Procurement $M	16.9	23.0	26.2	15.0

Q6b. What specifically is included in the institutional costs allocated to the Quiet Aircraft Technology program?

A6b. The non-procurement dollars are an important contributor to the research. Non-procurement dollars fund a cadre of world-recognized NASA researchers who are dedicated to noise reduction research, and who work hand-in-hand with external researchers funded with procurement dollars. The recent transfer of chevron nozzle technology for noise reduction was the result of a concept first proposed and developed by a NASA researcher. Non-procurement dollars also fund world-class laboratories, wind tunnels, test aircraft and other facilities that are used by NASA's partners as well as civil servants to research, mature and transfer technology.

Non-procurement dollars include:

- The cost, including civil service salaries, for the technical operations and maintenance of laboratories, wind tunnels and test facilities in support of projects.
- NASA Civil Service employees, including both researchers and support staff.
- Travel.

- G&A—General and administrative expenses associated with Administrative Operations.

Q7. Will NASA's Quiet Aircraft Technology meet the 10-year noise reduction goals by 2007 that NASA had previously signed up to meet? Will that require any industry funding? If so, how much?

A7. With the additional funding in the FY 2004 budget request, we believe that our goal of developing technology to enable a 10 dB reduction (based on 1997 levels) can be met at a Technology Readiness Level (TRL) of 6, which is the readiness level that is adequate to ensure the transfer of technology out to industry partners. However, the effective transfer of technology requires a willingness on the part of the user to implement this technology. We are developing cost-sharing partnerships to ensure that the user community has adequate buy-in to the technology transfer process. We anticipate industry to cost-share $50 million from FY 2004 to FY 2007 to facilitate the technology maturation.

Q8. In his testimony at the hearing, Mr. Armstrong noted his concern that no formal coordination occurs between NASA and the users of the national airspace system regarding NASA's research agenda for future technology developments aimed at improving the efficiency, safety and capacity of the airspace system.

Q8a. Is this concern of the air transportation industry something that NASA is aware of?

A8a. NASA is aware that some National Airspace System (NAS) users believe that more formal coordination of NASA's research agenda is desired. It is incorrect, however, to state that no formal coordination occurs. The formal coordination between NASA and the users of the NAS occurs through NASA's Advisory Committee structure, specifically the Revolutionize Aviation Subcommittee (RAS) of the Aerospace Technology Advisory Committee (ATAC). Recently, under the auspices of the RAS and the ATAC, a Task Force was convened to specifically review NASA's Airspace Systems Program. The members of that Task Force included representatives from airlines and other user organizations, from academia and from other research organizations. Additionally, NASA participates in forums sponsored by organizations representing industry where the content of NASA's research is a subject for discussion. Forum sponsors include RTCA, the Air Traffic Control Association, the American Institute of Aeronautics and Astronautics, the Society of Automotive Engineers and others. NASA also participates in discussions with industry representative groups either at their initiation or at NASA's. Recent such discussions include those with the General Aviation Manufacturers Association, Aircraft Owners and Pilots Association and the Air Transport Association.

Q8b. Do you believe better communication between NASA and airspace system users is important, and if so, how might it be addressed?

A8b. Interactive communication between NASA and the airspace users is essential for allowing these users to take maximum advantage of the content and value of NASA research efforts. NASA always strives to develop the best communication channels for improving the input of community users to the content and value of our research efforts. NASA will continue to make concerted efforts to improve interactions with the NAS user community both directly, through their representative organizations, and through NASA's formal Advisory Committee structure.

Q9. The FAA RE&D Advisory Committee recommended (4Feb02 letter to FAA on the FY04 budget review) that FAA develop a "fully competent and expertly staffed organization to absorb and use the results of NASA's R&D." FAA's response to this recommendation was that its Free Flight Office does this. What efforts have been made by NASA to help ensure that new technology developed by NASA transitions to use by FAA?

A9. For the past several years, the primary FAA customer for NASA's Air Traffic Management technology has been the Free Flight Program Office. Three products were delivered to the Free Flight Phase 1 Program and an additional three are under development for delivery to the Free Flight Phase 2 Program. Of these six products, five were also included in the FAA's Operational Evolution Plan.

Transition to FAA of technologies developed by NASA generally requires several steps, many of which can be lengthy. In addition to acquisition, these include resolution of issues related to changes in roles and responsibilities, acceptance of change in those roles and responsibilities, policy development, and the ability of the user community to provide their financial support for equipage.

In an effort to mitigate these issues, NASA has worked with the FAA to develop plans that provide longer-range visibility, so that many of these issues can be addressed early enough to eliminate them as roadblocks. For example NASA, under some conditions, has provided funds to allow FAA personnel to participate in development tests. However, NASA cannot assume any role in the implementation of technology in FAA facilities beyond providing support for FAA activities.

The long-term solution to this issue is the development of a National Plan for National Airspace System (NAS) transformation, which will define future "target" goals for the NAS. With significant participation from NASA and other government agencies, FAA is leading the development of this multi-agency plan. It will identify the requirements for development of technologies and procedures and for the implementation of the changes to the NAS. Implementation will consider the aspects mentioned above including acquisition, policy, and management of change and life cycle costs to accomplish the respective goals. The plan will describe the expectations of each of the parties responsible for implementing it, from technology development to implementation, thereby facilitating the transition of NASA technology to implementation by the FAA.

Questions submitted by Representative Sheila Jackson Lee

Q1. Many nations are under pressure to reduce emissions of greenhouse gases in order to come into compliance with the Kyoto Protocol.

A1. The governing document concerning aviation and its impact on global climate change is the United Nations Intergovernmental Panel on Climate Change document entitled *Aviation and the Global Atmosphere.* This multi-year effort, which concluded in 1999 with the publishing of the final report, is the prime source for answers to the questions.

Q1a. Are airplanes important contributors to global warming, due to their types of emissions, or the fact that they deliver contaminants higher in the atmosphere?

A1a. Global aircraft emissions account for about 3.5 percent of the global warming generated by human activities. However, jet aircraft are recognized to be the largest source of emissions deposited directly into the upper atmosphere. Carbon dioxide (CO_2) is a primary product of jet fuel combustion, and survives in the atmosphere for over 100 years. CO_2 is recognized to be a greenhouse gas. Other outputs from jet engines include water vapor, nitrogen oxides, soot, and sulfate combined with carbon dioxide. Atmospheric scientists project that these outputs could have as much as two to four times as great an impact on the atmosphere as carbon dioxide alone. However, further study and research are required to further understand and quantify the impacts.

Q1b. Will these influence choices of civil aviation aircraft for future purchases?

A1b. Currently no rules exist regarding cruise emissions levels for commercial aircraft (subsonic or supersonic). However, the Europeans are advocating the development of such a rule through the International Civil Aircraft organization (ICAO). It is possible that such a rule will come into existence within the next 5–10 years and companies that have the technologies and reduced emission product designs (aircraft and engine) will be at a strong advantage with regard to other competitors.

Q1c. Are we putting adequate resources into developing low-emissions/efficient engines to meet demand?

A1c. NASA believes we are adequately supporting the technologies needed for the future. Two projects within NASA's Aeronautics Technology Vehicle Systems program, the Ultra-Efficient Engine Technology project and the Propulsion & Power project, are developing technology to reduce emissions and improve efficiency of aircraft engines. Current objectives for Ultra-Efficient Engine Technology are to develop and transfer technology by 2005 that reduces the emissions of oxides of nitrogen by 65 percent below the 1996 ICAO standards and by 2007 to reduce carbon dioxide emissions by 15 percent. The Propulsion & Power project has a longer-range view and is exploring technology to further reduce emissions. Both projects are adequately funded to meet these objectives.

Q1d. How are the European Union and Airbus doing relative to the U.S. in this area, and do you believe it will affect our already dwindling market share in civil aviation?

A1d. The European Union has a bold, well-coordinated plan among the government, industry, and university sectors to develop and demonstrate required technologies for future commercial aircraft opportunities. However, it is not yet clear whether European resources expended on this effort will be sufficient for them to meet their ambitious goals. In their published vision document, they indicate they will reclaim the aerospace leadership role from the United States by 2020. The available documentation for the programs that support this vision indicates they have efforts underway to develop and demonstrate turbine engine technologies that will result in significant reductions in global and local emissions. The published goals of this project are very consistent with those of the Ultra-Efficient Engine Technology (UEET) project. The published schedule, including engine demonstrations, is very ambitious. The European plan also includes aggressively scheduled longer-term technology efforts for low emissions propulsion concepts beyond turbine engine architectures.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Charlie Keegan, Associate Administrator for Research and Acquisitions, Federal Aviation Administration (FAA)

Questions submitted by Chairman Dana Rohrabacher

Q1. What is the rationale for only funding safety and weather-related research in the R,E&D account?

A1. Safety is the FAA's highest priority, and research, engineering and development (R,E&D) is a key element in supporting the achievement of our safety goals. Weather is a significant safety concern, as it plays a role in approximately one fifth of aviation accidents. Accordingly, FAA's research program is heavily weighted toward those programs the agency feels are necessary for accident prevention as well as crew and passenger protection in the event of an accident. Yet, while safety is our first priority, the R,E&D account also supports research in other areas including air traffic management systems and avionics development, as well as a research program directed toward achieving the agency's goal of reducing the impact of aviation on the environment.

Q2. What circumstances led FAA to divest itself of performing long-term research and development for air traffic management technologies within the R,E&D account?

A2. Prior to FY 1999 the FAA included Capacity and Air Traffic Management Technologies Research, Communications, Navigation and Surveillance Research, and Airport Technology Research in its R,E&D budget request. In FY 1999, Congress transferred $52.6M from the R,E&D appropriation to the Facilities & Equipment appropriation, created the Advanced Technology Development and Prototyping budget item, and moved the Capacity and Air Traffic Management Technologies Research, Communications, Navigation and Surveillance Research, and Airport Technology Research into that line item.

It is our understanding that Congress transferred these activities because, according to the House Committee Report (H.R. Rep. No. 105–648), they fit closely with other F&E funded activities and management of these related programs would be improved by funding them together in a single budget item.

In keeping with this Congressional guidance, the FAA continues to include these programs in the Advanced Technology and Prototyping budget item in its request for Facilities & Equipment reauthorization.

Q3. NASA's FY04 budget request proposes to spend $100 million over five years for the National Airspace System Transition Initiative that will support, in part, the Joint Program Office. How much funding has FAA requested for the Joint Program Office?

A3. Because FAA has just begun informal coordination with NASA, the Department of Defense (DOD), the Department of Homeland Security (DHS), the Office of Science and Technology Policy (OSTP), and the Department of Commerce (DOC) to address these long-term research needs, the FAA has not yet identified specific funding requirements in current funding requests.

Research and development for the highly automated next generation air traffic management system will be accomplished through collaboration with NASA and other partners. NASA's Next NAS is the first step in the research that will fulfill this national mission. Other activities and resources will be identified through the creation of a national plan for the air transportation system of 2020 and beyond.

Questions submitted by Representative Bart Gordon

Q1. FAA and NASA are involved in efforts to establish a unified interagency aviation R&D program (NASA, FAA, DOD, DOC and DHS), including a process for developing a research plan and for providing periodic program reviews. Is OMB part of this planning process? What is the current status of the consolidated interagency research plan? Will we see results of this effort in the President's FY05 budget?

A1. FAA, NASA, DOD, DOC, and DHS are currently holding preliminary discussions on how to proceed with integrated planning for the creation of a national plan for the air transportation system of 2020 and beyond. It is difficult at this early stage to specify the resources we will need. However, as preliminary planning progresses to the point of interagency agreement, we will be in a better position to identify our needs. We will consult with OMB throughout the development of the plan, as OMB plays an integral role in coordinating multi-agency efforts.

Q2. Since insufficient funding seems to be a problem for both NASA and FAA's R&D programs, will the interagency group have the authority to propose and defend budget requests for the total Federal aviation R&D effort? If not, how can we be assured that adequate resources are proposed for the R&D areas that are high priorities?

A2. We do not expect the interagency group to have the authority to propose and defend budget requests for the total Federal aviation R&D effort. Each agency will, however, institutionalize within its planning documents and programs the appropriate elements of the National Plan and have responsibility of building and defending their budget based on their contribution to the National Plan. Each department is expected to manage their related programs in accordance with the National Plan developed by the interagency group.

Q3. The RE&D Advisory Committee in its July 2002 recommendations to FAA following review of FAA's planned FY04–08 R&D investments, indicated endorsement of a $15 million budget increase to supplement the NASA Quiet Aircraft Technology project and to sustain FAA's Center of Excellence for Aircraft Noise Mitigation. Why didn't FAA put the recommended funding in your FY 2004 budget request?

A3. While the FAA considers noise research important, safety related R&D programs have a higher priority within our R,E&D program. However, in the Flight-100 reauthorization proposal, FAA proposes using a small part ($20 million) of the noise set-aside of the Airport Improvement Program (AIP) fund for research to advance technology to mitigate aircraft noise and aviation emissions in collaboration with NASA, industry, and academia. Also, FAA will establish by year-end a Center of Excellence focused specifically on aviation environmental issues. Initially, Center of Excellence research projects will be funded through grants that require matching funds from the grantee, thereby leveraging U.S. government research dollars with funds from participating industry and educational institutions.

Q4. The 2002 National Research Council (NRC) report, "For Greener Skies: Reducing Environmental Impacts of Aviation," goes on to suggest that federal agencies should realign research goals with funding allocations to avoid raising unrealistic expectations for reducing aviation noise. That is, either relax noise goals or increase R&D funding. For example, the report shows the declining trend in aircraft noise generation from 1960 to 1997 suddenly needing to change sharply downward in order to meet NASA's stated 2007 and 2022 noise goals, while the annual federal noise reduction R&D budget, in constant dollars, is now only about 50 percent of its average level for the past 10 years.

Q4a. What is your reaction to the NRC report's recommendation?

A4a. The FAA welcomes the NRC findings and recommendations. The FAA shares the concern that unless environmental issues are properly addressed they will increasingly limit air transportation growth. In this regard, the Federal Government continues to play a vital role in achieving aviation environmental compatibility just as it has done in achieving the significant decrease in the number of people affected by aircraft noise. We will continue our balanced approach to noise issues for aviation.

Q4b. Do you believe that the NASA noise goals can be reached with the current level of R&D investment, or should the goals be watered down?

A4b. The FAA wholly endorses the long-term national goal of containing objectionable aircraft noise within airport and compatible land use boundaries and is working in close partnership with NASA to achieve that goal.

Government-funded research, in which industry and academia play an important role, is critical in advancing aviation noise reduction technology. The FAA does not believe that the long-term goal of reducing aviation's noise impact should be scaled back. Although reaching NASA's noise goals will prove challenging, the FY 2002 and 2003 appropriations gave the FAA a new role as a direct, equal partner with NASA so that we can help accelerate the introduction of lower noise aircraft technologies.

The FAA is seeking to bolster its commitment to long-term noise reduction R&D in its Flight-100 proposal. The proposal dedicates a limited amount ($20 million) from the noise-set aside funding in AIP monies for research efforts to reduce aircraft noise and emissions at the source.

Q5. How does the Federal Interagency Committee on Aviation Noise function? What are NASA's and FAA's roles? Does the committee produce an interagency research plan? If so, please provide a copy of that plan to the Committee.

A5. The FAA, along with NASA, DOD, the Department of Interior (DOI/NPS), the Department of Housing and Urban Development (HUD) and the Environmental Protection Agency (EPA) form the Federal Interagency Committee on Aviation Noise (FICAN). The purpose of the FICAN is to provide public forums for debate on future research needs and to encourage new development efforts in the areas of aircraft noise assessment, control, and reduction.

The Committee meets at least quarterly, conducts one or more public sessions or symposium each year, and publishes an annual report of its activities. When appropriate, the FICAN issues findings on particular aviation noise issues such as, the effects of aviation noise (1997), research on natural quiet (2000), and the effects of noise in the classroom (2000).

Each participating agency agrees to provide administrative support commensurate with its level of participation in the FICAN either directly, or by contributing funding for a central administrative support contract. The FICAN does not have its own research budget and therefore does not have a research plan, but the participating agencies do conduct research that supports the FICAN objectives.

Q6. In response to a recommendation by the RE&D Advisory Committee that FAA develop comprehensive human-system integration plans, FAA's response was that:

"funding constraints do not accommodate robust assessment of human-system integration considerations across all operational conditions associated with new technologies and capabilities."

What has been the experience at FAA when new technologies were introduced into operating environments without adequate consideration of human factors?

A6. Aviation safety and security improvements are dependent on developing a national aviation system that is not only technically sophisticated, but also human performance based and human-centered. One of the lessons the FAA has learned from past technology programs is that a lack of focus on human factors can result in increased costs caused by re-engineering and schedule delays.

Therefore, it is essential that human factors specialists remain full partners in the development and deployment of advanced aviation technologies. With that in mind, the FAA now requires that human factors be systematically integrated at each critical step in the design, testing, and acquisition of new technology introduced into the national aviation system.

We also conduct annual human factors engineering reviews for systems currently being acquired by the FAA. In FY 2002, for example, 88 of 104 systems were assessed as meeting human factors policies, processes, and best practices. For those systems that do not meet the human factors policies, processes, and best practices, the assessments are followed by appropriate corrective actions.

Q7. What is the rationale for the FY04 budget request for human factors research, which is five percent below the FY03 appropriated level?

A7. While the Human Factors components of the R,E,&D budget request are lower than last year, because funding for human factors research is spread across multiple appropriations, the FAA has been able to shift some of its work to other accounts.

For example, to meet critical human factors needs and to ensure effective implementation of new technologies, the Integrated Product Teams (IPTs) use Facilities and Equipment and Operations funding sources for their human factors specialists to undertake the necessary studies of human-system integration. Human factors reviews of these studies show that the IPTs can effectively address implementation issues without impact from reduced FY04 funding for human factors research.

Q8. In response to a recommendation of the RE&D Advisory Committee that FAA recognize and champion NASA research directed toward achieving capacity and safety gains for the air traffic management system, FAA stated that:

"FAA has not had the resources to fully participate in the technical effort with NASA that we feel are necessary to help guide long-term R&D."

Q8a. Isn't this a major impediment to ensuring that NASA research is relevant to FAA's needs, and doesn't it contribute to the problem of transitioning NASA's research results to FAA operational systems?

A8a. Transitioning NASA research to FAA operational systems has been difficult, but it is critical that FAA concentrate its resources on the immediate needs of the Nation's air transportation system. To improve this situation and to facilitate an easier transition of NASA products into the National Airspace System (NAS), the FAA's NASA Ames Field office has begun an effort with NASA to identify key NASA technologies suitable for more rapid transition into the NAS. In addition, we have a technology transfer process now, which we have demonstrated to be very successful.

The Traffic Management Advisor (TMA) is a prime example of a new technology developed by NASA and successfully transitioned into the NAS. The new TMA technology was first implemented as an operational prototype at the Fort Worth Air Route Traffic Control Center. The associated prototype software was then re-engineered at six additional sites. The re-engineering involved specific site operational requirements as well as the necessary artifacts for life-cycle support. The use of TMA National User Teams comprised of both management and labor facilitated the transition into the NAS.

Q8b. Given your stated lack of resources, how will *you ensure that NASA's research is relevant to FAA's needs?*

A8b. FAA's work with NASA, DOD, DHS, OSTP, and DOC in establishing a unified national plan for the air transportation system of 2020 and beyond, will provide the context for NASA's aeronautics research efforts, as well as continued support of the interagency integrated product team.

Questions submitted by Representative Sheila Jackson Lee

Q1. Many nations are under pressure to reduce emissions of greenhouse gases in order to come into compliance with the Kyoto Protocol.

Q1a. Are airplanes important contributors to global warming, due to their types of emissions, or the fact that they deliver contaminants higher in the atmosphere?

A1a. Although airplanes do have an impact on global warming, aviation emissions remain a very small source of air pollution. A recent GAO study noted that in the United States, aviation contributes less than 0.5 percent of air pollutants. Also, due to recent reductions in aviation activity, aviation-related air pollution emissions have declined significantly in the past two years. However, because of the altitude at which aviation emissions occur, their proportionate impact on global warming is arguably higher.

In 1999 the Intergovernmental Panel on Climate Change (IPCC), which was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP), published a special report on *Aviation and the Global Atmosphere,* which constitutes the most current authoritative view on the state of the science and technology related to aviation's potential impact on the atmosphere.

The report concludes that, "Aircraft emit gases and particles directly into the upper atmosphere and lower stratosphere where they have an impact on atmospheric composition. These gases and particles alter the concentration of atmospheric greenhouse gases, including carbon dioxide, ozone, and methane; trigger formation of condensation trails (contrails); and may increase cirrus cloudiness, all of which contribute to climate change."

Q1b. Will this influence choices of civil aviation aircraft for future purchases?

A1b. Yes, it will have an impact. An airline's choices of future aircraft purchases are driven by a variety of factors including fuel efficiency. All other factors being equal, the amount of emissions produced by an aircraft is essentially proportional to fuel consumption, which is proportional to flight activity.

To the extent that airlines purchase aircraft with improved fuel efficiency, there is the potential for reduced emissions. However depending upon the aircraft and engines selected there can be tradeoffs between reduced carbon dioxide emissions and increased emissions of nitrogen oxides, which can be specific to the engine combustor. Nitrogen oxide emissions are precursors of ozone.

In addition to concerns over climate change, national ambient air quality standards established by the EPA drive the need to reduce emissions during the landing and takeoff (LTO) cycle of aircraft around airports. These air quality standards also include ozone.

Again, depending upon the aircraft and engine selected there can be tradeoffs to consider in achieving reduced nitrogen oxide emissions during the LTO cycle versus nitrogen oxide emissions at altitude, as well as other tradeoffs with emissions of carbon monoxide and unburned hydrocarbons that are primarily generated during ground idle and taxi operations. Thus, the choice of aircraft is a complex decision that cannot be solely tied to emissions that potentially impact climate change.

Q1c. Are we putting adequate resources into developing low-emissions/efficient engines to meet demand?

A1c. The FAA's research in developing low-emissions/efficient engines, like much of our work on environmental technology, is done collaboratively with NASA and industry. So far, this collaboration has been productive, examining new approaches to engine design, retrofit of older engines, and changes to airfoil design to improve aircraft engine efficiency and thereby reduce emissions.

At present, it is very difficult to quantify the demand for low emission aircraft. However, it is likely that as concern about the impact of aircraft emissions continues to grow that additional regulations and requirements in various markets, such as Europe, will likely increase the demand for aircraft that use low emission technology.

Q1d. How are the European Union and Airbus doing relative to the U.S. in this area, and do you believe it will affect our already dwindling market share in civil aviation?

A1d. The European Union and Airbus have taken an interest in emissions reduction technology. However, the FAA and NASA are strongly committed to pursuing initiatives, both in a research and operational environment, to reduce aircraft emissions. While it is extremely difficult to predict, what, if any, market share advantage there might be at such an early stage of the technology's development, the U.S. is making strong efforts to stay competitive in this aspect of aviation research. Several projects, conducted jointly with NASA, are developing and testing new engine technologies that can have a substantial impact on aircraft emissions. One of these is an initiative to substantially reduce the level of nitrous oxide in high level jet aircraft emissions through more efficient combustion in large jet aircraft engines.

ANSWERS TO POST-HEARING QUESTIONS

Responses by R. John Hansman, Jr., Professor of Aeronautics and Astronautics; Director, MIT International Center for Air Transportation, Massachusetts Institute of Technology

Questions submitted by Representative Bart Gordon

Q1. You pointed out in your testimony that research funding level sat NASA and FAA for activities related to the National Airspace System have been flat or declining for the past five years.

Q1a. Has your advisory committee made explicit recommendations to FAA regarding what would be an adequate funding level for such research?

A1a. First, I must point out that while I am a member of the R,E&D Advisory Committee, I am not it's Chair so my responses represent my personal view or my best recollection.

The R,E&D Advisory Committee has recommended some specific programs and funding levels but I am not sure if we have recommended an aggregate funding level. The Committee has generally worked with the preliminary budget assumptions presented by the FAA and attempted to help the FAA prioritize within these budget constraints.

While there has been a clear sense that the budget levels were not adequate, it was thought that general requests for increased funding would not be considered credible.

Q1b. Is this matter discussed between the FAA and NASA advisory committees, which now have some members in common?

A1b. It has been discussed in general terms.

Q2. In your testimony, you mentioned the need for more research on the processes of air transportation system transition. Has your advisory committee made specific recommendations to FAA, and how has the agency responded?

A2. The issue of transition and modernization has been a focus of the Air Traffic Services Subcommittee of the R,E&D advisory committee for a number of years. While the FAA has made improvements in their transition process with the Operational Evolution Plan and other efforts, I am not aware of research being done in identifying fundamental barriers to transition.

Q3. What guidance has the R,E&D advisory committee provided FAA regarding human factors research and what level of priority would you ascribe to such research?

A3. The R,E&D advisory committee has a Human Factors Subcommittee. We review the elements of the Human Factors research program although we do not review the human factors efforts in the F&E programs. The FAA has increased it's awareness of human factors issues and has maintained reasonable support for human factors over the past few years.

I would note a specific area of concern for human factors research is the lack of access to the operational environment for the research community. Since September 11, security considerations have limited access to operational environments such as air traffic facilities, flight decks, and maintenance facilities. Such access is critical to develop systems which include consideration of the real human factors issues. While there is a legitimate need to maintain a secure air transportation system, processes need to be developed to give legitimate members of the research community access to the operational environment.

Q4. How helpful and forthcoming is FAA in assisting your committee in its review of R&D programs? Does you committee have access to information about all FAA R&D programs? If not, what information is withheld?

A4. The FAA has beef very helpful and forthcoming in assisting the R,E&D advisory committee and it's subcommittees. The most significant difficulty has been the limited time the committee members can devote to the process which limits the depth of review. The R,E&D advisory committee is reviewing it's own processes to see if it can become more efficient and effective in it's advisory role.

Q5. Does the advisory committee review all R&D programs, regardless of the appropriations account from which it is budgeted? At a minimum, does the committee *review all of the programs described in the annual National Aviation Research Plan?*

A5. The R,E&D advisory committee reviews all the research in the National Aviation Research Plan although the depth of review varies due to time limitations and different processes used by the subcommittees. The committee does not review in a systematic or comprehensive manner research and development elements supported by Facilities and Equipment funds. The committee also does not review the content of research and development activities at MITRE.

Q5a. If not, why not?

A5a. There is some ambiguity as to what research and development is within the purview of the R,E&D advisory committee.

Q6. In its comments on its review of the FAA's planned FY04–08 R&D investments, your advisory committee stated that the "movement of money from R&D to Facilities and Equipment creates several impediments to the conduct of research."

Q6a. Could you elaborate on what the committee believes are the most significant of these impediments?

A6a. The movement of a significant fraction of the R&D funds to Facilities and Equipment (F&E) makes it difficult to have an balanced research portfolio. The F&E activities constitute a significant fraction of the research funds but must be narrowly applied. There is a loss of capability in more basic, anticipatory or cross cutting research which cannot be tied to a specific acquisition effort. For example, it is my understanding that basic research grants cannot be funded from F&E funds even if the work would have significant relevance to F&E acquisitions.

Q7. The R,E&D Advisory Committee in its comments on its review of FAA's planned FY04–08 R&D investments stated that it supports FAA's aviation weather program being funded at the "base level." FAA's FY04 request for weather research is $21 million, compared with FY03 appropriate of $34 million. What does your committee recommend as the " base level"?

A7. I believe that the "base level" was in the range from $25 million to $30 million.

Q8. The R,E&D Advisory Committee has called on FAA to conduct a study to evaluate the effectiveness of current research in aircraft noise and emissions reduction technologies. What findings led the committee to this recommendation? What entity should carry out this study?

A8. This was motivated by the 2002 National Research Council (NRC) report, "For Greener Skies: Reducing Environmental Impacts of Aviation" report and by the observations of the members of the subcommittee on environment and energy. The entity that carries out this study should be independent such as the national research council with membership from academia and the stakeholder groups, airlines, airports, community groups, etc.

Q9. The R,E&D Advisory Committee made recommendations regarding increased efforts for characterization of aircraft emissions and provision for modeling of the effects of emissions that seem to suggest the relevant FAA budget is deficient. The FY04 R&D request for engine emissions is $2.4 million.

Q9a. Is this adequate, and if not, has the Advisory Committee made any explicit funding recommendations?

A9a. After conferring with the Chair of the Environmental Subcommittee, it was his best recollection that this was not considered adequate and that the subcommittee discussed a 50 percent increase although it was not formally recommended.

Q9b. Has your advisory committee made explicit recommendations for what would constitute an appropriate funding level for the FAA Environment and Energy program, and if so, what has been the agency's response to your recommendations?

A9b. The recommendation of the R,E&D Advisory Committee on funding for environment and energy was that funding should be at the $22 million level.

Q10. The 2002 National Research Council (NRC) report, "For Greener Skies: Reducing Environmental Impacts of Aviation," recommends that federal expenditures to reduce noise should be reallocated to shift some funds from local abatement, which provides near-term relief for affected communities, to research and technology that will ultimately reduce the total noise produced by aviation. Cur-

rently, funding for abatement activities by FAA totals approximately 18 times federal R&D related to noise.

Q10a. Please commend on the feasibility of this recommendation.

A10a. There are no significant problems with this recommendation that I am aware of although Congress may have to direct that the funds be spent in this way.

Q10b. In general, does FAA consider cost/benefit tradeoffs of the kind suggested here across different major categories of its budget?

A10b. I am not aware that they do.

Q11. The R,E&D Advisory Committee in its July 2002 recommendations to FAA following review of FAA's planned FY04–08 R&D investments, indicated endorsement of a $15 million budget increase to supplement the NASA Quiet Aircraft Technology project and to sustain FAA's Center of Excellence for Aircraft Noise Mitigation.

Q11a. Do you understand why this funding did not materialize in the FY04 budget request?

A11a. No.

Q11b. Do you believe FAA's FY04 request for noise research, $4 million, is sufficient?

A11b. No.

Q11c. What level of funding would be consistent with its importance and with being able to exploit opportunities for aircraft noise reduction?

A11c. Funding at the $19 million level would be appropriate.

Q12. The R,E&D Advisory Committee recommended (4Feb02)letter to the FAA on the FY04 budget review) that the FAA develop a "fully competent and expertly staffed organization to absorb and use the results of NASA's R&D." FAA's response to this recommendation was that its Free Flight Office does this.

Q12a. Does the Advisory Committee find this to be a satisfactory response: does the Free Flight Office function effectively in the tech transfer role?

A12a. It does not appear that the Free Flight Office can fulfill the role that the R,E&D Advisory Committee envisioned.

Questions submitted by Representative Sheila Jackson Lee

Q1. Many nations are under pressure to reduce emissions of greenhouse gasses in order to come into compliance with the Kyoto Protocol.

Q1a. Are airplanes important contributors to global warming, due to their types of emissions, or the fact that they deliver contaminants higher in the atmosphere?

A1a. Airplanes contribute about 3.5 percent of total man-made forcing. Their emissions contain the same chemical species as those from land-based hydrocarbon combustion (e.g., automobiles). However, the deposition at altitude causes more severe impacts because of physical processes (e.g., contrails) and chemical processes (e.g., lower background concentrations of some species—relatively more pristine environment). To first order, burning a gallon of fuel at 30,000 ft. has double the impact of burning a gallon of fuel at sea-level. Another significant difference is the very asymmetrical distribution of pollution (northern versus southern hemisphere). This is expected to further augment the role of aviation in climate change.

Q1b. Will this influence choices of civil aviation aircraft for future purchases?

A1b. It is likely that it will. There is some evidence that local and national governments may institute emissions based restrictions and trading programs.

Q1c. Are we putting adequate resources into developing low-emissions/efficient engines to meet demand?

A1c. We are putting in enough on engines, but it is the whole aviation system that produces the emissions. Within the engine there are some difficult trades—such trades may not be apparent within airframe or operations. Work to find emissions improvements in these areas is under funded. Further, much of the science is a moving target right now and we are not investing enough money in understanding the unique impacts of aviation.

Q1d. How are the European Union and Airbus doing relative to the U.S. in this area, and do you believe it will affect our already dwindling marketshare civil aviation?

A1d. The European Union and Airbus are putting more effort and resources into environmental effects. If they also put in place strict standards (like emissions trading, which they intend to do), then we may be at a disadvantage.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Malcolm B. Armstrong, Senior Vice President, Aviation Operations and Safety, Air Transport Association

Question submitted by Representative Bart Gordon

Q1. You point out that NASA funding for environmental research in noise and emissions has been less than half of what has been needed over the past few years. You also note the importance of federal funding to develop new technologies to a level of technological readiness sufficient to allow the private sector to perform testing and advanced development to transition promising technologies to commercial applications. In addition to inadequacies in the funding level for environmental R&D, does NASA support R&D for new technologies far enough in the development path to bring them to the technology readiness level at which industry will take over?

A1. The question appears to ask us to distinguish the funding level issue from other NASA support that may be provided in the development of new aeronautics technologies.

Unfortunately, if there is insufficient funding for aeronautics research, new technologies generally cannot be developed to the technology readiness level ("TRL") that is needed for industry to fully take over, even if NASA is willing to continue to provide other non-funding support.

As you no doubt are aware, NASA's TRL scale includes nine steps. As applied to aeronautics, the scale typically is presented as follows:

Technology Readiness Levels Summary

TRL 1 Basic principles observed and reported

TRL 2 Technology concept and/or application formulated

TRL 3 Analytical and experimental critical function and/or characteristic proof-of-concept

TRL 4 Component and/or breadboard validation in laboratory environment

TRL 5 Component and/or breadboard validation in relevant environment

TRL 6 System/subsystem model or prototype demonstration in a relevant environment

TRL 7 System prototype demonstration in flight environment

TRL 8 Actual system completed and "flight qualified" through test and demonstration

TRL 9 Actual system "flight proven" on operational flight

While the public-private partnership continues throughout the TRLs of a typical aeronautics R&D project, it is well accepted that to have a reasonable chance at commercial development and application, R&D programs must be brought through TRL 6 with government funding. In fact, this was a specific finding in the recent report of the National Research Council with respect to new technologies to enhance environmental performance. See National Research Council, "For Greener Skies: Reducing Environmental Impacts of Aviation," at 21, 47 (2002). The same report found that the NASA and FAA aeronautics programs for environmental development are under funded, such that they are bringing many of their noise and emissions programs only to TRL 4.

We are seeing the same trend overall in aeronautics research and development generally, as research funds are diminishing (as I pointed out in my testimony, in some cases because they are being diverted to the space program). Accordingly, based on these trends, we are concerned that NASA will have greater and greater difficulty providing the support necessary to bring new aeronautics technologies forward to TRL levels adequate to have significant chances at commercial application.

Questions submitted by Representative Sheila Jackson Lee

Q1. Many nations are under pressure to reduce emissions of greenhouse gases in order to come into compliance with the Kyoto Protocol.

Q1a. Are airplanes important contributors to global warming, due to their types of emissions, or the fact that they deliver contaminants higher in the atmosphere?

A1a. Aviation emits "greenhouse gas emissions" that are attributed to climate change. However, studies show that aviation is a small contributor, even taking into account the fact that much of the emissions from commercial aviation occur at significant altitudes. In 1999, the Intergovernmental Panel on Climate Change, a technical body established by the World Meteorological Organization and United Nations Environmental Programme, released a comprehensive study on this issue. Using radiative forcing ("RF") as a metric, which allows the location and volume of the various emissions attributable to climate change (whether positive or negative) to be taken into account, the IPCC found that aviation contributes approximately 3.5–4.0 percent of total RF attributed to human sources as measured against a pre-industrial atmosphere. *See* Intergovernmental Panel on Climate Change, "Aviation and the Global Atmosphere," at 187–88 (1999) (hereinafter "IPCC Report"). While this contribution is not particularly significant compared to other sources, we take our contribution to the environment very seriously, and seek to minimize our emissions to the extent possible.

Q1b. Will this influence choices of civil aviation aircraft for future purchases?

A1b. Greenhouse gas emissions, particularly the most prevalent one—carbon dioxide (CO_2)—are products of the combustion of fossil fuel. Given that fuel is the second highest cost to airlines, we have long had an incentive to buy the aircraft within mission parameters that are as fuel-efficient as possible. We likewise have an incentive to manage our operations as fuel efficiently as possible. In fact, Federal Aviation Administration statistics confirm that the North American airlines have achieved a 109 percent gain in fuel efficiency since 1975. This is a "win-win" for industry and the environment, as greenhouse gas emissions are minimized as we minimize our fuel burn and, hence, our operating expenses.

Q1c. Are we putting adequate resources into developing low-emissions/efficient engines to meet demand?

A1c. ATA and its airlines are very supportive of the programs at NASA and FAA to make further strides in low-emissions/efficient engines. However, we are concerned that funding cuts in recent years puts the results of those programs in jeopardy. NASA's Ultra-Efficient Engine Technology ("UEET") Program is intended to seek ways to reduce CO_2 and oxides of nitrogen (NO_X) emissions from aircraft engines. However, this program is funded at significantly lower levels than previous NASA emissions programs and does not address other aviation emissions. As confirmed by the National Research Council, this program is not funded sufficiently to meet its own milestones and federal research dollars for emissions-related R&D are insufficient to meet the challenges for continued environmental progress. *See* National Research Council, "For Greener Skies: Reducing Environmental Impacts of Aviation," at 33 (2002).

Q1d. How are the European Union and Airbus doing relative to the U.S. in this area, and do you believe it will affect our already dwindling marketshare in civil aviation?

A1d. Federal investment in aeronautics R&D has been shown to play an important role in the competitiveness of our industry. At the same time that the United States has been decreasing our investment in aviation R&D, the European Community has been increasing their investment. In fact, the various States in the European Union have now created an over-riding entity, the Advisory Council for Aeronautics Research in Europe ("ACARE"), to combine and leverage their R&D investments, with the stated goal of making Europe "the uncontested world leader in aeronautics" by 2020. *See* "European Aeronautics: A Vision for 2020," (January 2001) and ACARE web site, at http://www.acare4europe.org/. To the extent that the Europeans continue to put greater R&D dollars into their aeronautics program, and the United States continues the trend of decreased investments, it is inevitable that this will affect the competitiveness of our industry.

Appendix 2:

Additional Material for the Record

MAR --5 2003

Dr. Jeremiah Creedon
Associate Administrator for Aerospace Technology
NASA Headquarters, Code R
300 E Street SW.
Washington, DC 20560

Dear Dr. Creedon:

Many thanks for the time you and your staff spent with us last Tuesday. It was very helpful to hear directly from the team and have the opportunity to discuss the national plan in some depth with you. I am pleased with the progress we are making for a unified national air transportation plan and NASA's efforts are much appreciated.

Based on our discussion, this letter will serve as the follow-on working agreement to our meeting. The agreed-upon joint deliverables are listed below for your consideration.

NASA and FAA will jointly conduct the socio-economic demand study and construct future scenarios of the economic, societal, safety and security value of air transportation. The agencies will produce a unified, "not piece parts," Operations Concept that will capture how the people, products, and procedures work together to fulfill the strategies. Additionally, each interim state will be defined with criteria for the transition steps to ensure the evolution is stable. These are the first steps in developing a preliminary integrated research and requirements document for the future air transportation system. This plan will be completed in December '03 in order to meet your January '04 budget timeline.

We are particularly grateful to your staff and their flexibility as we proceed to build the infrastructure from the ground up. I enjoyed meeting your staff and, of course, seeing you again.

I look forward to hearing your assessment of our working agreement and national plan.

Sincerely,

ORIGINAL SIGNED BY
CHARLES E. KEEGAN
Charles E. Keegan
Associate Administrator for
Research and Acquisitions

ARA-3:PGervasi:psm:3/3/03:493-4437(Mydocuments/Creedon)
cc:ARA-1

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

March 24, 2003

Reply to Attn of: RP

Mr. Charles E. Keegan
Associate Administrator for
Research and Acquisition
Federal Aviation Administration
800 Independence Ave, S.W.
Washington, DC 20590

Dear Mr. Keegan:

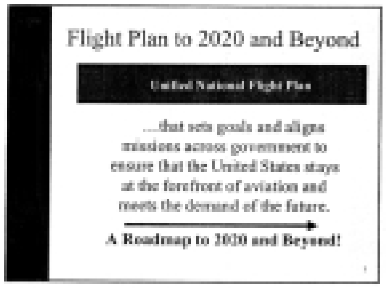
Thank you for your letter of March 5, 2003. I also was encouraged by the progress that is being made toward a unified national air transportation plan.

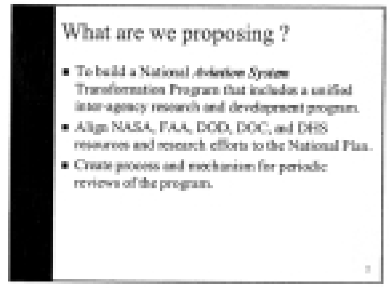
I would very much like to see us move as quickly as possible to develop the deliverables you proposed in your letter. I, on that basis, agree with you that NASA and FAA will jointly: (1) conduct socio-economic demand studies and construct future scenarios of the economic value, societal, safety and security value of Air Transportation; (2) produce a range of unified (not "piece parts") Operations Concepts that will capture how the people, products, and procedures work together to satisfy the projected demand for air transportation; (3) define interim states toward achieving future operational concept(s) with criteria for the transition to ensure the evolution is stable; and, (4) produce an integrated research requirements document for the future Air Transportation System. This plan will be completed in December 2003 in order to meet the FY 2005 budget timeline.

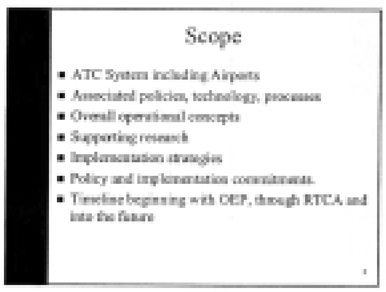
These are ambitious goals and achieving them will require strong FAA and NASA support. I would like to ensure that the team understands clearly the importance of developing a responsible, credible, and compelling plan. Accordingly, I recommend that we charge the team with developing a definition of what they will deliver by December 2003 in each of these areas and a detailed plan, including NASA and FAA responsibilities and resource requirements, for developing this December deliverable. I would ask the team to present this plan to us on April 15, 2003, for our review and approval.

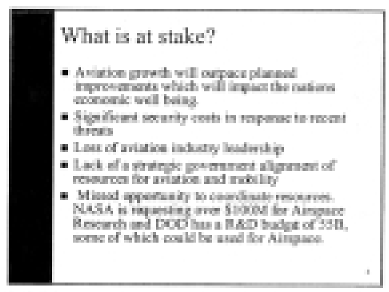
Cordially,

J. F. Creedon
Associate Administrator for
Aerospace Technology


Flight Plan to 2020 and Beyond
Unified National Flight Plan
....that sets goals and aligns missions across government to ensure that the United States stays at the forefront of aviation and meets the demand of the future.
A Roadmap to 2020 and Beyond!
1


What are we proposing ?
To build a National *Aviation System* Transformation Program that includes a unified inter-agency research and development program.
Align NASA, FAA, DOD, DOC, and DHS resources and research efforts to the National Plan.
Create process and mechanism for periodic reviews of the program.
2


Scope
ATC System including Airports
Associated policies, technology, processes
Overall operational concepts
Supporting research
Implementation strategies
Policy and implementation commitments.
Timeline beginning with OEP, through RTCA and into the future
3


What is at stake?
Aviation growth will outpace planned improvements which will impact the nations economic well being.
Significant security costs in response to recent threats
Loss of aviation industry leadership
Lack of a strategic government alignment of resources for aviation and mobility
Missed opportunity to coordinate resources. NASA is requesting over $100M for Airspace Research and DOD has a R&D budget of 35B, some of which could be used for Airspace.
4

U.S. Gov't Leadership

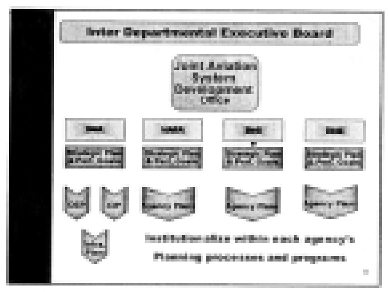
- Now is the time for the Government to provide leadership and develop a unified National Program
- Several recent studies have recommended action
- Boeing, RTCA, ICAO and others have developed concepts for the future.
- We need a National Strategy and Policies for transformation of the Air Transportation System.

NASA/FAA Relationship

- FAA has the requirement to meet future demand and modernize the system.
- FAA does not have the funds for the necessary R&D programs.
- NASA has been receiving 100M/yr for Airspace research and will be asking for more.
- We believe it is in the public interest to forge a strong inter-agency relationship.

Proposed Structure

- Two tiered
- Executive Board led by AOA-1
- Joint Aviation Development Group led by FAA



Program Management

- Each agency will institutionalize within its own planning documents and programs the appropriate elements of the National Plan.
- Each department is expected to manage their related programs in accordance with the National Plan developed by the JASDO.

9

Executive Board Composition

- **FAA** - Chairperson
- **NASA Administrator** – Focus on Aviation Research
- **DOC** – Ensure competitive industry and unimpeded growth for commercial space, etc.
- **DoD** – Largest system user and service provider, and user of new vehicles (UAVs)
- **TSA/DHS** – Needs data from aviation infrastructure

10

Executive Board Responsibilities

- Establish National Goals and objectives
- Develops and provides policy guidance and approval for the National Plan
- Provides ongoing policy review for modernization of the NAS.
- Proposes legislation where required and supports budget requests.

11

Joint Airspace Development Office

- FAA -- Chair
- NASA
- DOD
- TSA/DHS
- **OSTP**
- **DOC**

12

2003 Goal

- Develop a National Plan(Charting the next century of flight) with five chapters.
  1. National Vision
  2. Socio-Economic Demand
  3. National Goals, Objectives, and Policies
  4. Operational concepts and Transition Roadmap
  5. Consolidated inter-agency Research Plan

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