



AIR Transportation

THIRTEENTH EDITION

OVER
30
YEARS
IN PRINT!

Instructional CD-ROM Enclosed

Robert M. Kane

AIR Transportation

THIRTEENTH EDITION

Robert M. Kane



KENDALL/HUNT PUBLISHING COMPANY
4050 Westmark Drive Dubuque, Iowa 52002

Front cover image © 1998 PhotoDisc, Inc.
Back cover photo shows AIRFORCE I over Mt. Rushmore.

Copyright © 1967, 1969, 1971, 1974, 1975, 1977, 1979, 1982, 1987
by Robert M. Kane and Allan D. Vose

Copyright © 1990, 1993, 1996, 1999 by Robert M. Kane

Library of Congress Catalog Card Number: 98-75329

ISBN 0-7872-5583-1

All rights reserved. No part of this publication may be reproduced,
stored in a retrieval system, or transmitted, in any form or by any
means, electronic, mechanical, photocopying, recording, or otherwise,
without the prior written permission of the copyright owner.

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

*Dedicated in loving memory to my wife, Georgia,
for her constant love and support.*

Preface

Air Transportation has been in continuous publication by the original author since 1967, and it is now being used by a third generation of students. The continuous acceptance and use of this textbook may be attributed to the basic purpose determined by the author in 1967. That purpose was, and continues to be, to provide a text with the needs of the classroom teacher and the students in mind. The author well remembers being a student in classrooms as well as standing at the front of classes for thirty years as a college professor.

The new thirteenth edition of *Air Transportation* continues this basic premise. Obsolete material has been deleted or combined with relevant subject material so as not to be lost entirely, but to be saved as historical information. The current conditions of the industry are discussed along with expectations for the future as reflected in the Federal Aviation Administration ten year forecast.

The author does not believe that opinion, speculation, or discussion of current events should enter into this text. Discussion of current issues that influence the air transportation industry should take place in the classroom using the textbook as a basis for such discussion.

The author hopes that this textbook will encourage the reader to make a more complete study into any of the various facets of air transportation that are highlighted in this comprehensive presentation of the industry.

Robert M. Kane

For I dipped into the future, far as human eye can see
Saw the vision of the world, and all the wonder that would be;
Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight, dropping down with costly bales.

From "Locksley Hall" by Tennyson who foresaw air transportation before
the advent of the airplane.

Acknowledgements

.....

Grateful acknowledgments are made to the many individuals who supplied resource material as well as personnel of the following air transportation organizations at the governmental, corporate, and private levels.

- Federal Aviation Administration
- Department of Transportation
- National Transportation Safety Board
- Air Transportation Association of America
- International Air Transport Association
- International Civil Aviation Organization
- Airports Council International
- General Aviation Manufacturers Association
- Aerospace Industries Association
- National Air Transport Association
- The Boeing Company
- Airbus Industrie
- Cessna Aircraft Company
- Piper Aircraft Company

A special thank you to Eric Smith, computer wizard, who created the program to run the CD-ROM which is included on the back cover of this text.

Acknowledgment is extended to the students for whom this text is prepared. It is hoped that they will find the subject of air transportation interesting and fascinating.

.....

Features of the Thirteenth Edition

.....

- New Look—the interior of the book has been reformatted to provide a user-friendly page layout that will invite instructors and students into the content.
- Call-outs highlight textual material of important historical significance.
- Boxes focus on vignettes that are pertinent to textual information within chapters.
- Tables, charts, and graphs provide the latest statistical data for various aspects of aviation.
- Photos have been added to illustrate aviation from its beginnings to present times.
- Writing style is non-technical, gender-neutral, and easy-to-read.
- CD-ROM included in the back of this textbook is a CD-ROM that outlines the chapters and provides additional aviation information. Complete installation instructions are given on the last page of the book facing the back cover. We suggest that you install the CD-ROM and preview it.

There are several unique features on the CD-ROM that will draw you into this subject:

- The opening page audio of a jet flyby.
- At the end of the Introduction is a photo of the author during WWII.
- Video clips in Chapter 3 are WWII airplanes and Lindberg's takeoff.
- Video clips in Chapter 9 are airplane crashes.
- Tower talk audio in Chapter 8 demonstrates what pilots hear from the control tower.
- Cessna audio clip in Chapter 26 is the sound of a Cessna engine.

Organization of Text

AIR TRANSPORTATION is organized into five parts. Each part and chapter therein is intended to be complete within itself to allow for ease of reference and to allow instructors to teach the material in the order they prefer.

- Part One HISTORICAL AND PRESENT STATUS OF AIR TRANSPORTATION presents the history of air transportation and therefore few updates are required.
- Part Two REGULATION OF AIR TRANSPORTATION presents the various regulations that govern the air transportation industry. This part is updated significantly to provide current information about various aspects of the regulatory agencies.
- Part Three ADMINISTRATION OF AIR TRANSPORTATION is updated throughout the chapters. Chapter 18 is new and includes the latest forecasts for the future of aviation.

- Part Four AIRCRAFT is extensively updated with new data, and Chapter 19 has been completely rewritten.
- Part Five GENERAL AVIATION is rewritten to include the latest statistics about the general aviation aspect of air transportation along with new chapters on Cessna and Piper aircraft.
- Appendices—material consisting of organizations and memberships in aviation has been relocated to appendices to provide an organized section for quick access to this information.
 - A—Aviation Associations and Organizations
 - B—International Air Transport Association Membership List
 - C—Airport Council International Membership List
 - D—International Aviation Authorities
- Glossary—is updated to include new terminology included in this edition.
- Index—provides quick access for locating information throughout the text.

Brief Contents

Contents	vii
Preface	xiii
List of Illustrations	xix
List of Tables	xxiii

Part 1

Historical and Present Status of Air Transportation

1. The Importance of Air Transportation 3
2. Man's Efforts to Fly 29
3. Development of the Airplane 43
4. The Beginning of Commercial Air Transportation 93
5. The Air Carrier Industry and Federal Legislation 103
6. Department of Transportation 149

Part 2

Regulation of Air Transportation

7. The Federal Aviation Administration 195
8. Aviation Safety and the National Transportation Safety Board 223
9. Aviation Accident Investigation and Safety Performance 247
10. Air Carrier Economic Regulations 291
11. Air Carriers 317
12. International Air Transportation Law 357

13. International Air Transportation Organizations 377

Part 3

Administration of Air Transportation

14. Air Carrier Management and Organization 407
15. Air Carrier Marketing 425
16. Air Carrier Accounting and Financial Analysis 441
17. Legal Aspects of Air Transportation 459
18. Aviation Industry Performance and Forecasts 475

Part 4

Aircraft

19. Aircraft Performance 499
20. The Boeing Company 511
21. The McDonnell Douglas Corporation 557
22. The Lockheed Martin Corporation 583
23. Airbus Industrie 595
24. Space Plane 613

Part 5
General Aviation

.....

- 25. General Aviation 625
- 26. Cessna 647
- 27. Piper 651

Appendices

.....

- A. Aviation Associations and
Organizations 655
- B. International Air Transport Association 659
- C. Airports Council International Membership
List 677
- D. International Aviation Authorities 695

Glossary 705

Index 729

CD-ROM (Inside back cover)

Contents

Part 1 **Historical and Present Status of** **Air Transportation**

1. The Importance of Air Transportation 3

- The Importance of Air Transportation 5
- Economic 5
- Manufacturing 7
- Commercial Air Transportation 9
- General Aviation 13
- Social 13
- Political 15
- War Air Service Program (WASP) 16
- The Civil Reserve Air Fleet (CRAF) 16

2. Man's Efforts to Fly 29

- Leonardo da Vinci 33
- Development of the Lighter-than-Air-Ship 37
- The Dirigible 38

3. Development of the Airplane 43

- George Cayley 44
- William Henson and John Stringfellow 44
- Jean-Marie Le Bris 46
- Francis Wenham 47
- Alphonse Penaud 48
- H. F. Phillips 48
- Clement Ader 49
- Hiram Maxim 52

- Otto Lilienthal 54
- Percy Pilcher 57
- John J. Montgomery 59
- Octave Chanute 59
- Samuel P. Langley 61
- The Wright Brothers 65

4. The Beginning of Airmail and Commercial Air Transportation 93

- The First Experimental Airmail Route 95
- Permanent Civilian Airmail 98

5. The Air Carrier Industry and Federal Legislation 103

- Airmail Act of 1925 (The Kelly Act) 104
- Air Commerce Act of 1926 106
- Airmail Act of 1930 (McNary-Watres Act) 107
- Airmail Act of 1934 (Black-McKellar Act) 112
- Civil Aeronautics Act of 1938 (McCarran-Lea Act) 114
- The Federal Aviation Act—1958 116
- Civil Aeronautics Board 125
- Federal Airport Act of 1946 126
- Airport and Airway Development Act of 1970 (Airport Development Aid Program) 128
- Airport Improvement Program 129
- Airline Deregulation Act of 1978 130
- Deregulation 131
- Regional/Commuter Airline Industry 140

What Remains Regulated 143

Department of Transportation Act—
1966 147

International Air Transportation
Competition Act of 1979 147

6. Department of Transportation 149

Organizations of the Department of
Transportation 150

Regional Representatives 157

United States Coast Guard 158

Federal Aviation Administration 162

Federal Highway Administration 165

Federal Railroad Administration 169

National Highway Traffic Safety
Administration 170

Federal Transit Administration 173

Saint Lawrence Seaway Development
Corporation 177

Maritime Administration 178

Research and Special Programs
Administration 180

Materials Transportation Bureau 180

Transportation Systems Center 182

Office of Emergency
Transportation 183

Office of Program Management and
Administration 184

Bureau of Transportation
Statistics 184

National Transportation Policy 185

Intermodal Surface Transportation
Efficiency Act of 1991 192

Part 2

Regulation of Air Transportation

.....

7. The Federal Aviation Administration 195

Federal Aviation Administration 200

The Administrator 200

The Deputy Administrator 202

Associate Administrators 209

8. Aviation Safety and the National Transportation Safety Board 223

Aviation Regulation 223

Air Traffic Control (ATC) 230

The National Transportation Safety
Board (NTSB) 237

9. Aviation Accident Investigation and Safety Performance 247

Aircraft Accident Investigation 250

Accident Category Changes 270

Sources of Accident Information 271

Aviation Accidents and Safety
Performance 271

Aviation Economics 273

Aviation Transportation Fatalities 274

10. Air Carrier Economic Regulations 291

Deregulation 291

Economic Regulations Administered
by the Department of
Transportation 296

Description of Regulatory
Functions 296

Tariffs, Fares, and Rates 302

International Aviation Relations 304

Essential Air Service Program 305

Antitrust Matters and Unfair Methods
of Competition 307

Consumer Protection 307

Data Collection and
Dissemination 309

Employee Protection Program 311

Rulemaking, Litigation, Enforcement,
and Legal Counsel 311

	Formal Proceedings Requiring Oral Evidentiary Hearings	313
	Documentary Services	314
11.	Air Carriers	317
	Reclassification of Air Carrier Groups	330
	The Air Carrier Industry	334
	Economics of Air Carrier Routes	339
	The Air Transport Association of America (ATA)	346
12.	International Air Transportation Law	357
	Conferences and Conventions	357
	Outcomes of Chicago Conference— 1944	363
	International Deregulation	367
	The United States Policy on International and Foreign Air Transportation	368
	United States Policy for the Conduct of International Air Transportation Negotiations (August 21, 1978)	370
	Free Trade	375
	Bibliographic Note	376
13.	International Air Transportation Organizations	377
	International Civil Aviation Organization	377
	Office of the Secretary General	380
	Council of ICAO	381
	Air Navigation Bureau	381
	Air Transport Bureau	381
	Technical Cooperation Bureau	384
	Legal Bureau	384
	Bureau of Administration and Services	384
	International Air Transport Association (IATA)	387

Core Functions of IATA	391
Industry Coordination Activities	393
Self-Financing Services	395
IATA Education Programs	398
Airports Council International	399

Part 3

Administration of Air Transportation

.....

14.	Air Carrier Management and Organization	407
	Principles of Air Carrier Management	408
	Characteristics of Air Carriers	412
	Air Carrier Organization	417
	Staff Departments	418
	Line Departments	420
	Sales and Marketing	420
	Operations	421
	Subcontractors	423
	Summary	423
15.	Air Carrier Marketing	425
	Product	427
	Place	429
	Air Carrier Distribution Channels	429
	Promotion	430
	Price	432
	Demand	433
	Supply	439
16.	Air Carrier Accounting and Financial Analysis	441
	Balance Sheet	443
	Profit and Loss	444
	Reporting System	446
	Financial Analysis	451

17. Legal Aspects of Air Transportation	459
National Supremacy in Air Space	459
Airports and Liability	460
Damages and Injuries on Ground	461
Liability to Passengers and Others	461
Tariffs—Limitation of Liability	463
Workmen's Compensation—Limitation of Liability	464
Warsaw Convention—Limitation of Liability	464
Airline Mutual Insurance (AMI)	465
Liability of Manufacturers and Repairs	466
Product Liability and General Aviation	466
General Aviation Revitalization Act	469
Taxpayer Relief Act of 1997	472
18. Aviation Industry Performance and Forecasts	475
Industry Performance	475
Scheduled Passenger Traffic and Capacity	476
Nonscheduled Traffic and Capacity	479
Air Cargo Traffic	480
Industry Structure	480
Market Changes	481
Jet Fuel Prices	482
Passenger Trip Length	482
Passenger Load Factor	482
Air Carrier Forecasts	483
Revenue Passenger Miles	485
Passenger Enplanements	486
Regionals/Commuters	487
Industry Summary	488

Revenue Passenger Enplanements	488
Revenue Passenger Miles	489
Industry Composition	490
Average Aircraft Size	491
Passenger Trip Length	492
Passenger Load Factor	493
Regional/Commuter Forecasts	493
Revenue Passenger Enplanements	495
Revenue Passenger Miles	495

Part 4 Aircraft

.....

19. Aircraft Performance	499
Fleet Planning	500
Air Carrier Fleet	501
Average Aircraft Size	501
Airborne Hours	507
Regional/Commuter Fleet	507
Flight Hours	509
20. The Boeing Company	511
The 727	522
Boeing Model 737 Short- to Medium-Range Jetliner	523
The Boeing 747	529
747-400 Performance Summary	530
The Boeing 757-200	535
The Boeing 757-300	538
The Boeing 767	540
Boeing 757-300 Specifications	541
767 Specifications	543
The Boeing 777	545
767—Basic Specifications	546
Boeing 777	550
Boeing 717	554
Boeing 717 Specifications	555

- 21. The McDonnell Douglas Corporation 557**
 The DC-8 562
 DC-8 Configuration and Performance Data 562
 DC-8 (Retrofitted) 563
 DC-9 Configuration and Performance Data 565
 McDonnell Douglas DC-10 Jetliner 566
 DC-10 Configuration and Performance Data 569
 The MD-80 571
 McDonnell Douglas MD-80 Technical Specifications 572
 McDonnell Douglas MD-90 Background Information 575
 McDonnell Douglas MD-90 Technical Specifications 576
 McDonnell Douglas MD-11 Background Information 578
 McDonnell Douglas MD-11 Technical Specifications—1996 Level 578
 McDonnell Douglas MD-11 Combi, Freighter and Convertible Freighter 580
 MD-95 582
- 22. The Lockheed Martin Corporation 583**
 L-1011 Tristar 585
 The Skunk Works 589
 Lockheed Martin F-117A Stealth Fighter 592
 Twenty-First Century Space Transportation System X-33 and VentureStar™ 594

23. Airbus Industrie 595

- A319 600
 A320 601
 A321 602
 A310 603
 A300-600 604
 A300-600F 605
 A330/A340 606
 A330 607
 A340-200 608
 A340-300 609
 A3XX 611

24. Aerospace Plane 613

- X-33 and the Reusable Launch Vehicle AdventureStar 614
 Technology Transfer 621

Part 5

General Aviation

.....

25. General Aviation 625

- Ownership Cost Factors 629
 Active Aircraft 630
 Use of Aircraft 631
 Aircraft Utilization 632
 Pilots 634
 Hours Flown 637
 Revitalization of an Industry 637
 Optimism in the Industry 637
 Operations 639
 General Aviation Forecasts 639
 Federal Aviation Administration Programs and Initiatives 641
 General Aviation Policy Statement 644

26. Cessna 647

27. Piper 651

Appendices



A. Aviation Associations and Organizations 655

B. International Air Transport Association
 Membership List 659

C. Airports Council International
 Membership 677

D. International Aviation Authorities 695

Glossary 705

Index 729

CD-ROM (Inside back cover)

List of Illustrations

- 1.1 Net Profit after Taxes 8
- 1.2 Airline vs. Consumer Prices 9
- 1.3 Traffic Growth Rates 10
- 2.1 Ancient Attempts at Flight 30–31
- 2.2 Early Flight Machines 32
- 2.3 Leonardo da Vinci's Sketches 34
- 2.4 Manuscript Drawing of Flying Machine, Leonardo da Vinci (1452–1519) 35
- 2.5 Leonardo da Vinci's Sketches of Muscle-Powered Flying Machines 36
- 2.6 Joseph and Etienne Montgolfier 37
- 2.7 Balloon Launch 37
- 2.8 Blanchard's Flight from Philadelphia 38
- 2.9 Ferdinand von Zeppelin 39
- 2.10 The *Macon* 40
- 2.11 *Hindenburg* Crash 41
- 3.1 Sir George Cayley 44
- 3.2 Cayley's Aerial Carriage 44
- 3.3 William Samuel Hensen and John Stringfellow 45
- 3.4 Henson's Aerial Steam Carriage 45
- 3.5 Jean-Marie Le Bris Albatross 47
- 3.6 Francis Herbert Wenham 47
- 3.7 Stringfellow's Triplane 48
- 3.8 Alphonse Penaud 48
- 3.9 Early Experiments in Flight—1670 to 1880 50–51
- 3.10 Clement Ader 49
- 3.11 Ader's Avion III 52
- 3.12 Edison's Ornithopter 52
- 3.13 Maxim's Steam Engine 53
- 3.14 Otto Lilienthal 54
- 3.15 Flights by Lilienthal 56
- 3.16 Pilcher's Hawk 57
- 3.17 Advertisement for the Montgomery Aeroplane 58
- 3.18 Octave Chanute 59
- 3.19 Katydid 60
- 3.20 Manly and Langley 60
- 3.21 Drawing of Langley's Aerodrome 61
- 3.22 Drawing of Manly's Engine 62
- 3.23 Launching the Aerodrome 63
- 3.24 "The Washington Star" Report 64
- 3.25 The Rebuilt Langley Aerodrome 65
- 3.26 The Wright Brothers and Their Flyer 67
- 3.27 Drawings of the Wright Brothers' Flying Machine-Patent Application 68
- 3.28 Taylor's Engine 69
- 3.29 The Wright Cycle Shop 70
- 3.30 First Fatality in a Crash 71
- 3.31 The Wright Flyer 73
- 3.32 Glenn Curtiss in his *June Bug* 73
- 3.33 Early Aircraft Designs 74–77
- 3.34 The *June Bug* 78
- 3.35 Eugene Ely—First Flight from a Ship 78
- 3.36 Roland Garros 79
- 3.37 Alberto Santos Dumont, 14 BIS, France 1906 79
- 3.38 Cal Rogers 80
- 3.39 Harriet Quimby 81
- 3.40 Arch Hoxsey 81
- 3.41 Wilbur Wright and Harriet Quimby 81