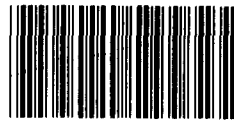


February 1992

AVIATION RESEARCH

Information on Funding, Staffing, and Timing of FAA's Research Projects



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United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-247221

February 28, 1992

The Honorable George E. Brown, Jr.
Chairman
The Honorable Robert S. Walker
Ranking Minority Member
Committee on Science, Space, and Technology
House of Representatives

The Honorable Tom Lewis
The Honorable Tim Valentine
House of Representatives

The Federal Aviation Administration's (FAA) Research, Engineering, and Development (RE&D) Program is an important element in ensuring the safety and efficiency of the U.S. air transport system. Although FAA is modernizing the air traffic control system through its \$32 billion Capital Investment Plan, the need to accommodate increasing air travel and maintain aviation safety continues to pose long-term challenges. To assist FAA in meeting these challenges, the Congress enacted the Aviation Safety Research Act of 1988 (P.L. 100-591) mandating, in part, that FAA allocate at least 15 percent of its RE&D Program funding to long-term research for fiscal years 1989 and 1990.

To assist you in overseeing FAA's fiscal year 1993 budget request, you asked us to study the agency's research programs. This fact sheet provides information on project level funding, staffing, and scheduling data for fiscal years 1988-91. As agreed with your offices, we will provide a second report at a later date addressing the long-term research under way within FAA's program and the agency's progress toward implementing the Aviation Safety Research Act of 1988.

Highlights of the aviation research data we have developed include the following:

- Congressional appropriations for RE&D have grown from \$153 million in fiscal year 1988 to \$205 million for fiscal year 1991, an increase of 34 percent. At an estimated \$199 million in fiscal year 1991, FAA's obligations almost kept pace with appropriated funds.

Projects related to capacity and air traffic management are the most numerous and have received increased funding. These projects accounted for 40 percent of FAA's 1991 RE&D obligations. In response to recent aviation safety and security incidents, FAA subsequently expanded research in the areas shown in table 1.

Table 1: Obligations for Research Areas That FAA Expanded in Response to Recent Safety and Security Incidents

Dollars in Millions

<u>Research area</u>	<u>Fiscal year</u>		<u>Percentage increase</u>
	<u>1988</u>	<u>1991^a</u>	
Security	\$9.6	\$30.9	222
Aircraft safety	9.0	28.6	218
Human factors and medicine	6.2	17.6	184

^aEstimated.

Notwithstanding the overall increase in RE&D appropriations, funding for projects related to communications, navigation, and surveillance declined by about 81 percent. Funding for projects related to weather declined to a lesser extent--by 9 percent. (See sec. 1.)

- Authorized staffing has increased by 3 percent, from 645 positions in fiscal year 1988 to 668 positions in fiscal year 1991. Projects related to capacity and air traffic management accounted for 39 percent of all RE&D staffing in fiscal year 1991.¹ Significant staffing increases of almost 300 percent occurred in projects related to innovative and cooperative research. The additional staff were provided to, among other things, manage and direct research efforts at and grants to colleges and

¹All staffing information in this report is provided in full-time equivalents. Full-time equivalent employment is the total number of hours (worked or to be worked) divided by the number of compensable hours applicable to each fiscal year.

universities. Other significant increases in staffing are shown in table 2.

Table 2: Staffing Levels for Selected Research Areas

Staffing Levels Expressed in Full-Time Equivalents

<u>Research area</u>	<u>Fiscal year</u>		<u>Percentage increase</u>
	<u>1988</u>	<u>1991</u>	
Management and analysis	32	47	47
Security	18	26	44
Aircraft safety	93	125	34
Human factors and medicine	77	95	23

During the same period, staffing for projects related to weather decreased by 64 percent. Similarly, staffing for projects related to communications, navigation, and surveillance declined by 18 percent. (See sec. 2.)

-- Over half of the 140 projects on which we collected data for fiscal years 1988-91 have been completed, according to FAA. These completions include projects on Global Positioning System utilization and low altitude communications and surveillance--two projects whose results should in time increase the efficiency of air traffic control. About 40 percent of the 70 active projects are scheduled to be completed within the next 5 to 7 years. Some projects, such as aviation weather analysis and forecasting, are long-term in nature and will not be completed until the year 2000. On the basis of research results and growing demand for certain technologies, FAA has added to the content of and revised the completion dates for some projects. For example, FAA now estimates that its recently expanded explosives detection project to refine existing and explore emerging detection technologies will continue on from 1993 through 1997. In addition, FAA has not set a date for some projects to be completed, such as the capacity development project, which will continue well into the future. (See sec. 3.)

- - - -

Because FAA budget documents do not provide historical information on funding and staffing from 1988 to 1991 or

contain schedule information at the project level, we developed the information contained in sections 1, 2, and 3 on funding, staffing, and scheduling for FAA's RE&D projects. We obtained information from numerous sources, including research project files, reports, and project summaries. On the basis of information from these sources, we created an automated data base from which we developed the tables in this fact sheet.

In addition, we formatted the data by the major research areas used in FAA's revised RE&D budget submission to allow for year-to-year comparisons of projects, as well as major research areas. Individual projects fall into 1 of the following 10 research areas: management and analysis; capacity and air traffic management technology; communications, navigation, and surveillance; weather; airport technology; aircraft safety technology; system security technology; human factors and aviation medicine; environment and energy; and innovative/cooperative research.

We obtained additional information on how the program functions from discussions with FAA budget staff and RE&D managers at FAA's Technical Center in Pomona, New Jersey. Because of your need for this information before oversight hearings, we did not validate its accuracy by tracing it to original vouchers or source documents. However, we discussed the contents of this fact sheet with FAA program officials, who agreed that the information was accurate. As requested by your office, we did not obtain written agency comments on this fact sheet. We conducted our work between August and December 1991 in accordance with generally accepted government auditing standards.

Unless you publicly announce its contents earlier, we plan no further distribution of this fact sheet until 30 days from the date of this letter. At that time, we will provide

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copies to the Secretary of Transportation, the FAA Administrator, and other interested parties. If you have questions on this fact sheet, please call me at (202) 275-1000. Major contributors to this fact sheet are listed in appendix I.

A handwritten signature in cursive script, appearing to read "K. M. Mead".

Kenneth M. Mead
Director, Transportation Issues

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ABBREVIATIONS

AAS	Advanced Automation System
ADS	Automatic Dependent Surveillance
AERA	Automated Enroute Air Traffic Control
AMASS	Airport Movement Areas Safety System
ARTS	Automated Radar Terminal Systems
ATC	Air Traffic Control
CWP	Central Weather Processor
FAA	Federal Aviation Administration
GAO	General Accounting Office
GPS	Global Positioning System
IFR	Instrument Flight Rules
LLWAS	Low Level Windshear Alert System
MLS	Micro-wave Landing System
NADIN	National Aviation Data Interchange Network
NASA	National Aeronautics and Space Administration
NASPAC	National Airspace Performance Analysis Capability
NEXRAD	Next Generation Weather Radar
RE&D	Research, Engineering, and Development
TATCA	Terminal Air Traffic Control Automation
TCAS	Traffic Alert and Collision Avoidance System
VSCS	Voice Switch and Control System

SECTION 1

FUNDING INFORMATION ON FAA'S RE&D PROJECTS

Figure 1.1: RE&D Obligations for Major Research Areas, Fiscal Years 1988 and 1991

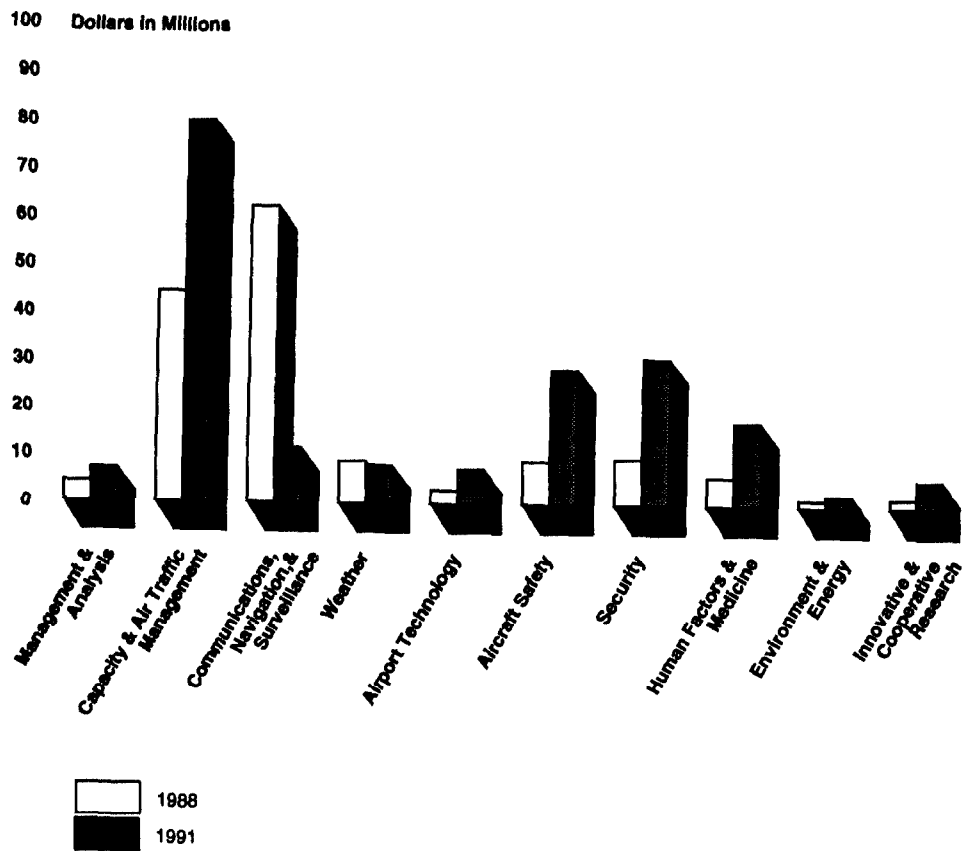


Table 1.1: Obligations for Major Research Areas, Fiscal Years 1988-91

Dollars in Thousands

<u>Research area</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Management and Analysis	\$ 4,155	\$ 6,009	\$ 25,227	\$ 7,000
Capacity and Air Traffic Management	44,325	51,130	71,157	79,936
Communications, Navigation, and Surveillance	62,152	20,357	21,557	11,578
Weather	8,844	15,115	14,094	7,964
Airport Technology	2,881	4,302	5,976	7,279
Aircraft Safety	9,034	15,082	21,243	28,630
Security	9,565	9,907	16,983	30,912
Human Factors and Medicine	6,186	9,578	17,518	17,573
Environment and Energy	1,500	2,256	1,978	2,402
Innovative and Cooperative Research	<u>1,835</u>	<u>1,797</u>	<u>2,515</u>	<u>5,767</u>
Total	<u>\$150,477</u>	<u>\$135,533</u>	<u>\$198,248</u>	<u>\$199,041</u>

^aEstimated.

Table 1.2: Obligations for RE&D Management and Analysis Projects,
Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Future System Definition Management and Control Process	\$ 114	\$ 15	\$ 578	\$1,010
System Concept Definition	0	1,031	3,038	1,176
RE&D Plan	60	270	11,835	0
System Requirements	325	556	740	464
Systems Engineering Management	1,817	859	607	794
NAS Development Studies	99	304	491	431
ASD Program Support	745	0	0	0
RE&D Advisory Committee	40	1,183	4,129	1,557
Management Initiatives	0	25	150	180
Support Contract Reduction	1	1,150	2,828	668
AND Program Support	0	0	0	400
AAS Study	590	616	831	320
	<u>364</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	<u>\$4,155</u>	<u>\$6,009</u>	<u>\$25,227</u>	<u>\$7,000</u>

^aEstimated.

Table 1.3: Obligations for Capacity and Air Traffic Management Projects, Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Capacity and Air Traffic Management Technology:				
Surface Traffic Surveillance	143	197	0	0
Low Altitude Communications and Surveillance	263	256	0	250
Terminal NASPAC Application	0	466	0	0
Precision Runway Monitor - Hi Data	8,832	2,237	2,402	2,126
Enroute Metering	412	0	0	0
Wake Vortex Avoidance/Advisory Systems	355	1,813	1,712	1,876
Direct User Access	191	0	0	0
Terminal Airspace Assessment	0	1,200	0	0
Sustain ARTS II/IIA	-23	0	0	0
Airport Surface Traffic Automation	64	1,771	0	0
Airport Surface Traffic Automation/AMASS	0	0	7,600	9,082
ATC Application of ADS	3,969	6,022	3,500	5,070
Advanced Traffic Management	2,649	5,120	5,054	4,265
Precision Runway Monitor - Back Antenna	2,170	3,419	0	0
AERA-3	674	40	5,268	4,641
Terminal ATC Automation (TATCA)	0	0	6,919	8,375
Terminal ATC Automation	1,996	4,092	369	0
Dynamic Special Use Airspace	37	360	264	328
Jet Route and Terminal Optimization	0	0	0	312
Advanced Automation System Program Management	5,881	6,961	7,362	4,963
ATC Automation Bridge Development	0	0	0	5,559
Dynamic Ocean Track System	0	0	363	907
NASPAC	0	0	3,238	2,516

(continue)

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Future Systems Engineering: Separation Standards	2,257	2,383	3,482	3,812
Aircraft Technology:				
TCAS III Development	2,750	2,299	1,921	2,331
TCAS II Implementation	1,479	902	2,071	2,943
TCAS II Commuter Evaluation	0	143	4,355	576
TCAS Deobligation	0	-1,812	0	0
Synthetic Vision	0	0	0	1,000
TCAS I Implementation	0	206	403	595
TCAS II Development	1,394	403	0	0
TCAS III Implementation	3,430	1,596	1,242	1,971
Passive TCAS I	380	0	0	0
Cockpit Display Evaluation	0	0	200	0
Rotorcraft TERPs	403	0	0	0
Rotorcraft IFR Operations Evaluation	1,418	1,485	1,608	926
Rotorcraft Obstruction Avoidance	89	1,196	678	331
Rotorcraft ATC Procedures	151	362	284	116
Special Projects Office Support (Rotorcraft)	4	50	0	0
Rotorcraft Simulator Standards	55	313	310	182
Heliport/Vertiport Design	30	1,770	1,244	1,206
Civil Tiltrotor Application Studies	150	0	20	0
Rotorcraft Separation Standards	14	0	302	255
Rotorcraft Display and Control Studies and Certification	46	303	411	1,002
Capacity Planning:				
Capacity Development	730	1,229	2,496	2,490
System Capacity Enhancement Planning	199	900	2,166	1,201
Airport Capacity Design Team	969	1,869	1,604	2,349
Implementation Planning for Task Force Studies	0	385	450	0

(continue)

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Modeling and Simulation:				
National Simulation Lab	0	0	0	4,082
Simulation Model				
Development and				
Validation	764	1,194	1,272	1,352
Airspace System Models	<u>0</u>	<u>0</u>	<u>587</u>	<u>946</u>
Total	<u>\$44,325</u>	<u>\$51,130</u>	<u>\$71,157</u>	<u>\$79,936</u>

^aEstimated.

Table 1.4: Obligations for Communications, Navigation, and Surveillance Projects, Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Special Surveillance System (S3)	\$ 1,004	\$ 1,415	\$ -1	\$ 0
Mode S Integrated Tracker	0	799	996	1,130
Communications, Planning, and Design	78	719	867	766
Rotorcraft Communications	115	0	0	0
Network Management Control	58	320	884	0
Instrument Approach Improvement	416	32	21	0
Mobile Satellite Technology Communications	121	902	3,248	3,164
NADIN	1,307	265	567	230
Data Link Technical Development	2,772	0	0	0
MLS ATC Integration	64	390	0	0
VSCS	50,044	1,436	987	1,063
Aeronautical Data Link Communications/Navigation	4,948	11,913	11,557	1,966
Spectrum Planning	-10	0	0	0
GPS Utilization	448	1,030	436	1,581
Navigation Systems Development	213	497	529	782
Navigation Systems Engineering	574	639	1,466	896
Total	<u>\$62,152</u>	<u>\$20,357</u>	<u>\$21,557</u>	<u>\$11,578</u>

^aEstimated.

Table 1.5: Obligations for Weather Projects, Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
WCP Enhancements	\$ 135	\$ 0	\$ 0	\$ 0
Central Weather Processor	5,990	9,879	6,258	413
Airborne Wind Shear Detection and Avoidance	1,054	1,274	1,815	1,166
Advanced Wind Shear Sensor Development	11	0	0	0
Expanded LLWAS	243	913	680	503
ATC/Aircraft Wind Shear Information Transfer	20	216	0	0
Wind Shear Terminal Information Systems Integration	251	0	480	641
Airborne Wind Shear Advanced Technology	0	0	0	1,125
Terminal Weather Radar	510	1,277	877	1,964
Weather Radar (NEXRAD)	431	837	2,754	0
CWP Interface Development	199	719	0	1,000
Aviation Weather Analysis and Forecasting	<u>0</u>	<u>0</u>	<u>1,230</u>	<u>1,152</u>
Total	<u>\$8,844</u>	<u>\$15,115</u>	<u>\$14,094</u>	<u>\$7,964</u>

^aEstimated.

Table 1.6: Obligations for Airport Technology Projects, Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Airport Design, Configuration, and Capacity	\$ 159	\$ 478	\$ 164	\$ 5
Airport Pavement	422	1,109	2,180	2,168
Runway Exit Advisory System	805	757	33	0
Handicapped Passenger Assistance	36	0	149	0
Airport Design and Configuration	0	0	1,686	1,295
Airport Safety Planning	421	468	58	773
Airport Surface Visual Control (light)	850	804	674	1,595
Airport Safety Support System	188	336	707	868
Terminal/Landside Traffic Modeling	<u>0</u>	<u>350</u>	<u>325</u>	<u>575</u>
Total	<u>\$2,881</u>	<u>\$4,302</u>	<u>\$5,976</u>	<u>\$7,279</u>

^aEstimated.

Table 1.7: Obligations for Aircraft Safety Projects, Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Flight Safety/Atmospheric Hazards	\$2,055	\$ 2,624	\$ 2,185	\$ 4,188
Aircraft Systems Fire Safety	3,544	3,432	4,207	5,047
Propulsion/Fuel Systems	1,755	2,351	1,706	2,286
Structural Crash Worthiness/Airworthiness	1,680	2,089	2,716	4,660
Aging Aircraft	0	4,062	5,335	12,449
International Aircraft Operator Database	0	524	1,992	0
Cooperative Aircraft Crashworthiness Program	<u>0</u>	<u>0</u>	<u>3,102</u>	<u>0</u>
Total	<u>\$9,034</u>	<u>\$15,082</u>	<u>\$21,243</u>	<u>\$28,630</u>

^aEstimated.

Table 1.8: Obligations for Security Projects, Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Explosive Detection	\$ 0	\$9,907	\$16,983	\$27,165
Weapons Detection	9,565	0	0	1,899
Airport Security	0	0	0	1,249
Security Systems Integration	<u>0</u>	<u>0</u>	<u>0</u>	<u>599</u>
Total	<u>\$9,565</u>	<u>\$9,907</u>	<u>\$16,983</u>	<u>\$30,912</u>

^aEstimated.

Table 1.9: Obligations for Human Factors and Medicine Projects,
Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Information Transfer and Management	\$ 264	\$ 321	\$ 522	\$ 1,032
Causal Factors in Accidents	703	671	828	1,067
Human Factors Applications	500	696	1,420	582
Control and Display Technology	0	336	804	882
Flight Crew Certification and Training	374	749	2,658	2,687
Intelligent Machine Interface	111	0	0	0
Expert Systems Applied to ATC	0	0	677	639
Human Performance Assessment and Improvement	0	745	834	877
Controller Human Factors	11	94	714	1,608
Automated Radar Training	457	694	0	0
Aircraft Automation	0	0	309	979
Flight Deck Certification Criteria	0	0	330	515
Aeromedical Program Support	381	253	1,131	796
Protection and Survival	1,395	1,563	2,964	2,594
Workforce Optimization Research	1,329	1,789	1,720	1,695
Human Performance	661	791	796	642
Aging Aircraft Human Factors	<u>0</u>	<u>876</u>	<u>1,811</u>	<u>978</u>
Total	<u>\$6,186</u>	<u>\$9,578</u>	<u>\$17,518</u>	<u>\$17,573</u>

^aEstimated.

Table 1.10: Obligations for Environment and Energy Projects,
Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
Aircraft Engine Emissions Reduction and Control	\$ 513	\$ 562	\$ 445	\$ 350
Aviation Fuel Shortage Contingency	182	83	0	0
Aviation Fuel Conservation	235	200	0	0
Aircraft Noise Reduction and Environmental Control	<u>570</u>	<u>1,411</u>	<u>1,533</u>	<u>2,052</u>
Total	<u>\$1,500</u>	<u>\$2,256</u>	<u>\$1,978</u>	<u>\$2,402</u>

^aEstimated.

Table 1.11: Obligations for Innovative and Cooperative Research
Projects, Fiscal Years 1988-91

Dollars in Thousands

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991^a</u>
FAA/NASA Cooperative Programs	\$ 812	\$ 872	\$1,065	\$1,057
Joint University Program	200	200	237	310
Technology Transfer	0	0	0	960
University Fellowship Research Program	0	0	0	1,256
Small Business Innovative Research	823	525	1,013	1,000
National Aviation Institute	0	0	0	984
Transportation Research Board	<u>0</u>	<u>200</u>	<u>200</u>	<u>200</u>
Total	<u>\$1,835</u>	<u>\$1,797</u>	<u>\$2,515</u>	<u>\$5,767</u>

^aEstimated.

SECTION 2

STAFFING INFORMATION ON FAA'S RE&D PROJECTS

Figure 2.1: Staffing Levels for Major Research Areas, Fiscal Years 1988 and 1991

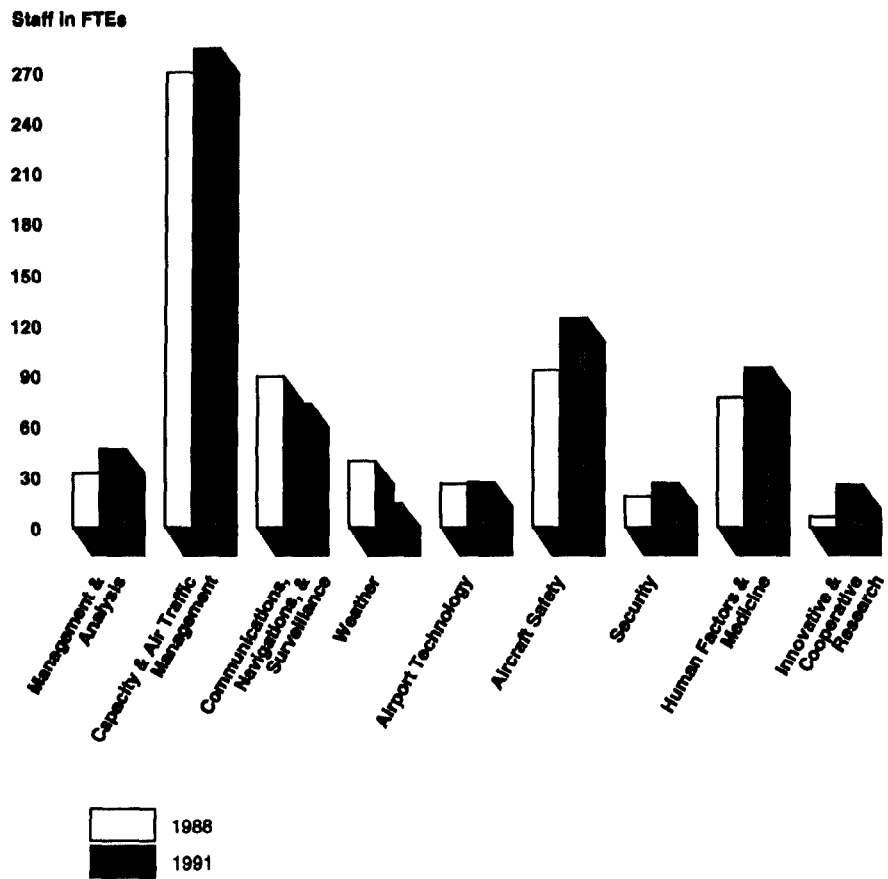


Table 2.1: Staffing Levels for Major Research Areas, Fiscal Years 1988-91

In full-time equivalents

<u>Research area</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Management and Analysis	32.3	32.3	77.9	46.5
Capacity and Air Traffic Management	270.2	277.2	255.8	284.0
Communications, Navigation, and Surveillance	89.6	83.4	72.4	73.4
Weather	39.8	25.5	17.1	14.2
Airport Technology	25.9	25.6	18.5	26.8
Aircraft Safety	93.4	94.9	99.8	124.6
Security	18.3	46.4	25.4	26.1
Human Factors and Medicine	77.2	77.1	85.3	94.6
Environment and Energy ^a				
Innovative and Cooperative Research	<u>6.5</u>	<u>6.8</u>	<u>10.2</u>	<u>25.0</u>
Total	<u>653.2</u>	<u>669.2</u>	<u>662.4</u>	<u>715.2</u>

^aThe Office of Environment and Energy's RE&D projects are staffed through a budget account called "Operations Development and Direction."

Table 2.2: Staffing Levels for RE&D Management and Analysis Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Future System Definition Management and Control	0.0	0.0	5.6	3.3
Process	0.0	0.0	0.0	4.7
System Concept Definition	0.2	0.0	0.0	0.0
RE&D Plan	0.2	0.0	2.9	2.2
System Requirements	21.0	14.2	7.3	9.8
Systems Engineering Management	1.0	4.2	5.9	4.5
NAS Development Studies	0.6	0.0	0.0	0.0
ASD Program Support	0.0	5.5	47.2	19.0
RE&D Advisory Committee	0.0	0.0	0.0	0.0
Management Initiatives	0.0	0.1	0.0	0.0
Support Contract Reduction	0.0	0.0	0.0	0.0
AND Program Support	9.3	8.3	9.0	3.0
AAS Study	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Total	<u>32.3</u>	<u>32.3</u>	<u>77.9</u>	<u>46.5</u>

Table 2.3: Staffing Levels for Capacity and Air Traffic Management Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Capacity and Air Traffic Management Technology:				
Surface Traffic Surveillance	2.2	2.9	0.0	0.0
Low Altitude Communications and Surveillance	0.2	0.0	0.0	0.0
Terminal NASPAC Application Precision Runway Monitor - Hi Data	0.0	2.4	0.0	0.0
Enroute Metering	0.0	0.0	4.1	0.0
Wake Vortex Avoidance/ Advisory System	0.3	0.0	0.0	0.0
Direct User Access	3.4	1.9	3.9	3.9
Terminal Airspace Assessment	3.4	0.0	0.0	0.0
Sustain ARTS II/IIA	0.0	0.0	0.0	0.0
Airport Surface Traffic Auto	0.1	0.0	0.0	0.0
Airport Surface Traffic Automation/AMASS	1.0	0.8	0.0	0.0
ATC Application of ADS	0.0	0.0	0.6	1.1
Advanced Traffic Management Precision Runway Monitor - Back Antenna	12.0	16.1	12.8	22.6
AERA-3	0.6	0.3	0.6	0.9
Terminal ATC Automation (TATCA)	0.3	0.1	0.0	0.0
Terminal ATC Automation	1.2	0.6	3.4	5.2
Dynamic Special Use Airspace	0.0	0.0	2.5	1.1
Jet Route & Terminal Optimization	1.2	0.8	0.7	0.0
Advanced Automation System Program Management	0.6	0.3	0.4	1.8
ATC Automation Bridge Development	0.0	0.0	0.0	0.0
Dynamic Ocean Track System	0.0	0.0	0.3	3.3
NASPAC	0.0	0.0	5.6	6.5
Future Systems Engineering:				
Separation Standards	40.9	34.7	24.6	42.7
Aircraft Technology:				
TCAS III Development	22.9	9.8	12.2	19.1
TCAS II Implementation	9.0	7.8	12.2	11.4
TCAS II Commuter Evaluation	0.0	1.2	1.2	3.3
TCAS Deobligation	0.0	0.0	0.0	0.0

(continue)

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Synthetic Vision	0.0	0.0	0.0	0.0
TCAS I Implementation	0.0	2.4	2.7	4.0
TCAS II Development	4.3	3.7	0.0	0.0
TCAS III Implementation	4.1	12.1	3.8	10.3
Passive TCAS I	0.2	0.0	0.0	0.0
Cockpit Display Evaluation	0.0	0.0	0.0	0.0
Rotorcraft TERPS	6.6	0.0	0.0	0.0
Rotorcraft IFR Operations Evaluation	21.5	8.6	5.6	8.4
Rotorcraft Obstruction Avoidance	1.4	8.2	6.5	3.7
Rotorcraft ATC Procedures	0.5	1.1	1.1	0.6
Special Projects Office Support	0.0	0.0	0.0	0.0
Rotorcraft Simulator Standards	0.5	0.0	0.8	1.1
Heliport/Vertiport Design	0.5	9.2	9.3	5.2
Civil Tiltrotor Application Studies	0.0	0.0	0.0	0.0
Rotorcraft Separation Standards	0.2	0.0	1.6	0.8
Rotorcraft Display and Control Studies and Certification	0.7	4.5	4.3	9.9
Capacity Planning:				
Capacity Development	12.4	15.1	9.0	18.9
System Capacity Enhancement Planning	1.7	0.0	2.0	5.5
Airport Capacity Design Team Implementation Planning for Task Force Studies	15.9	23.6	22.4	14.2
	0.0	0.0	0.0	0.0
Modeling & Simulation:				
National Simulation Lab	0.0	0.0	0.0	0.0
Simulation Model Development and Validation	3.8	1.9	2.0	7.6
Airspace System Models	<u>0.0</u>	<u>0.0</u>	<u>2.0</u>	<u>3.3</u>
Total	<u>270.2</u>	<u>277.2</u>	<u>255.8</u>	<u>284.0</u>

Table 2.4: Staffing Levels for Communications, Navigation, and Surveillance Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Special Surveillance System (S3)	0.0	0.1	0.0	0.0
Mode S Integrated Tracker	0.0	0.7	0.8	1.8
Communications, Planning, and Design	1.2	3.2	0.4	0.0
Rotorcraft Communications	0.2	0.0	0.0	0.0
Network Management Control	0.9	0.0	1.1	0.0
Instrument Approach Improvement	0.5	0.5	0.3	0.0
Mobile Satellite Technology Communications	2.1	1.9	8.3	2.2
NADIN	1.9	3.8	2.5	0.0
Data Link Technical Development	5.2	0.0	0.0	0.0
MLS ATC Integration	1.0	0.9	0.0	0.0
VSCS	27.7	21.6	12.5	14.5
Aeronautical Data Link Communications/Navigation	36.0	34.9	31.0	34.5
Spectrum Planning	0.0	0.0	0.0	0.0
GPS Utilization	2.7	10.2	2.1	16.6
Navigation Systems Development	0.6	3.6	2.1	1.1
Navigation Systems Engineering	<u>9.6</u>	<u>2.0</u>	<u>11.3</u>	<u>2.7</u>
Total	<u>89.6</u>	<u>83.4</u>	<u>72.4</u>	<u>73.4</u>

Table 2.5: Staffing Levels for Weather Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
WCP Enhancements	2.1	0.0	0.0	0.0
Central Weather Processor	13.0	7.5	9.9	5.6
Airborne Wind Shear Detection and Avoidance	0.6	1.0	0.8	0.6
Advanced Wind Shear Sensor Development	0.2	0.0	0.0	0.0
Expanded LLWAS	1.3	8.9	1.0	0.0
ATC/Aircraft Wind Shear Information Transfer	0.3	0.2	0.0	0.0
Wind Shear Terminal Information Systems Integration	3.9	0.0	1.0	0.6
Airborne Wind Shear Advanced Technology	0.0	0.0	0.0	0.0
Terminal Weather Radar	8.0	3.8	3.7	6.3
Weather Radar (NEXRAD)	7.3	1.5	0.7	0.0
CWP Interface Development	3.1	2.6	0.0	0.0
Aviation Weather Analysis and Forecasting	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>1.1</u>
Total	<u>39.8</u>	<u>25.5</u>	<u>17.1</u>	<u>14.2</u>

Table 2.6: Staffing Levels for Airport Technology Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Airport Design, Configuration, and Capacity	0.3	1.2	0.5	0.0
Airport Pavement	0.8	0.8	0.5	0.5
Runway Exit Advisory System	4.0	4.8	0.5	0.0
Handicapped Passenger Assistance	0.0	0.0	0.3	0.0
Airport Design and Configuration	0.0	0.0	4.6	4.9
Airport Safety Planning	4.9	3.3	0.8	4.6
Airport Surface Visual Control (lights)	14.2	12.1	7.0	12.3
Airport Safety Support System	1.7	3.4	4.3	4.5
Terminal/Landside Traffic Modeling	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Total	<u>25.9</u>	<u>25.6</u>	<u>18.5</u>	<u>26.8</u>

Table 2.7: Staffing Levels for Aircraft Safety Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Flight Safety/Atmospheric Hazards	16.8	18.1	14.8	20.5
Aircraft Systems Fire Safety	43.6	41.0	40.3	55.0
Propulsion/Fuel Systems	19.5	16.8	16.3	17.7
Structural Crash Worthiness/Airworthiness	13.5	10.6	11.9	13.7
Aging Aircraft	0.0	8.0	12.7	17.7
International Aircraft Operators Database	0.0	0.4	1.7	0.0
Cooperative Aircraft Crashworthiness Program	<u>0.0</u>	<u>0.0</u>	<u>2.1</u>	<u>0.0</u>
Total	<u>93.4</u>	<u>94.9</u>	<u>99.8</u>	<u>124.6</u>

Table 2.8: Staffing Levels for Security Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Explosive Detection	0.0	46.4	25.4	15.5
Weapons Detection	18.3	0.0	0.0	5.7
Airport Security	0.0	0.0	0.0	2.1
Security Systems Integration	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>2.8</u>
Total	<u>18.3</u>	<u>46.4</u>	<u>25.4</u>	<u>26.1</u>

Table 2.9: Staffing Levels for Human Factors and Medicine Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
Information Transfer and Management	4.2	1.0	0.4	1.1
Causal Factors in Accidents	4.1	1.0	0.7	1.1
Human Factors Applications	0.0	1.0	0.0	1.1
Control and Display Technology	0.0	0.5	0.4	1.1
Flight Crew Certification and Training	0.5	0.5	0.4	1.1
Intelligent Machine Interface	0.2	0.0	0.0	0.0
Expert Systems Applied to ATC	0.0	0.0	1.6	2.2
Human Performance Assessment and Improvement	0.0	0.0	0.7	1.1
Controller Human Factors	0.2	1.0	2.1	10.9
Automated Radar Training	4.8	4.0	0.0	0.0
Aircraft Automation	0.0	0.0	0.7	1.1
Flight Deck Certification Criteria	0.0	0.0	0.4	1.1
Aeromedical Program Support	5.0	3.9	10.9	10.8
Protection and Survival	24.1	31.2	38.9	37.9
Workforce Optimization				
Research	22.9	22.3	19.2	18.7
Human Performance Research	11.2	10.7	8.1	5.3
Aging Aircraft Human Factors	<u>0.0</u>	<u>0.0</u>	<u>0.8</u>	<u>0.0</u>
Total	<u>77.2</u>	<u>77.1</u>	<u>85.3</u>	<u>94.6</u>

Table 2.10: Staffing Levels for Innovative and Cooperative Research Projects, Fiscal Years 1988-91

In full-time equivalents

<u>Project</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>
FAA/NASA Cooperative Programs	6.5	6.8	8.8	9.3
Joint University Program	0.0	0.0	0.8	1.6
Technology Transfer	0.0	0.0	0.0	1.6
University Fellowship Research Program	0.0	0.0	0.0	10.9
Small Business Innovative Research	0.0	0.0	0.6	1.6
National Aviation Institute	0.0	0.0	0.0	0.0
Transportation Research Board	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Total	<u>6.5</u>	<u>6.8</u>	<u>10.2</u>	<u>25.0</u>

SECTION 3

SCHEDULE INFORMATION ON FAA'S RE&D PROJECTS

Table 3.1: Schedules for RE&D Management and Analysis Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Future System Definition	10/01/87	09/01/92
Management and Control Process	10/01/88	12/01/07
System Concept Definition	10/01/88	09/01/90
RE&D Plan	10/01/87	Continuing
System Requirements	10/01/85	09/01/92
Systems Engineering Management	10/01/77	09/01/97
NAS Development Studies	10/01/87	09/01/89
ASD Program Support	10/01/88	12/01/07
RE&D Advisory Committee	10/01/89	Continuing
Management Initiatives	10/01/87	09/01/91
Support Contract Reduction	10/01/90	09/01/91
AND Program Support	10/01/79	09/01/91
AAS Study	10/01/85	09/01/88

Table 3.2: Schedules for Capacity and Air Traffic Management Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Capacity and Air Traffic Management Technology:		
Surface Traffic Surveillance	10/01/88	09/01/90
Low Altitude Communications and Surveillance	10/01/84	09/01/91
Terminal NASPAC Application	10/01/88	09/01/90
Precision Runway Monitor - Hi Data	04/01/87	09/01/91
Enroute Metering	10/01/77	09/01/88
Wake Vortex Avoidance/Advisory System	10/01/77	09/01/91
Direct User Access	10/01/77	09/01/88
Terminal Airspace Assessment	10/01/88	09/01/89
Sustain ARTS II/IIA	10/01/87	09/01/88
Airport Surface Traffic Automation	10/01/87	09/01/90
Airport Surface Traffic Automation/AMASS	10/01/90	09/01/00
ATC Application of ADS	10/01/84	09/01/91
Advanced Traffic Management	10/01/80	09/01/97
Precision Runway Monitor - Back Antenna	10/01/87	09/01/90
AERA-3	10/01/86	03/01/97
Terminal ATC Automation (TATCA)	10/01/90	Continuing
Terminal ATC Automation	10/01/87	09/01/90
Dynamic Special Use Airspace	10/01/87	09/01/91
Jet Route & Terminal Optimization	01/01/91	09/01/97
Advance Automation System Program Management	10/01/82	09/01/92
ATC Automation Bridge Development	12/01/91	12/01/92
Dynamic Ocean Track System	10/01/90	09/01/94
NASPAC	10/01/88	Continuing
Future Systems Engineering:		
Separation Standards	10/01/77	12/01/97
Aircraft Technology:		
TCAS III Development	10/01/81	09/01/91
TCAS II Implementation	10/01/83	09/01/91
TCAS II Commuter Evaluation	10/01/89	09/01/91
TCAS Deobligation	10/01/89	09/01/89

(continue)

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Synthetic Vision	10/01/90	09/01/91
TCAS I Implementation	10/01/89	09/01/91
TCAS II Development	10/01/83	09/01/89
TCAS III Implementation	10/01/86	09/01/91
Passive TCAS I	10/01/87	09/01/88
Cockpit Display Evaluation	10/01/88	09/01/90
Rotorcraft TERPS	10/01/79	09/01/88
Rotorcraft IFR Operations Evaluation	10/01/77	09/01/91
Rotorcraft Obstruction Avoidance	10/01/87	09/01/91
Rotorcraft ATC Procedures	10/01/87	09/01/91
Special Projects Office Support (Rotorcraft)	10/01/88	09/01/89
Rotorcraft Simulator Standards	10/01/87	09/01/91
Heliport/Vertiport Design	10/01/88	09/01/91
Civil Tiltrotor Application Studies	10/01/88	09/01/90
Rotorcraft Separation Standards	10/01/87	09/01/97
Rotorcraft Display, Control Studies & Certification	10/01/87	09/01/91
Capacity Planning:		
Capacity Development	10/01/77	Continuing
System Capacity Enhancement Planning	10/01/86	Continuing
Airport Capacity Design Team Implementation Planning for Task Force Studies	10/01/81	09/01/97
	10/01/88	09/01/90
Modeling and Simulation:		
National Simulation Lab	10/01/88	09/01/03
Simulation Model Development and Validation	10/01/86	Continuing
Airspace System Models	01/01/90	Continuing

Table 3.3: Schedules for Communications, Navigation, and Surveillance Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Special Surveillance System (S3)	10/01/87	09/01/90
Mode S Integrated Tracker	10/01/88	09/01/92
Communication, Planning, and Design	10/01/77	09/01/91
Rotorcraft Communications	10/01/86	09/01/88
Network Management Control	10/01/87	09/01/90
Instrument Approach Improvement	10/01/86	09/01/90
Mobile Satellite Technology		
Communications	10/01/77	Continuing
NADIN	10/01/77	09/01/91
Data Link Technical Development	10/01/87	09/01/89
MLS ATC Integration	10/01/88	09/01/89
VSCS	10/01/78	09/01/92
Aeronautical Data Link	10/01/78	12/01/03
Communications/Navigation		
Spectrum Planning	10/01/82	09/01/88
GPS Utilization	10/01/87	09/01/91
Navigation Systems Development	10/01/77	12/01/07
Navigation Systems Engineering	10/01/81	09/01/91

Table 3.4: Schedules for Weather Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
WCP Enhancements	10/01/88	12/01/88
Central Weather Processor	10/01/80	09/01/91
Airborne Wind Shear Detection and Avoidance	10/01/86	09/01/91
Advanced Wind Shear Sensor Development	10/01/88	09/01/89
Expanded LLWAS	10/01/87	09/01/91
ATC/Aircraft Wind Shear Information Transfer	10/01/88	09/01/89
Wind Shear Terminal Information Systems Integration	10/01/88	09/01/91
Airborne Wind Shear Advance Technology	10/01/91	09/01/97
Terminal Weather Radar	10/01/83	09/01/92
Weather Radar (NEXRAD)	10/01/80	09/01/90
CWP Interface Development	10/01/87	09/01/92
Aviation Weather Analysis and Forecasting	10/01/90	12/01/01

Table 3.5: Schedules for Airport Technology Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Airport Design, Configuration, and Capacity	10/01/87	09/01/91
Airport Pavement	10/01/77	12/01/03
Runway Exit Advisory System	10/01/87	09/01/90
Handicapped Passenger Assistance	10/01/87	09/01/90
Airport Design & Configuration	10/01/90	Continuing
Airport Safety Planning	06/01/84	Continuing
Airport Surface Visual Control (light)	10/01/80	Continuing
Airport Safety Support System	10/01/77	09/01/91
Terminal/Landside Traffic Modeling	10/01/86	Continuing

Table 3.6: Schedules for Aircraft Safety Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Flight Safety/Atmospheric Hazards	10/01/77	12/01/98
Aircraft Systems Fire Safety	10/01/77	12/01/07
Propulsion/Fuel Systems	10/01/77	09/01/06
Structural Crash Worthiness/ Airworthiness	10/01/77	12/01/99
Aging Aircraft	10/01/88	09/01/97
International Aircraft Operator Database	10/01/89	12/01/98
Cooperative Aircraft Crashworthiness Program	10/01/90	12/09/90

Table 3.7: Schedules for Security Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Explosive Detection	10/01/77	09/01/97
Weapons Detection	10/01/84	09/01/97
Airport Security	10/01/91	09/01/97
Security Systems Integration	10/01/91	09/01/97

Table 3.8: Schedules for Human Factors and Medicine Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Information Transfer and Management	10/01/85	09/01/91
Causal Factors in Accidents	10/01/87	09/01/91
Human Factors Applications	10/01/88	09/01/91
Control & Display Technology	10/01/88	09/01/91
Flight Crew Certification and Training	10/01/88	09/01/91
Intelligent Machine Interface	10/01/87	09/01/88
Expert Systems Applied to ATC	10/01/90	09/01/91
Human Performance Assessment and Improvement	10/01/88	09/01/91
Controller Human Factors	10/01/87	09/01/06
Automated Radar Training	10/01/87	09/01/90
Aircraft Automation	10/01/90	09/01/91
Flight Deck Certification Criteria	10/01/90	09/01/91
Aeromedical Program Support	10/01/77	12/01/07
Protection and Survival	10/01/77	12/01/07
Workforce Optimization Research	10/01/87	09/01/06
Human Performance Research	10/01/87	09/01/99
Aging Aircraft Human Factors	10/01/89	09/01/97

Table 3.9: Schedules for Environment and Energy Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
Aircraft Engine Emissions Reduction and Control	10/01/77	09/01/91
Aviation Fuel Shortage Contingency	10/01/87	10/01/89
Aviation Fuel Conservation	10/01/87	09/01/89
Aircraft Noise Reduction and Environmental Control	10/01/77	12/01/07

Table 3.10: Schedules for Innovative and Cooperative Research Projects

<u>Project</u>	<u>Start date</u>	<u>End date</u>
FAA/NASA Cooperative Programs	10/01/77	Continuing
Joint University Program	10/01/88	Continuing
Technology Transfer	10/01/90	Continuing
University Fellowship Research Program	10/01/90	Continuing
Small Business Innovative Research	10/01/83	Continuing
National Aviation Institute	10/01/90	09/01/91
Transportation Research Board	10/01/88	12/01/07

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