

CONTENTS

	<i>Page</i>
CHAPTER 1: SUMMARY	3
Evaluating Safety in Times of Change	4
Safety Management	5
System Operating Improvements	7
Changes in the Safety System: Industry	12
Changes in the Safety System: FAA	15
FAA Planning and Air Traffic System Management	16
Personnel and Training	17
Technologies To Enhance Safety	18
R&D Management	20
FAA Safety Data Programs	20
CHAPTER 2: AIRLINE ECONOMIC CONTEXT	25
Commercial Air Transportation—Major Changes	25
Growth in the Industry	26
Consolidations	27
Aircraft Acquisition	29
Regional Airlines	29
Shift Away From Open Entry	31
International Ties	32
Operational Changes	32
Hub and Spoke Service	33
Code-sharing	33
Computerized Reservation Systems (CRS)	33
Controlling Costs	34
Profit and Debt Trends	35
Policy Issues Related to Industry Changes	36
Airport Capacity	36
Demand Management	38
Effects of Consolidations on Employees	39
Federal Labor Policy Changes	39
Public Policies Affecting Airline Operations	40
Air Traffic Controller Strike in 1981	40
Federal Budget Cutbacks and FAA Inspection Program	40
Environmental Concerns	41
Conclusions	41
CHAPTER 3: REGULATORY AND INSTITUTIONAL FRAMEWORK	45
How It All Began	45
Air Mail Service	45
Early Safety Initiatives	46
The Beginning of Economic Regulation	47
An Expanding Federal Role	47
Industry Expansion	48
Responding to Industry Growth	48
Airline Deregulation	50
Federal Aviation Safety Structure	52
FAA Responsibility	52
Other Federal Safety Roles	54
FAA Funding	54
Organizational Issues—System Safety Management	54
FAA Regulatory Program	56
The Office of Airworthiness	56
Office of Flight Standards	56
Regulatory Program Issues	58

	<i>Page</i>
Adequacy of FAA Minimum Standards	59
The FAA Rulemaking Process	59
Air Traffic Control Issues	60
FAA Technology Development Issues	61
Manpower and Training Needs	62
Airport Issues and Safety	62
Local Control of Airports	63
Airport Noise	63
Land Use Policies and Airport Capacity	64
Conclusions and Policy Options	65
CHAPTER 4: SAFETY MEASUREMENTS AND DATA RESOURCES	69
Measuring Transportation Safety	69
Safety Factors	69
Exposure Data	70
Nonaccident Safety Data	71
Primary Safety Factors	73
Secondary and Tertiary Safety Factors: Industry Safety Posture	75
Data Resources	77
Federal Safety Data Resources	77
FAA	77
National Transportation Safety Board	84
NASA	85
RSPA	86
Conclusions and Options	87
CHAPTER 5: AVIATION SAFETY DATA ANALYSIS	93
Accident Data	93
Accidents and Fatalities	93
Accident Causes and Types	95
Nonaccident Safety Data	98
Incident Data	98
Air Traffic Incidents	99
General Incidents	102
Accident/Incident Causal Factors	103
Aircraft Capabilities	103
Personnel Capabilities	105
Traffic Environment	105
Management Practices	105
Maintenance	106
Operations	108
Regional/Commuter Airline Operations	109
Employee Selection and Training	110
Management Policies	111
Conclusions and Policy Options	112
CHAPTER 6: HUMAN FACTORS UNCOMMERCIAL AVIATION	117
Human Error	118
Preventing Errors	119
Compensating for Errors	120
Human Factors Data	120
Industry and Federal Roles in Human Factors	121
Growing Concerns	121
Federal Responsibilities	127
Industry Responsibilities	129
Labor's Role	131
Conclusions and Policy Options	131

	<i>Page</i>
CHAPTER 7: AIR TRAFFIC SYSTEM TECHNOLOGIES	135
Elements of the Air Traffic System	135
Models for Evaluating Changes to the Air Traffic System.	135
Airports	137
Airspace	139
The National Airspace System Plan.	139
Air Traffic Control Hardware and Software	140
TRACON Improvements	143
Training Air Traffic Controllers	146
Collision Avoidance Technology	147
Ground Collision Avoidance	148
Communications	150
Navigation	153
Surveillance	154
Weather Technologies and Training	155
Windshear	155
National Weather Service	157
Air Traffic Control Role	157
Weather Research and Development	158
Liability Issues	159
Conclusions and Policy Options	159
CHAPTER 8: AIRCRAFT TECHNOLOGIES	165
Regulation of Aircraft Technologies.	165
Airworthiness	166
Equipment Certification Process	167
Simulators for Pilot and Mechanic Training.	169
The Future of Commercial Aircraft Technology	170
Cockpit Technologies	170
Advanced Materials for Aircraft	171
New Aircraft Engine Types	172
Technologies and Training for Icing.	174
Crash and Fire Safety Technologies	175
Conclusions and Policy Options.	175
APPENDIX A: LIST OF ACRONYMS	179
APPENDIX B: WORKSHOP PARTICIPANTS, REVIEWERS, AND CONTRIBUTORS. ..	180

Boxes

<i>Box</i>	<i>Page</i>
1-A. Commercial Aviation Safety Policy Options	6
2-A. Airport Scheduling Meetings	37
3-A. A Regulatory Enigma: When is a Commuter an Air Carrier and When is it an Air Taxi?	50
3-B. Overview of the FAA Regulatory Program	56
3-C. A Case Study: 747-400 Passenger Exit Doors	57
4-A. Measures of Transportation Safety: Definitions	73
6-A. Air Traffic Control Automation	125

Figures

<i>Figure</i>	<i>Page</i>
1-1. Passenger Fatality Rates for Part 121 Scheduled Airlines	3
1-2. Total Operations at Towered Airports	7
1-3. Air Traffic Activity at Selected Hubs	8
1-4. Air Carrier Near-Midair Collisions	9
1-5. Accident Cause and Prevention Chain	11

<i>Figure</i>	<i>Page</i>
1-6. Part 121 Total and Human Error-Caused Accidents	12
1-7. Average Flight Equipment Maintenance Expense for B727-200 Fleet	14
1-8. Basic In-Flight Rate, B727/JT8D Engines	15
2-1. Scheduled Airline Passengers	27
2-2. Air Traffic Activity at Selected Hubs	28
2-3. Large Aircraft in Commercial Service	29
2-4. Industry Market Share: Revenue Passenger-Miles	30
2-5. Expense Indicators of Major Airlines, 1978-1986: Labor and Maintenance	34
2-6. Net Profits of Major Airlines, 1986	36
4-1. Commercial Aviation Accident Causal and Preventive Factors	72
5-1. Passenger Fatality Rates for Part 121 Scheduled Airlines	93
5-2. Airline Accidents Initiated by Aircraft Equipment Failure	96
5-3. Part 121 Accident Broad Causes and Factors	96
5-4. Air Carrier Near Midair Collisions (1975-87).	100
5-5. operations Per Controller at Towers and Centers	102
5--6. Basic In-flight Shutdown Rate, B727/JT8D Engines	104
5-7. Average Flight Equipment Maintenance Expense for B727-200 Fleet	107
6-1. Part 121 Total and Human Error-Caused Accidents	117
7-1. Air Traffic Control on a Typical Commercial Flight	141
7-2. Locations of Air Route Traffic Control Centers	142
7-3. Terminal Areas Where Radar Coverage is Provided	144
7-4. Locations of TRACONS With ARTS-111A and ARTS-IIIIE Equipment.	145
7-5. Locations of Airport Surface Detection Equipment Radars	150
7-6. Windshear Accidents and Incidents Before and After LLWAS Implementation	158
8-1. Controlled Flight Into Terrain: Descent and Approach Phases of Flight	166

Tables

<i>Table</i>	<i>Page</i>
1-1. Commercial Aviation Accident and Fatality Rates	5
1-2. Part 121 Accident Causes	10
1-3. Qualifications of New-Hire Commercial Flight Crews	14
1-4. Selected FAA Employee Totals (1978-87)	17
2-1. Commercial Aviation Traffic Statistics, 1986	16
2-2. Regional Airline Revenue Passenger-Miles	30
2-3. Percentage of Passengers Enplaned by Airlines at Selected U.S. Airports	32
3-1. Selected FAA Employee Totals, 1978-87	52
4-1. Safety Measures and Exposure Parameters	71
4-2. Federal Aviation Safety Databases	78
5-1. Commercial Aviation Accident and Fatality Totals, 1975-1987	94
5-2. Commercial Aviation Accident and Fatality Rates	94
5-3. Accident Categories	97
5-4. Part 121 Fatal Accidents, 1975-86	97
5-5. Part 121 Total Accidents, 1982-1985	98
5-6. Commercial Aircraft Midair Collisions	99
5-7. Qualifications of New-Hire Commercial Flight Crews	110
6--1. Significant Jetliner Accident Causes in 93 Major Accidents Worldwide (1977-1984)	117
7-1. Status of Major National Airspace System (NAS) Plan Projects	140