



MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(AUTONOMOUS INSTITUTION – UGC, GOVT. OF INDIA)

**B.Tech
Aeronautical
Engineering**

DEPARTMENT OF AERONAUTICAL ENGINEERING



AIRLINE AND AIRPORT MANAGEMENT

**Prepared by:
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Department of ANE**

AIRLINE AND AIRPORT MANAGEMENT



DIGITAL NOTES

**B.TECH (R-22 Regulation)
(IV YEAR – I SEM)
(2025-26)**

DEPARTMENT AERONAUTICAL ENGINEERING



MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

Recognized under 2(f) and 12 (B) of UGC ACT 1956

(Affiliated to JNTUH, Hyderabad, Approved by AICTE - Accredited by NBA & NAAC – 'A' Grade - ISO 9001:2015 Certified)
Maisammaguda, Dhulapally (Post Via. Hakimpet), Secunderabad – 500100, Telangana State, India

MRCET VISION

- To become a model institution in the fields of Engineering, Technology and Management.
- To have a perfect synchronization of the ideologies of MRCET with challenging demands of International Pioneering Organizations.

MRCET MISSION

To establish a pedestal for the integral innovation, team spirit, originality and competence in the students, expose them to face the global challenges and become pioneers of Indian vision of modern society.

MRCET QUALITY POLICY

- To pursue continual improvement of teaching learning process of Undergraduate and Post Graduate programs in Engineering & Management vigorously.
- To provide state of art infrastructure and expertise to impart the quality education

PROGRAM OUTCOMES

(PO's)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.
12. **Life- long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF AERONAUTICAL ENGINEERING

VISION

Department of Aeronautical Engineering aims to be indispensable source in Aeronautical Engineering which has a zeal to provide the value driven platform for the students to acquire knowledge and empower themselves to shoulder higher responsibility in building a strong nation.

MISSION

The primary mission of the department is to promote engineering education and research. To strive consistently to provide quality education, keeping in pace with time and technology. Department passions to integrate the intellectual, spiritual, ethical and social development of the students for shaping them into dynamic engineers.

QUALITY POLICY STATEMENT

Impart up-to-date knowledge to the students in Aeronautical area to make them quality engineers. Make the students experience the applications on quality equipment and tools. Provide systems, resources and training opportunities to achieve continuous improvement. Maintain global standards in education, training and services.

PROGRAM EDUCATIONAL OBJECTIVES – Aeronautical Engineering

1. **PEO1 (PROFESSIONALISM & CITIZENSHIP):** To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, ecological and economic issues.
2. **PEO2 (TECHNICAL ACCOMPLISHMENTS):** To provide knowledge based services to satisfy the needs of society and the industry by providing hands on experience in various technologies in core field.
3. **PEO3 (INVENTION, INNOVATION AND CREATIVITY):** To make the students to design, experiment, analyze, and interpret in the core field with the help of other multi disciplinary concepts wherever applicable.
4. **PEO4 (PROFESSIONAL DEVELOPMENT):** To educate the students to disseminate research findings with good soft skills and become a successful entrepreneur.
5. **PEO5 (HUMAN RESOURCE DEVELOPMENT):** To graduate the students in building national capabilities in technology, education and research

PROGRAM SPECIFIC OUTCOMES – Aeronautical Engineering

1. To mould students to become a professional with all necessary skills, personality and sound knowledge in basic and advance technological areas.
2. To promote understanding of concepts and develop ability in design manufacture and maintenance of aircraft, aerospace vehicles and associated equipment and develop application capability of the concepts sciences to engineering design and processes.
3. Understanding the current scenario in the field of aeronautics and acquire ability to apply knowledge of engineering, science and mathematics to design and conduct experiments in the field of Aeronautical Engineering.
4. To develop leadership skills in our students necessary to shape the social, intellectual, business and technical worlds.

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

IV Year B. Tech, ANE-II Sem

(R22A2139) AIRLINE AND AIRPORT MANAGEMENT (PROFESSIONAL ELECTIVE – V)

Objectives:

To understand and acquire a sound understanding on basic management aspect of airport and airlines system such as airports layout, air traffic control, landing procedure, scheduling, flight planning and other economic and commercial activities.

UNIT I

AIRPORTS AND AIRPORT SYSTEMS

Introduction-Airport Management on an international level- Rules that govern airport management- Organization and administration Airport ownership and organization , responsibilities of Airport manager .Components of an airport-The airfield-Navigation aids(NAVAIDS)located on airfields-Air traffic Control and surveillance facilities located on the airfield.

UNIT II

AIRPORT OPERATIONS MANAGEMENT: Airspace and air traffic management, Airport operations management under FAR Part 139, Airport terminals and ground access, Airport security and Administration -Security at commercial service airports-Security at general aviation airports.

UNIT III

AIRPORT ADMINISTRATION AND FINANCIAL MANAGEMENT ,CAPACITY AND DELAY

concept of Airport planning and financial accounting-Revenue strategies at commercial airports-Pricing of airport facilities and services, , The future of airport management.

Defining capacity-Factors affecting capacity and delay-estimating capacity-Simulation Models- Defining delay-Estimating delay-Analytical estimates of delay.

UNIT IV

INTRODUCTION TO AIRLINE PLANNING: Structure of Airline Industry (Domestic & International)-Growth and Regulation-Deregulation-Major and National Carriers-Regional Carriers-Economic characteristics of the Airlines Airline Planning Process-Airline Terminology and Measures: airline demand, airline supply, average load factor, unit revenue, Airline Planning Decisions

UNIT-V

FLEET PLANNING AND ROUTE EVALUATION: Factors in Fleet Planning-Hub-and-Spoke System-Technical Aspects-Fleet Rationalization-Fleet Commonality-Long Range Aircraft-Noise Restrictions-Factors in Design and Development-Fleet Planning Process; Route Evaluation in Hub Networks-Route profitability estimation issues-Demand Driven Dispatch.

Text Books

1. Airport Planning and Management 6/E 0006 Edition by Young Seth, Mc GRAW Hills.
2. Airport Management by Ravindran P.C.K, Asian Law House.
3. Air Transportation: A Management Perspective (Fifth Edition) by Alexander T.Wells and John G.Wensveen, Brooks Cole,2003

1. Airport Systems: Planning, Design and Management by Recharde De Neufville Tata Mc Graw Hills.
2. Airline Marketing and Management by Stephen Shaw, Ashgate Publishing, 2004
3. Airline Management, by Peter P Belobaba MIT Open Courseware Lecture Notes, 2006

Outcomes:

- Understand the functioning of the airline industry.
- Focus on the underlying marketing, financial, operational and competitive factors that influence airline viability..
- Investigate how the sensitivity of airline profitability impacts airline management decisions
- Analyze the principles of airline economics, costs and pricing.
- The student and assess the individual characteristics of low-cost carriers and business only airlines.

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY**(Autonomous Institution – UGC, Govt. of India)****IV B.Tech- II Semester Advance Supplementary Examinations, August 2021****Airport Management****(AE)**

Roll No									
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Time: 3 hours**Max. Marks: 70**

Answer Any **Five** Questions
All Questions carries equal marks.

- 1 What is the importance of advisory circulars in airport management? List out the ten advisory circulars in the 150 series. [14M]

- 2 Explain about the following
 - i. Very-High frequency Omnidirectional range radio beacons. [7M]
 - ii. GPS local area Augmentation systems [7M]

- 3 List the technologies that are considered to apply biometrics to the airport security environment and share your views on the future security systems at airports. [14M]

- 4
 - i. What is the organizational structure of the transportation security administration? [7M]
 - ii. What are the various security sensitive areas found at airports, as per the Transportation security regulations? [7M]

- 5
 - i. Write step-by-step procedure for snow removal. [7M]
 - ii. what does the typical snow and ice control plan include? [7M]

- 6 Establish a checklist designed for operators at airports for
 - i. Runways [7M]
 - ii. Fuelling facilities [7M]

- 7
 - i. What is Airport Improvement Program, what are its benefits? [7M]
 - ii. Discuss about the general obligation bonds & General airport revenue bonds. [7M]

- 8 Explain about the two accepted simulation models to estimate airport capacity. [14M]

Code No: **R15A2130****MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY**

(Autonomous Institution – UGC, Govt. of India)

IV B. Tech II Semester Regular Examinations, April/ May 2019**Airline and Airport Management**

(AE)

Roll No									
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Time: 3 hours**Max. Marks: 75****Note:** This question paper contains two parts A and B

Part A is compulsory which carries 25 marks and Answer all questions.

Part B Consists of 5 SECTIONS (One SECTION for each UNIT). Answer FIVE Questions ,
Choosing ONE Question from each SECTION and each Question carries 10 marks.

PART-A (25 Marks)

- 1). a What is the purpose of an organization chart? [2M]
- b What specific rules and regulations are used to operate airports? [3M]
- c What is the mobile lounge concept? [2M]
- d How are runways identified on an airfield? [3M]
- e What are the different types of budget strategies found at airports? [2M]
- f What are the primary differences between the residual cost approach and compensatory approach? [3M]
- g What is airline demand and airline supply? [2M]
- h Describe an airline fleet. [3M]
- i Why is payload/range curve is most important in studying performance characteristics? [2M]
- j Write the difference between Top-down and Bottom-up Fleet Planning [3M]

PART-B (50 MARKS)**SECTION-I**

- 2 What are the different hub classifications described in the NPIAS? [10M]

OR

- 3 What are the principal duties of a typical airport manager at a medium size commercial airport? [10M]

SECTION-II

- 4 What types of taxiways exist on an airfield? Explain. [10M]

OR

- 5 What are MPOs? What authority do MPO's have over airport ground access? [10M]

SECTION-III

- 6 What is biometrics? What are some of the technologies that are considered to apply biometrics to the airport security environment? [10M]

OR

- 7 How does airport security differ between commercial service airports and general aviation airports? [10M]

SECTION-IV

- 8 Explain the structure of airline industry at domestic and international level. [10M]

OR

- 9 How do runway configurations affect capacity and delay? [10M]

SECTION-V

10 Explain about the hub and spoke system in fleet planning. [10M]

OR

11 What are the objectives of Air Transportation Systems on airline fleet planning? [10M]

UNIT-1

AIRPORTS AND AIRPORT SYSTEMS

It is often said that managing an airport is like being mayor of a city. Similar to a city, an airport is comprised of a huge variety of facilities, systems, users, workers, rules, and regulations. Also, just as cities thrive on trade and commerce with other cities, airports are successful in part by their ability to successfully be the location where passengers and cargo travel to and from other airports. Furthermore, just as cities find their place as part of its county's, state's, and country's economy, airports, too, must operate successfully as part of the nation's system of airports.

The airport forms an essential part of the air transport system because it is the physical site at which a modal Transfer is made from the air mode to the land mode or vice versa It is the point of interaction of the three major components of the air transport system. The airport, including its commercial & operational concessionaires, tenants and partners, plus. These discussion purposes, the airways control system.

- The airline
- The user

The interaction among these three major components must be made to have successful rate and planning and operation is also must. To operate well, each should reach some form of equilibrium with the other two.

Function of the airport:

An airport is either an intermediate or terminal point for an aircraft on the air portion of a trip. In simple functional terms the facility must be designed to enable an a/c to land & take off In b/w their two operations, the aircraft may, if required, unload and load payload & crew & be serviced Airport operations are divided into airside & land side functions. After approach and landing an aircraft uses the runway, taxiway and apron prior to docking at a Packing position, where its payload is processed through the terminal to the access system. The airport passenger and freight terminals are themselves facilities that have three distinct functions.

Change of mode: To provide linkage b/w the air vehicle of the surface vehicle designed to accommodate the operating characteristics of the vehicles on landside & airside respectively.

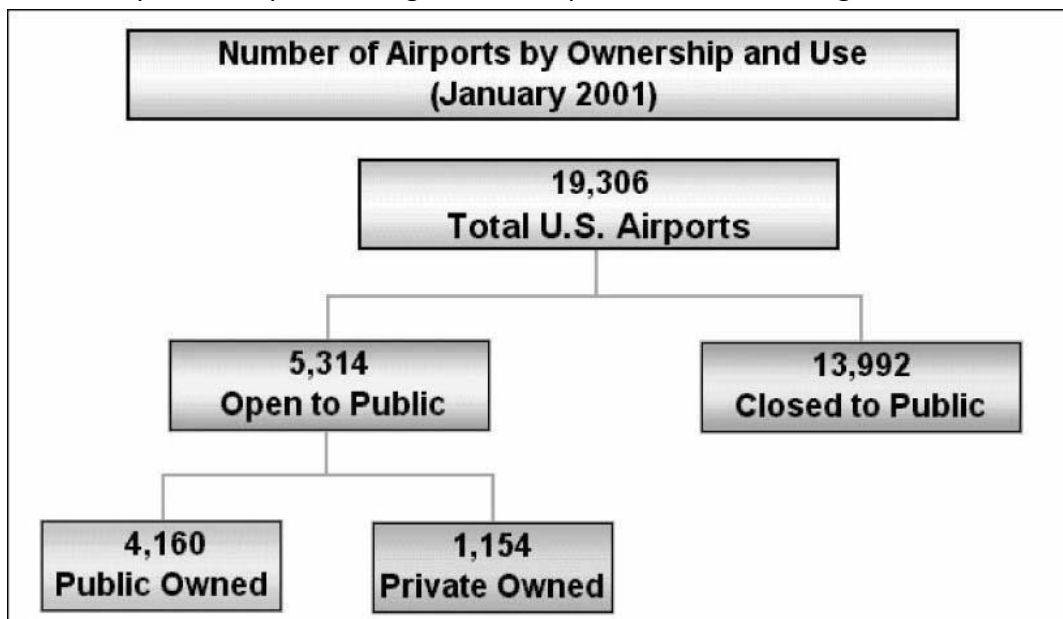
Processing: To provide the necessary facilities for ticketing, documentation and control of passengers and freight.

Change of movement type: To convert continual shipments of freight by trucks of departing passengers by car, bus, taxi & train to aircraft sized batches that generally depart according to a preplanned schedule or to reverse this process for arriving aircraft. Airports of a significant size must have an organization that can either supply or administer the following Faculties

Airports in the United States—An overview

The United States has by far the greatest number of airports in the world. More than half the world's airports and more than two-thirds of the world's 400 busiest airports are located in the United States. There are more than 19,000 civil landing areas in the United States, including heliports, seaplane bases, and "fixed-wing" landing facilities. Most of these facilities are privately owned, and for private use only. Such facilities include helipads operated at hospitals and office buildings, private lakes for seaplane operations, and, most common, small private airstrips that accommodate the local owners of small aircraft operations. Many of these facilities are nothing more than a cleared area known as a "grass strip."

There are approximately 5,400 airports that are open for use to the general public. Of these, approximately 4,150 are equipped with at least one paved and lighted runway. Of the 5,400 public-use airports in the United States, approximately 4,200 are publicly owned, either by the local municipality, county, state, or by an "authority" made up of municipal, county, and/or state officials. The remaining 1,200 are privately owned, either by individuals, corporations, or private airport management companies, see below. Fig.



Airports are often described by their levels of activity.

The activities,

1. services,
2. investment levels vary greatly among the nation's airports.
3. The most common measures used to describe the level of activity at an airport are the number of passengers served, the amount of cargo carried, and the number of operations performed at the airport.

Specifically, the term **enplanements** (or *enplaned passengers*) is used to describe the number of passengers that board an aircraft at an airport. Annual enplanements are often used to measure the amount of airport activity, and even evaluate the amount of funding to be provided for improvement projects. The term **deplanements** (or *deplaned passengers*) is used to describe the number of passengers that deplane an aircraft at an airport. The term *total passengers* is used to describe the number of passengers that either board or deplane an aircraft at an airport. At many airports, the number of total passengers is roughly double the number of annual enplanements.

Cargo activity is typically used to measure the level of activity at airports that handle freight and mail. Airports located near major seaports, railroad hubs, and large metropolitan areas, as well as airports served by the nation's cargo carriers (such as FedEx and UPS) accommodate thousands of tons of cargo annually.

The number of **aircraft operations** is used as a measure of activity at all airports, but is the primary measure of activity at general aviation airports. An aircraft operation is defined as a takeoff or a landing. When an aircraft makes a landing and then immediately takes off again, it is known as a "touch and go" and is counted as two operations. This activity is common at many general aviation airports where there is a significant amount of flight training. When an aircraft takes off and lands at an airport without landing at any other airport, the aircraft is said to be performing **local operations**. An **itinerant operation** is a flight that takes off from one airport and lands at another.

Another, albeit, indirect measure of airport activity is identified by the number of aircraft "based" at the airport. A **based aircraft** is an aircraft that is registered as a "resident" of the airport. The number of based aircraft is used to indirectly measure activity primarily at smaller airports where private "general" aviation is dominant. At airports that primarily handle the air carriers, relatively few aircraft are actually based. In general, airport management measure the activity levels of their airports on the basis of all levels of passenger, cargo, operations, and based aircraft activity; virtually all airports, especially the largest airports in the nation, accommodate passengers and cargo, as well as air carrier and private aircraft operations.

Airport as an Operational system

1. Private airports and public use airports.

Airport planning is a systematic process used to establish guidelines for the efficient development of airports that is consistent with local, state & national goals. Key object of airport planning is to assure the effective use of airport resources in order to satisfy aviation demand in a financially feasible manner.

1. National system planning.

2. State airport system planning
3. Metropolitan airport system planning
4. Airport Master planning

Limitations of use:

FAA policies are applicable such as USC, United States Code, Public Law (PL), Code of Federal Regulations and official FAA policies.

Public & Private use airport

When we think of public airports, it is usually commercial service we think. However, Oregon's system of more than 100 public use airports includes a half dozen commercial service airports. All public categories for purpose of Oregon aviation plan.

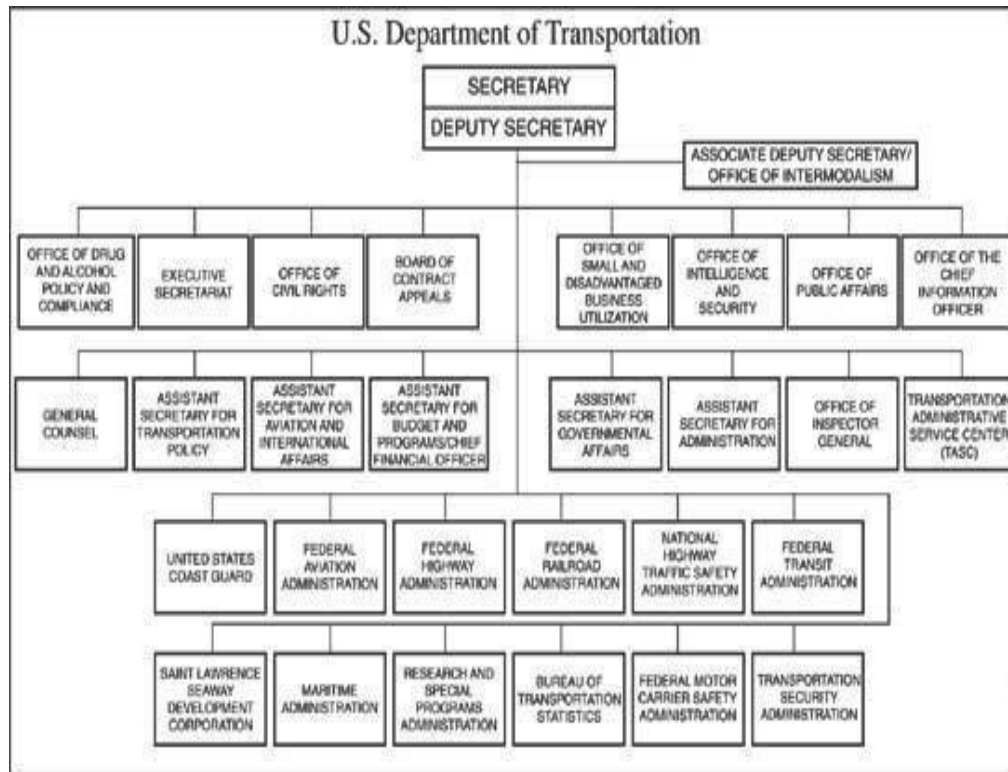
Private air charter services, one advantage to use a private airport is the privacy factor.

Travelling

Details are kept confidentially including the destination, members of travelling party & Potential return dates.

The national administrative structure of airports

All civil-use airports, large and small, in one way or another, utilize the United States' Civil Aviation System. The civil aviation system is an integral part of the United States' transportation infrastructure. This vital infrastructure is administered through the United States **Department of Transportation (DOT)**, led by the secretary of transportation.



U.S Department of Transportation organization chart.

The DOT is divided into several administrations that oversee the various modes of national and regional transportation in the United States. Such administrations include:

FHWA—The Federal Highway Administration FMCSA—

The Federal Motor Carrier Safety Administration FRA—

The Federal Railroad Administration

FRA—The Federal Transit Administration

MARAD—The Maritime Administration

NHTSA—The National Highway Traffic Safety Administration

USCG—The United States Coast Guard

The administration that oversees civil aviation is the **Federal Aviation Administration (FAA)**.

The FAA's primary mission is to oversee the safety of civil aviation. The FAA is responsible for the rating and certification of pilots and for the certification of airports, particularly those serving commercial air carriers. The FAA operates the nation's air traffic control system, including most air traffic control towers found at airports, and owns, installs, and maintains visual and electronic navigational aids found on and around airports. In addition, the FAA

administers the majority of the rules that govern civil aviation and airport operations, as well as plays a large role in the funding of airports for improvement and expansion. The FAA is led by an administrator who is appointed by the secretary of transportation for a 5-year term. The FAA is headquartered in Washington, D.C. Headquarter offices within the FAA include the offices of Air Traffic Services (ATS), Office of Security and Hazardous Materials (ASH), Commercial Space Transportation (AST), Regulation and Certification (AVR), Research and Acquisitions (ARA), and Airports (ARP). Within the Office of Airports lies the Office of Airport Safety and Standards (AAS) and the Office of Planning and Programming (APP). It is in these offices where Federal Aviation Regulations and policies specific to airports are administered. The FAA is also divided into nine geographic regions, as illustrated in Fig.

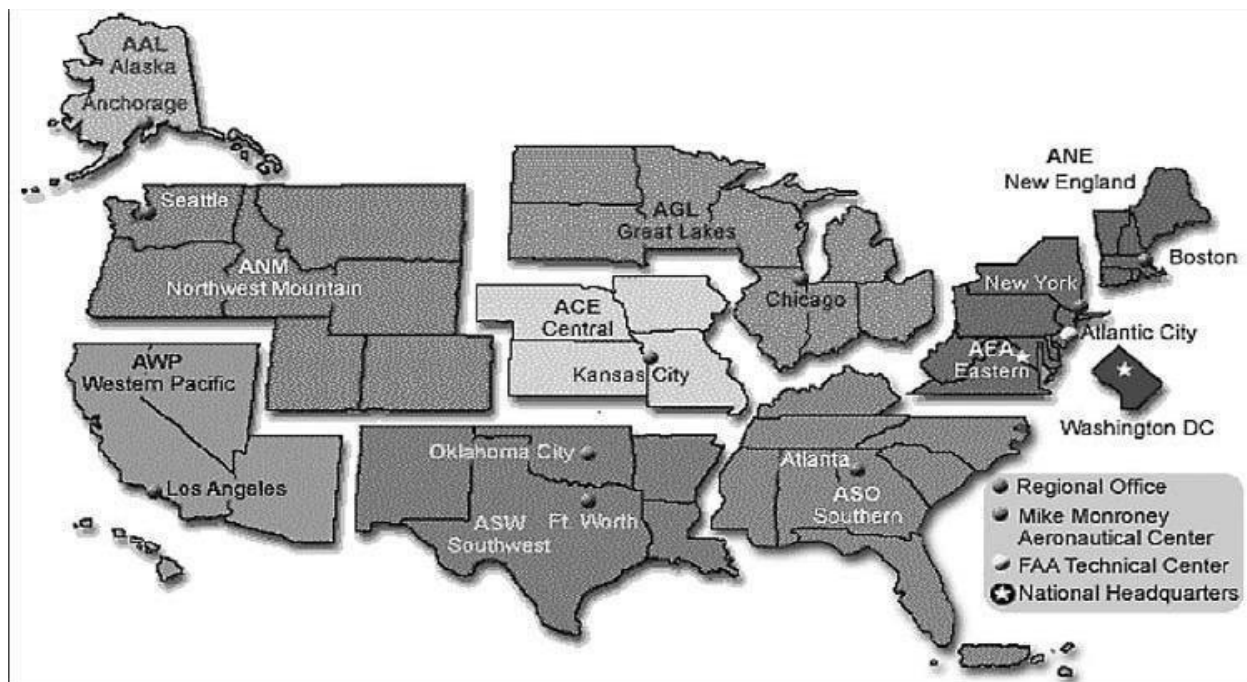


Figure FAA regions.

Within each region are two or more **Airport District Offices (ADOs)**. ADOs keep in contact with airports within their respective regions to ensure compliance with federal regulations and to assist airport management in safe and efficient airport operations as well as in airport planning. Many civil-use airports, including those that are not directly administered by the FAA, may be under the administrative control of their individual states, which in turn have their own departments of transportation and associated offices and regions. Airport management at individual airports should be familiar with all federal, state, and even local levels of administration that govern their facilities.

Airport management on an international level

Internationally, the recommended standards for the operation and management of civil-use airports are provided by the **International Civil Aviation Organization (ICAO)**. ICAO, headquartered in Montreal, Quebec, Canada, is a membership-based organization, comprised

of 188 contracting states that span the world. ICAO came into existence as a part of the 1944 Chicago Convention on International Civil Aviation for the purpose of providing a source of communication and standardization among participating states with respect to civil aviation operations. ICAO publishes a series of recommended policies and regulations to be applied by individual states in the management of their airports and civil aviation systems.

The National Plan of Integrated Airport Systems

Since 1970, the Federal Aviation Administration has recognized a subset of the 5,400 public-use airports in the United States as being vital to serving the public needs for air transportation, either directly or indirectly, and may be made eligible for federal funding to maintain their facilities. The **National Airport System Plan (NASP)** was the first such plan, which recognized approximately 3,200 such airports. In addition, the NASP categorized these airports on the basis of each airport's number of annual enplanements and the type of service provided. The NASP categorized airports as being "commercial service airports" if the airport enplaned at least 2,500 passengers annually on commercial air carriers or charter aircraft. Commercial service airports were subcategorized as "air carrier" airports and "commuter" airports, depending on the type of service dominant at a given airport. Airports that enplaned less than 2,500 passengers annually were classified as "general aviation airports." In 1983, the final year of the NASP, a total of 780 commercial service airports (635 air carrier airports and 145 commuter airports) and 2,423 general aviation airports were recognized under the NASP.

With the passage of the Airport and Airway Act of 1982, the FAA was charged with preparing a new version of the NASP, to be called the **National Plan of Integrated Airport Systems (NPIAS)**. The NPIAS revised the method of classifying airports, primarily to reflect the extreme growth in annual enplanements that a relative few of the largest airports were experiencing at the time. As of 2002, a total of 3,364 airports in the United States were included in the NPIAS.

The categories of airports listed in the NPIAS are:

1. Primary commercial service airports
2. Commercial service airports
3. General aviation airports
4. Reliever airports

Commercial service airports

Commercial service airports are those airports that accommodate scheduled air carrier service, provided by the world's certificated air carriers. Virtually all of the 650 million passengers that boarded commercial aircraft in 2001 began, transferred through, and ended their trips at commercial service airports. Commercial service airports operate under very specific regulations enforced by the Federal Aviation Administration, Transportation Security Administration, as well as state and local governments. In addition, other federal and local administrations, such as the Environmental Protection Agency, and local economic development organizations, indirectly affect how commercial service airports operate. The goal of commercial service airports, of course, is to provide for the safe and efficient movement of

passengers and cargo between population centers through the nation's aviation system. In 2002, there were a total of 546 commercial service airports throughout the United States striving to fulfill this mission.

Primary commercial service airports are categorized in the NPIAS as those public-use airports enplaning at least 10,000 passengers annually in the United States. In 2002, there were 422 airports (less than 3 percent of the nation's total airports) categorized as primary commercial service airports. Within this exclusive group of airports, the range of airport size and activity level is very wide, and the distribution of passenger enplanements is highly skewed. About half the primary commercial service airports handle relatively little traffic; the vast majority of passengers are enplaned through relatively few very large airports. This phenomenon is a direct result of the airline routing strategy, known as the "hub and spoke. In fact, the top five airports in the United States, in terms of annual enplanements, boarded nearly 25 percent of all the passengers in the United States. The top two airports, Chicago O'Hare Field and the Hartsfield Atlanta International Airport, enplaned nearly 70 million (over 10 percent) of the nation's commercial air travelers in 2002.

Because of this wide range of size within the primary commercial service airport category, the NPIAS subcategorizes these airports into "hub" classifications. It should be noted that the term "hub" used by the FAA in the NPIAS is very different than the term used by the airline industry. Whereas the airline industry uses the term "hub" as an airport where the majority of an airline's passengers will transfer between flights to reach their ultimate destinations, the FAA defines hub strictly by the number of annual enplaned passengers to use the airport. Furthermore, if there is more than one airport in a **standard metropolitan statistical area (SMSA)**, the total number of enplaned passengers of the airports within the SMSA is used to determine the airport's "hub" classification (Fig.).

Number Airports	Airport Type	Percentage of All Enplanements	Percentage of Active GA Aircraft
31	Large-Hub Primary	89.6	1.3
37	Medium-Hub Primary	19.3	2.9
74	Small-Hub Primary	7.7	4.7
280	Nonhub Primary	3.2	11.3
124	Other Commercial Service	0.1	2.0
260	Relievers	0.0	27.1
2,558	General Aviation	0.0	37.2
3,364	Existing NPIAS Airports	100.0	86.4
15,942	Low Activity Landing Areas (Non-NPIAS)	0.0	13.6

Figure . Airports by level of activity. (Figure courtesy FAA)

The hub classifications used by the FAA in the NPIAS are:

1. Large hubs
2. Medium hubs
3. Small hubs
4. Nonhubs

Large hubs are those airports that account for at least 1 percent of the total annual passenger enplanements in the United States. In 2002, there were 31 large hub airports in the NPIAS. These 31 large hub airports accounted for 70 percent of all passenger enplanements in the United States.

Medium hubs are those airports that account for at least 0.25 percent but less than 1 percent of the total annual passenger enplanements. In 2002, there were 37 airports classified as medium hubs.

Small hubs are defined as those airports accommodating greater than 0.05 percent but less than 0.25 percent of annual U.S. enplanements. Seventy-four NPIAS airports were categorized as small hubs.

Nonhubs are those airports that enplane at least 10,000 annual enplanements but less than 0.05 percent of the annual total U.S. enplanements. In 2002, 280 primary commercial service airports fell into the nonhub category.

Airports that handle at least 2,500 but less than 10,000 annual enplanements are categorized as **nonprimary commercial service airports**, or simply commercial service airports. In 2002, there were 124 nonprimary commercial service airports included in the NPIAS.

General aviation airports

Those airports with fewer than 2,500 annual enplaned passengers and those used exclusively by private business aircraft not providing commercial air carrier passenger service are categorized as **general aviation (GA) airports**. Although there are over 13,000 airports that fit this category, only a subset is included in the NPIAS. There is typically at least one general aviation airport in the NPIAS for every county in the United States. In addition, any general aviation airport that has at least 10 aircraft based at the airport and is located at least 20 miles away from the next nearest NPIAS airport is usually included in the NPIAS. In 2002, a total of 2,558 general aviation airports were included in the NPIAS. General aviation airports have facilities and activity that rival their commercial service counterparts. These airports have multiple runways, at least one long enough to accommodate corporate and larger-size jet aircraft, and have a full spectrum of maintenance, fueling, and other service facilities. Many such general aviation airports even have rental car, restaurant, and hotel services to accommodate their customers. An important aspect of general aviation airports is that they serve many functions for a wide variety of airports. Some GA airports provide isolated communities with valuable links to other population centers. The principal function of general aviation airports, however, is to provide facilities for privately owned aircraft to be used for business and personal activities. In most recent years, there has been a significant increase in the amount of small business jet aircraft using general aviation airports.

A general aviation airport is generally categorized as being either a **basic utility** or **general utility facility**. Basic utility airports are designed to accommodate most single-engine and small twin-engine propeller-driven aircraft. These types of aircraft accommodate approximately 95 percent of the general aviation aircraft fleet. General utility airports can accommodate larger aircraft, as well as the lighter, smaller aircraft handled by basic utility airports.

Reliever airports

Reliever airports comprise a special category of general aviation airports. Reliever airports, generally located within a relatively short distance (less than 50 miles) of primary commercial service airports, are specifically designated by the NPIAS as “general aviation-type airports that provide relief to congested major airports.” To be classified as a reliever airport, the airport must have at least 50 aircraft based at the airport or handle at least 25,000 itinerant operations or 35,000 local operations annually, either currently or within the last 2 years. Reliever airports are located within an SMSA with a population of at least 500,000 or where passenger enplanements at the nearest commercial service airport exceed 250,000 annually. As the name suggests, reliever airports are intended to encourage general aviation traffic to use the facility rather than the busier commercial service airport. In many major metropolitan areas, reliever airports account for a majority of airport operations. Of the general aviation airports recognized in the NPIAS, 260 have been classified as reliever airports. These airports are home to over 38 percent of all general aviation aircraft.

The rules that govern airport management

Ensure the safe and efficient operation of public-use airports. All airports included in the NPIAS are subject to a variety of **Federal Aviation Regulations(FAR)**. FAR’s are found in Title 14 of the United States **Code of Federal Regulations(CFR)** (14 CFR—Aeronautics and Space). The 14 CFR series is made up of over 100 chapters, known as parts, each of which provide regulatory mandates that govern various elements of the civil aviation system, including regulations for pilots, general aviation and commercial flight operations, and, of course, airport operations and management. Within airport management, regulations regarding airport operations, environmental policies, financial policies, administrative policies, airport planning, and other issues of direct concern to airports are covered. Although all Federal Aviation Regulations are important to airport management, the following FARs are of specific importance to airport management, operations, and planning, and will be referenced in detail in this text:

FAR Part 1 Definitions and Abbreviations

FAR Part 11 General Rulemaking Procedures

FAR Part 36 Noise Standards: Aircraft Type and Airworthiness Certification

FAR Part 71 Designation of Class A, Class B, Class C, Class D, and Class E Airspace Areas; Airways, Routes, and Reporting Points

FAR Part 73 Special Use Airspace

FAR Part 77 Objects Affecting Navigable Airspace

FAR Part 91 General Operating and Flight Rules
FAR Part 93 Special Air Traffic Rules and Airport Traffic Patterns
FAR Part 97 Standard Instrument Approach Procedures
FAR Part 121 Operating Requirements: Domestic, Flag, and Supplemental Air Carrier Operations
FAR Part 129 Operations: Foreign Air Carriers and Foreign Operators of U.S. Registered Aircraft Engaged in Common Carriage
FAR Part 139 Certification and Operations: Land Airports Serving Certain Air Carriers
FAR Part 150 Airport Noise and Compatibility Planning
FAR Part 151 Federal Aid to Airports
FAR Part 152 Airport Aid Program
FAR Part 156 State Block Grant Pilot Program
FAR Part 157 Notice of Construction, Alteration, Activation, and Deactivation of Airports
FAR Part 158 Passenger Facility Charges
FAR Part 161 Notice and Approval of Airport Noise and Access Restrictions
FAR Part 169 Expenditure of Federal Funds for Nonmilitary Airports or Air Navigation Facilities Thereon (for airports not operated under Federal Aviation Administration regulations)

In addition to the 14 CFR series, regulations regarding the security of airport and other civil aviation operations are published under Title 49 of the Code of Federal Regulations (49 CFR—Transportation) and are known as **Transportation Security Regulations (TSRs)**. TSRs are enforced by the Transportation Security Administration (TSA). TSRs of specific importance to airport management include

49 CFR Part 1500 Applicability, Terms, and Abbreviations
49 CFR Part 1502 Organization, Functions, and Procedures
49 CFR Part 1503 Investigative and Enforcement Procedures
49 CFR Part 1510 Passenger Civil Aviation Security Service Fees
49 CFR Part 1511 Aviation Security Infrastructure Fee
49 CFR Part 1520 Protection of Security Information (replaced FAR Part 191)
49 CFR Part 1540 Civil Aviation Security: General Rules
49 CFR Part 1542 Airport Security (replaced FAR Part 107)
49 CFR Part 1544 Aircraft Operator Security: Air Carriers and Commercial Operators (replaced FAR Part 108)
49 CFR Part 1546 Foreign Air Carrier Security (replaced parts of FAR Part 129)
49 CFR Part 1549 Indirect Air Carrier Security (replaced FAR Part 109)
49 CFR Part 1550 Aircraft Security Under General Operating and Flight Rules (replaced parts of FAR Part 91)

To assist airport management and other aviation operations in understanding and applying procedures dictated by federal regulations, the FAA makes available a series of **advisory circulars (ACs)** associated with each regulation and policies. The advisory circulars specific to airports are compiled into the 150 Series of Advisory Circulars. There are over 100 current and historical advisory circulars in the 150 series available to airport management. Those advisory circulars of particular general interest to airport management are referenced throughout this text. Some of these include:

AC 150/5000-5C Designated U.S. International Airports
AC 150/5020-1 Noise Control and Compatibility Planning for Airports
AC 150/5060-5 Airport Capacity and Delay
AC 150/5070-6A Airport Master Plans
AC 150/5190-5 Exclusive Rights and Minimum Standards for Commercial Aeronautical Activities
AC 150/5200-28B Notices to Airmen (NOTAMS) for Airport Operators
AC 150/5200-30A Airport Winter Safety and Operations
AC 150/5200-31A Airport Emergency Plan
AC 150/5300-13 Airport Design
AC 150/5325-4A Runway Length Requirements for Airport Design
AC 150/5340-1H Standards for Airport Markings
AC 150/5360-12C Airport Signing and Graphics
AC 150/5360-13 Planning and Design Guidelines for Airport Terminal Facilities
AC 150/5360-14 Access to Airports by Individuals with Disabilities

Airports are also subject to state and local civil regulations specific to the airport's metropolitan area. In addition, airport management itself may impose regulations and policies governing the operation and administration of the airport. Each airport is encouraged to have a published set of rules and regulations covering all the applicable federal, state, local, and individual airport policies to be made available for all employees and airport users on an as-needed basis.

Organization and administration

Introduction

Whether privately owned or part of a public system, there are fundamental characteristics of the administrative and organizational structure of an airport. The number of people employed at a given airport can range from as few as one, at the smallest of general aviation facilities, to as many as 50,000 at the world's largest airport authorities.

Those airports that employ fewer numbers of people expect these people to accept a wider range of responsibilities. For example, an airport management employee at a small airport might be responsible for maintaining the airfield, managing finances, and maintaining good relations with the local public. At the larger airports, employees are typically given very specific responsibilities for a particular segment of airport management.

Airport ownership and operation

Public airports in the United States are owned and operated under a variety of organizational and jurisdictional arrangements. Usually, ownership and operation coincide: commercial airports might be owned and operated by a city, county, or state; by the federal government; or by more than one jurisdiction (a city and a county). In some cases, a commercial airport is owned by one or more of these governmental entities but operated by a separate public body, such as an airport authority specifically created for the purpose of managing the airport. Regardless of ownership, legal responsibility for day-to-day operation and administration can

be vested in any of five kinds of governmental or public entities: a municipal or county government, a multipurpose port authority, an airport authority, a state government, or the federal government.

A typical **municipally operated airport** is city owned and run as a department of the city, with policy direction by the city council and, in some cases, by a separate airport commission or advisory board. County-run airports are similarly organized. Under this type of public operation, airport policy decisions are generally made in the broader context of city or county public investment needs, budgetary constraints, and development goals.

Some commercial airports in the United States are run by multipurpose port authorities. **Port authorities** are legally chartered institutions with the status of public corporations that operate a variety of publicly owned facilities, such as harbors, airports, toll roads, and bridges. In managing the properties under their jurisdiction, port authorities have extensive independence from the state and local governments. Their financial independence rests largely on the power to issue their own debt, in the form of revenue bonds, and on the breadth of their revenue bases, which might include fees and charges from marine terminals and airports as well as proceeds (bridge or tunnel tolls) from other port authority properties. In addition, some port authorities have the power to tax within the port district, although it is rarely exercised.

Another type of arrangement is the single-purpose **airport authority**. Similar in structure and in legal charter to port authorities, these single-purpose authorities also have considerable independence from the state or local governments, which often retain ownership of the airport or airports operated by the authority. Like multipurpose port authorities, airport authorities have the power to issue their own debt for financing capital development, and in a few cases, the power to tax. Compared to port authorities, however, they must rely on a much narrower base of revenues to run a financially self-sustaining enterprise.

Since the early 1950s, there has been a gradual transition from city- and county-controlled airports to the independent single or multipurpose authorities. The predominant form is still municipally owned and operated, particularly the smaller commercial and GA airports; however, there are reasons for this transition:

- Many airport market or service areas have outgrown the political jurisdiction whose responsibility the airport entails. In some cases there is considerable, actual or potential, tax liability to a rather limited area. In these cases the creation of an authority to “spread the potential or actual tax support” for the airport might be recommended. By spreading the tax base of support for the airport, more equitable treatment of the individual taxpayer can result and the taxpayers supporting the airport in most cases more nearly match the actual users of the facility.
- Another advantage of authority control of an airport is that such an organization allows the board to concentrate and specialize on airport matters.
- Aviation authorities can also provide efficiency of operation and economies of scale when several political jurisdictions, each with separate airport responsibilities, choose to combine these under one board. This has been done quite successfully in many areas of the country.

Normally, the staff required by an airport authority will be quite small compared to the personnel requirements of a city or county government. This factor generally results in better coordination with the airport management team.

- Authorities can also provide on-scene decision makers, rates, and charges unclouded by off airport costs, and with less political impact on the business of running the airport. State operated airports are typically managed by the state's department of transportation. Either general obligation or revenue bonding might be used to raise investment capital, and state taxes on aviation fuel might be applied to capital improvement projects.

Although several states run their own commercial airports, only a handful of large- and medium-size commercial airports are operated in this way, primarily in Alaska, Connecticut, Hawaii, Maryland, and Rhode Island. The federal government owns and operates the airport at Pomona (Atlantic City), New Jersey, which is part of the FAA Technical Center. The FAA manages this facility with capital development financed through congressional appropriations. Several airports in the United States are managed by private companies generally operating under a fixed-fee contract with a local government. By contrast, many U.S. airports are managed by the local government, but contract out a significant number of airport functions to private contractors, including janitorial, security, maintenance, and concession management. Neither of these situations is particularly controversial, nor are the economics of these airports unusual.

Airport privatization

Privatization refers to shifting governmental functions and responsibilities, in whole or in part, to the private sector. The most extensive privatizations involve the sale or lease of public assets.

Airport privatization, in particular, typically involves the lease of airport property and/or facilities to a private company to build, operate, and/or manage commercial services offered at the airport. No commercial airport property in the United States has been completely sold to a private entity. Long-term operating leases are the standard privatization contract. Only in the United Kingdom have outright sales of airport property been completed.

Although no U.S. commercial airport has been sold to a private entity, publicly owned airports have extensive private sector involvement. Most services now performed at large commercial airports, such as airline ticketing, baggage handling, cleaning, retail concessions, and ground transportation, are provided by private firms. Some estimates indicate as many as 90 percent of the people working at the nation's largest airports are employed by private firms. The remaining 10 percent of the employees are local and state government personnel performing administrative or public safety duties; federal employees, such as FAA air traffic controllers and TSA security screeners; or other public employees, primarily military personnel. Airports have been increasingly dependent on the private sector to provide services as a way to reduce costs and improve the quality and the range of services offered.

The airport organization chart

An organization chart shows the formal authority relationships between superiors and subordinates at various levels, as well as the formal channels of communication within the organization. It provides a framework within which the management functions can be carried out. The chart aids employees to perceive more clearly their positions in the organization in relation to others and how and where managers and workers fit into the overall organizational structure.

Airport management organization charts range from the very simple to the very complex, depending primarily on the size, ownership, and management structure of the airport.

The organization chart is a static model of an airport's management structure; that is, it shows how the airport is organized at a given point in time. This is a major limitation of the chart, because airports operate in a dynamic environment and thus must continually adapt to changing conditions. Some old positions might no longer be required, or new positions might have to be created in order that new objectives can be reached; therefore, it is necessary that the chart be revised and updated periodically to reflect these changing conditions. The duties, policies, and theories that govern the job of airport management vary widely over time. In addition, many such policies vary from airport to airport on the basis of individual airport operating characteristics. As a result, it is difficult to say that any organization chart is typical or that the chart of one airport at any particular time is the one still in effect even a few months later; however, all airports do have certain common functional areas into which airport activities are divided. Understandably, the larger the airport, the greater the specialization of tasks and the greater the departmentalization.

Job descriptions

The following is a brief job description for each position shown in Fig.



Typical airport management organization chart.

Airport director. The airport director is responsible for the overall day-to-day operation of the airport. He or she reports directly to the airport authority, the airport board, or governmental commission charged with the development and administration of the airport. This individual directs, coordinates, and reviews through subordinate supervisors, all aircraft operations, building and field maintenance, construction plans, community relations, and financial and personnel matters at the airport. The airport director also:

- Supervises and coordinates with airline, general aviation, and military tenants use of airport facilities.
- Reviews airport tenant activities for compliance with terms of leases and other agreements.
- Supervises enforcement of aircraft air and ground traffic and other applicable regulations.
- Confers with airlines, tenants, the FAA, and others regarding airport regulations, facilities, and related matters.
- Participates in planning for increased aircraft and passenger volume and facilities expansion.
- Determines and recommends airport staffing requirements.
- Compiles and submits for review an annual airport budget.
- Coordinates airport activities with construction, maintenance, and other work done by departmental staff, tenants, public utilities, and contractors.
- Promotes acceptance of airport-oriented activities in surrounding communities.

Assistant director—finance and administration The **assistant director— finance and administration** is charged with the responsibility for overall matters concerning finance, personnel, purchasing, facilities management, and office management. Specifically, this individual's duties include:

- Fiscal planning and budget administration.
- Accomplishment of basic finance functions such as accounts receivable and payable, auditing, and payroll.
- Administration of the purchasing function.
- Administration and use of real property including negotiation of tenant leases and inventory control.
- Personnel functions including compensation, employee relations, and training.
- Adequate telephone and mail service.

Public relations.

Personnel manager The **personnel manager** is responsible for administering the airport personnel program. In such capacity, this individual's duties include:

- Dealing with personnel problems involving position classification, compensation, recruitment, placement, transfers, layoffs, promotions, leaves of absence, supervisor-subordinate relationships, and working conditions.
- Serving as equal rights and equal opportunity officer for the airport.
- Handling worker's compensation cases.
- Evaluating the organization pattern, reviewing and recommending proposed departmental organizational changes, and preparing position descriptions.
- Conferring with employees and their supervisors on personnel problems.
- Preparing personnel documents and maintaining personnel records.
- Interviewing or supervising the interviewing of applicants for airport positions.

Chief accountant The **chief accountant** is responsible for financial planning, budgeting, accounting, payroll, and auditing. The principal duties include:

- Coordinating, consolidating, and presentation of financial plans.
- Administering basic accounts such as general accounts, cost accounting, and accounts receivable and payable.
- Administering budget; reviewing and analyzing actual performance at budget review sessions.
- Supervising all receipts and disbursements.
- Administering payroll.
- Conducting periodic internal audit of all airport functions.

Facilities chief The **facilities chief** establishes criteria and procedures for the administration of all airport property. In this capacity, he or she is responsible for inventory control of all equipment and facilities. Principal duties and responsibilities of this individual include:

- Identification and control of all property and equipment including periodic audits.
- Evaluating and making recommendations concerning the most efficient use of airport real property utilization.
- Soliciting tenants and concessionaires.
- Developing policy and rate structure applicable to use of property by tenants and concessionaires.

Coordinating with purchasing and legal staff concerning tenant and concessionaire leases.

Chief purchasing agent The **chief purchasing agent** directs the procurement of materials and services to support the airport; he or she prepares, negotiates, interprets, and administers contracts with vendors. This individual's principal duties include:

- Coordinating requirements for materials and services to be purchased.
- Purchasing all materials and services.
- Establishing bidding policies and procedures.
- Working closely with the facilities' chief and legal staff regarding contracts associated with purchasing equipment.

Manager of public relations The **manager of public relations** is the chief liaison officer between the airport and the surrounding community. In this capacity, he or she is responsible for all public relations activities including the development of advertising and publicity concerning the airport. This individual is also responsible for handling all noise and other environmental matters. Principal duties include:

- Consulting with and advising airport management regarding public relations policies and practices.
- Coordinating all publicity releases to the various media.
- Supervising all airport guides and information booths.
- Coordinating VIP visits to the airport.
- Receiving and analyzing all public complaints regarding such things as noise and other environmental concerns.
- Preparing answers to complaints and advising management as appropriate.
- Sponsoring activities and special events to generate goodwill and public acceptance.

Assistant director—planning and engineering The **assistant director— planning and engineering** provides technical assistance to all airport organizations, and ensures the engineering integrity of construction, alteration, and installation programs. This individual also establishes industrial safety standards. Principal duties and responsibilities include:

- Developing standards and specifications for construction, alteration, and installation programs; monitors such programs to ensure compliance therewith.
- Reviewing all construction plans to determine technical integrity and conformance to aesthetic design standards.
- Developing and publishing standards and procedures for industrial safety.
- Participating in the negotiation of construction contracts.

Assistant director—operations The **assistant director—operations** is responsible for all airside and landside operations including security, and crash, fire, and rescue operations. Principal duties include:

- Directing the operations and security programs for the airport.
- Coordinating and supervising security activities with field maintenance personnel, police and fire departments, federal agencies, and airport tenants.
- Recommending and assisting in promulgating operational rules and procedures.
- Supervising investigations of violations of airport regulations.
- Preparing annual operations budget.
- Directing monitoring of noise levels and coordinating noise level studies.
- Participating in special programs relating to or affecting airport operations, such as studies of height limits around airport property and studies of noise control.

Chief—airside operations The **chief—airside operations** is responsible for all airfield operations. In this capacity, principal duties include:

- Enforcing operating and security rules, regulations, and procedures concerning landing, taxiing, parking, servicing loading and unloading of aircraft, operation of vehicular traffic on the airfield, airline activities, and emergency situations.
- Inspecting conditions of airfield lighting, runways, taxiways, and ramp areas.
- Correcting hazardous conditions.
- Coordinating airfield activities with maintenance and security personnel.
- Assisting in all airfield emergency calls and disasters by notifying control tower to close runways, directing maintenance personnel, directing security officers in crowd control, and overseeing other safety considerations and activities necessary to resume normal airport operations.
- Investigating and reporting on complaints and disrupted airport operations, including unscheduled plane arrivals, aircraft accidents, rule and procedure violations, airline activities, and other operations of the airport.
- Assigning gate and parking spaces to all aircraft.
- Coordinating special arrangements for arrivals and departures of important persons.
- Completing all report forms pertaining to operations activities on assigned shifts.
- Assisting in directing noise level studies with other departmental personnel.

Chief—landside operations The chief—landside operations is responsible for all landside operations. In this capacity, principal duties include:

- Enforcing operating and security rules, regulations, and procedures concerning buildings, access roads, and parking facilities.
- Exercising authority to halt hazardous or unauthorized activities by tenants, employees, or the public in violation of safety regulations and procedures.
- Answering inquiries and explaining terminal use procedures and safety regulations to tenants.
- Coordinating terminal building and other facility activities with maintenance and security personnel.
- Coordinating all parking facility activities with tenants and transit companies.
- Preparing personal injury and property damage reports and general incident reports.

• Completing all report forms pertaining to operations activities on assigned shifts. *Security chief* The security chief enforces interior security, traffic, and safety rules and regulations and participates in law enforcement activities at the airport. This individual also works closely with federal security officials assigned to the airport. Principal duties include:

- Enforcing ordinances and regulations pertaining to parking, traffic control, safety, and property protection.
- Patrolling facilities to prevent trespass and unauthorized or hazardous use.
- Preventing public entry into dangerous or restricted areas.
- Issuing citations and warnings for violations of specific provisions of airport rules and regulations.
- Securing gates and locks and watching buildings and facilities for indications of fire, dangerous conditions, unauthorized entry, and vandalism.
- Responding to emergencies and taking immediate action to control crowds, direct traffic, assist the injured, and turn in alarms.
- Responding to calls for police service; participating in arrests; apprehending, or assisting members of the police department in apprehending, law violators.
- Providing information to the public regarding locations and operations of the airport.
- Assigning uniformed and armed personnel to patrol and stand watch, on a 24-hour basis, to protect and safeguard all persons in the airport and property on the airport.

Aircraft rescue/fire fighting chief The aircraft rescue/fire fighting chief develops procedures and implements accident, fire, and disaster plans. Principal duties include:

- Conducting a training (continuing) program for all aircraft rescue, fire fighting personnel.
- Developing and implementing all aircraft rescue and fire fighting programs.
- Staffing and operating all aircraft rescue and fire fighting equipment on the airport.
- Inspecting and testing all types of fixed fire prevention and extinguishing equipment on the airport.

• Inspecting all facilities for fire and/or safety hazards. *Assistant director—maintenance* The assistant director—maintenance is responsible for planning, coordinating, directing, and reviewing the maintenance of buildings, facilities, vehicles, and utilities. Principal duties include:

- Developing, directing, and coordinating policies, programs, procedures, standards, and schedules for buildings, utilities, vehicle maintenance, and field facilities.
- Coordinating work done by tenants and contractors.

- Inspecting maintenance work for compliance with plans, specifications, and applicable laws.
- Making recommendations as to adequacy, sufficiency, and condition of buildings, facilities, and vehicles.
- Overseeing maintenance contracts. *Buildings and facilities chief* The buildings and facilities chief is responsible for ensuring that buildings are adequately maintained with a minimum of cost. Types of maintenance required are primarily electrical, mechanical, plumbing, painting, carpentry, masonry, and cement work. Principal duties include:
 - Developing an approved maintenance schedule for all building maintenance requirements.
 - Assigning qualified personnel to perform maintenance. Inspecting work for adequacy and compliance with requirements.
 - Developing special maintenance methods where necessary.

Grounds chief The **grounds chief** is responsible for ensuring that the grounds are maintained in good repair and that the landscape is adequately maintained. Principal duties include:

- Developing approved schedules for maintaining all airport surface areas including paving, landscaping, and drainage systems.
- Assigning qualified personnel to accomplish ground maintenance.
- Inspecting work for adequacy and compliance with maintenance standards.

Vehicle chief The **vehicle chief** is responsible for the maintenance of all vehicles utilized by the airport. Vehicle maintenance includes tune-up, minor maintenance, washing and polishing, tires and batteries, lubrication, and fueling. Principal duties include:

- Developing an approved vehicle maintenance schedule.
- Coordinating schedule with users of airport vehicles.
- Assigning qualified personnel to perform maintenance.
- Inspecting all work to determine compliance with established maintenance standards.
- Coordinating with purchasing to obtain vendor services as required.
- Maintaining vehicle usage and maintenance records.
- Coordinating with purchasing in developing a vehicle disposal and replacement program.

Although the aforementioned positions represent a typical managerial structure at a commercial airport, there are numerous employees with a wide variety of job skills reporting to them. Some of the typical job titles found at major airports include the following:

Accountant Buyer
Administrative assistant Carpenter
Air-conditioning mechanic Cement finisher
Airport guide Civil engineer
Airport noise abatement officer Construction inspector
Architect Contract analyst
Auditor Custodian
Auto mechanic Drafter
Bus driver Electrician
Elevator mechanic Plumber
Equipment mechanic Public relations representative
Equipment operator Secretary
Facility planner Security officer

Financial analyst
Sheet metal mechanic
Firefighter
Software engineer
Groundskeeper
Student intern
Heavy-duty equipment operator
Supervisor of operations
Industrial engineer
Tiler
Setter
Maintenance and construction
Toolroom keeper
laborer
Maintenance foreman
Traffic painter and sign poster
Operations assistant
Tree surgeon
Painter
Truck operator
Personnel representative
Welder
Plasterer
Window cleaner

Airport management as a career

There are many career paths within the field of airport management as evidenced by the wide variety of job descriptions under the previous section. Even the job of airport manager varies greatly. At one extreme is the manager of a large metropolitan airport, an appointee or civil service employee of the city government or airport authority, who heads a large staff of assistants and specialists through which he or she manages a highly complex organization. At the other extreme is the owner-manager of a small private field near a rural community. The latter might combine activities as airport manager with work in some other business.

Between these two extremes is the manager of a municipally owned or privately owned airport where there are a limited number of scheduled airline flights each day. Based at the airport are several fixed-base operators (FBOs) and a number of aircraft owned by individuals and corporations. The typical manager of a medium-size airport deals with all segments of the aviation community including the airlines, general aviation, and federal and state agencies.

In the early days of aviation, an individual could become an airport manager if he or she was a pilot and had several years of experience in some segment of the industry. Although the individual had to be able to manage the operation for the owner, his or her experience was likely to be in some area of flying rather than in business management.

Today an airport manager must be primarily a skilled and experienced executive with a broad background in all facets of aviation and management in general. It is no longer necessary that the manager be a pilot. Almost every airport manager's job situation is unique in some major respects because of the wide variety of size of airport and type of ownership and operation. There are also wide variations in government procedures in different communities. This sometimes causes the responsibilities, salaries, and authority of airport managers to be completely different from one city to the next. Even the job title varies. Director of aviation, airport superintendent, executive director, airport director, general manager, and other titles are often used instead of airport manager.

Duties of an airport manager

An airport manager is often part landlord and part business executive. As a landlord, the safe condition and operation of the airport is the manager's greatest responsibility. The maintenance of the airport buildings and land is also important. As a business executive, the manager is in charge of public relations; financial planning; profitable and efficient day-to-day operation; and coordination of airline, concession, and airport facilities to best serve the tenants and flying public. The airport manager's primary duty is the safe and efficient operation of the airport and all its facilities regardless of its size. However, at least in the larger commercial airports, the manager does not have direct control over most flying activities. He or she must deal with all groups and individuals who use the airport facilities. These include representatives of the airlines that schedule flights, maintain and service their aircraft, and process passengers; all segments of the general aviation community, including FBOs and individual and corporate owners and operators of aircraft; and the government-employed staffs of the air traffic control facilities, customs, and so forth.

All of these groups can be regarded as tenants of the airport, carrying on their independent activities. Besides dealing with the companies and individuals directly concerned with flying, the manager is in contact with concessionaires who operate restaurants, shops, and parking facilities, and with the traveling public.

The size of the airport and the services it offers its tenants and the public play an important part in determining the airport manager's specific duties. Some of these duties were enumerated earlier in this chapter under job descriptions. A manager must formulate fiscal policy, secure new business, recommend and enforce field rules and regulations, make provisions for handling spectators and passengers, oversee construction projects, see that the airport is adequately policed and that airplane and automobile traffic is regulated. The manager interprets the functions and activities of the airport to the city or other local government and to the public; he or she is a public relations expert as well as a business manager. This public relations function is extremely important and will be taken up at the end of this chapter in a separate section. Not all of these duties are required of all managers of airports. Many airports are too small to have FAA-staffed control towers; others have no scheduled airline flights. In these airports the job is simpler, but the manager must usually do all of the work personally. In large airports, the manager has many assistants and supervises the work. The job of airport manager is obviously not completed between 9 and 5. The hours are often irregular and most managers have some weekend and holiday work. They will often have to work at night. In emergency situations they will usually work additional hours. Difficult weather conditions, labor problems, personnel irregularities, and flight schedule changes are only some of the things that will affect job hours. Even when not actually working, most airport managers are on call.

Education and training

The major requirement for the job of airport manager is business and administrative ability; this means the ability to make decisions, to coordinate details, to direct the work of others, and to work smoothly with many kinds of people. Perhaps the best college program to follow is one that leads to a degree in aviation management. College courses in engineering; management; accounting; finance and economics; business and aviation law; and airline, general aviation, and airport management are good preparation for a career in airport management. Many schools

that are members of the University Aviation Association (UAA) offer programs and courses that can be applied to the problems of managing an airport.

A number of the primary airports in the United States have 1- or 2-year internship programs that train college graduates for various aspects of airport management. Other individuals have started at a small GA airport where they become involved in all aspects of airport management—from maintenance and repair to attending city commission meetings. Some college graduates have taken jobs with aviation or airport consulting firms and after several years have moved into airport management. Many others have acquired experience in some other area of aviation before entering the field.

The airport manager and public relations

Unquestionably, one of the most important and challenging aspects of an airport manager's job is that of public relations. **Public relations** is the management function that attempts to create goodwill for an organization and its products, services, or ideals with groups of people who can affect its present and future welfare. The most advanced type of public relations not only attempts to create goodwill for the organization as it exists, but also helps formulate policies, if needed, that of themselves result in a favorable reaction.

Aviation and airports have such great impact on our lives, and on the life of our nation, that it is difficult to find a person who has no knowledge or opinion of airports. Despite the tremendous growth in all segments of aviation over the past 25 years, and the resulting challenges, problems, and opportunities, aviation has not been exempted from the controversies that inevitably are part of any endeavor affecting or touching the lives of a large number of people. This controversy is the reason why every opinion, whether positive or negative, will be a strong one. The net result is that every airport has an image—either good or bad.

The great problems of airports are always related to the original and elemental images resulting from the collective opinions of the public. These images are really the balancing or compensating factors that correspond with the problems the public encounters with airports. These images are deposits representing the accumulated experience of jet noise, hours of struggle to reach the airport on clogged highways under construction, the frustration of trying to find a closein parking place, the lines to obtain tickets, the time waiting for luggage, and other inconveniences.

Regardless of the size of an airport, there are several basic principles underlying the public relations process:

- Every airport and every company and interest on the airport has public relations, whether or not it does anything about them.
- Public goodwill is the greatest asset that can be enjoyed by any airport, and public opinion is the most powerful force. Public opinion that is informed and supplied with facts and fair interpretation might be sympathetic. Public opinion that is misinformed or uninformed will probably be hostile and damaging to an airport.

- The basic ingredient of good relations for any airport is integrity. Without it, there can be no successful public relations.
- Airport policies and programs that are not in the public interest have no chance of final success.
- Airport public relations can never be some kind of program that is used only to respond to a negative situation. Good public relations have to be earned through continuing effort.
- Airport public relations go far beyond press relations and publicity. Public relations must interpret the airport interests to the public, and should be a two-way flow with input and interpretation of public opinion to airport management and community leadership. Public relations must use many means of reaching the various segments of the public interested in airport operations, and must try to instill the public relations spirit into all facets of the airport's operation.

The airport and its public

Basically, every airport has four “publics” with which it deals, and despite the wide variance in size and scope of activities of airports, these publics are basically the same for all airports:

- *The external business public.* These are the past, present, and future airport customers for all the services offered on an airport. It includes all segments of the business, government, educational, and general flying public.
- *The external general public.* These are the local citizens and taxpayers, many of whom have never been to the airport but who vote on airport issues or who represent citizen groups with particular concerns.

The internal business public. These are the businesses and enterprises whose interests are tied directly to the airport—the airlines, FBOs, other members of the general aviation community, government officials, and other aviation and travel-oriented local businesses and trade organizations, and the employees of all of these enterprises.

- *The internal employee public.* This group includes everyone who works for the airport and its parent organization. These are the most important airport publics. These are the sources of vital information that management must have in order to know what and how it is doing, and they are the ones who must be informed and persuaded if any airport objective is to be achieved.

Public relations objectives

The primary objectives of an airport's public relations activities are as follows:

- Establishing the airport in the minds of the external public as a facility that is dedicated to serving the public interest: Many airports work closely with the local chamber of commerce in developing a brochure or pamphlet citing various accomplishments and activities at the airport that would be of interest to the local business community and the community in general.
- Communicating with the external public with the goal of establishing and building goodwill: The airport manager and other members of his or her staff often serve as guest speakers at various civic and social organizations. They also become active members of local or civic organizations in order to informally promote the airport and determine the pulse of the

community. Public announcements of new developments at the airport are made through all media. This is a continuing part of the communications process.

- Answering general and environmental complaints on an individual basis: It is important that the airport develop a good rapport with its neighbors and concerned citizen groups. Working closely with the airlines and other internal business publics, airport management attempts to work out such problems as noise by changing traffic patterns and adjusting hours of flight operation. Tours of the airport are given to various community groups in order for them to get a better understanding of operations. Civic-oriented activities are also conducted at the airport to improve relations with airport neighbors and address their concerns. Citizen participation in airport planning and public hearings is another means by which airport management is continually apprised of community feelings about airport-related activities.

Establishing good working relationships with internal business publics whose interests are similar to those of airport management.

- Promoting programs designed to enhance and improve employee morale. Like any other facility that serves the total community, an airport requires total community understanding. A well-executed public relations program can make the community aware of the airport and its benefits and create an atmosphere of acceptance. Attitudes are not changed overnight, so the public relations effort must be a continuous campaign to build understanding and develop attitudes of acceptance.

historical and legislative perspective

The formative period of aviation and airports: 1903–1938

The birth of civil aviation: 1903–1913

December 17, 1903, the day Orville and Wilbur Wright succeeded in achieving flight with a fixed-wing, heavier-than-air vehicle at Kitty Hawk, North Carolina, has gone down in history as being the “birth of aviation.” Their first airplane flight occurred on a large field, with sufficient room for the aircraft to take off and land. There were no paved runways, gates, fuel facilities, lights, or air traffic control. There was no terminal building and there was no automobile-parking garage. There were no rules and regulations governing the flight. That field in Kitty Hawk was, however, the first airport.

In the 10 years following the Wright brothers’ first flight, the aviation world evolved in a very slow and hesitant manner, with most of the advances focusing on improving aircraft technology, and much of the efforts trying to promote the technology. Little, if any, consideration was focused on creating facilities for aircraft to take off and land. As a result, by 1912, there were only 20 recognized landing facilities in the country, all of which were privately owned and operated.

World War I: 1914–1918

The outbreak of World War I in 1914 opened up initial opportunities for fixedwing aircraft to serve in a military capacity. The effort to use aviation as a military force in World War I resulted in the production of thousands of aircraft (most of which were produced and served in France,

Germany, and England), and hundreds of military pilots, to first fly reconnaissance and later fighting missions. As a result, the U.S. military built 67 airports for the war effort. These predominantly grass fields provided facilities to base, fuel, and maintain aircraft, as well as provide sufficient room for takeoff and landing—but required little other infrastructure. After the war, 25 of these military airfields remained operational, and the rest were decommissioned.

Early airmail service: 1919–1925

After the end of World War I in 1918, many of the aircraft and airmen that had served in the military turned their talents towards civil uses. One of the first civil applications of aviation was that of providing air transportation for the U.S. mail. The first regular airmail route in the United States was established on May 15, 1918, between New York City and Washington, D.C. The service was conducted jointly by the United States War Department and the Post Office Department. The War Department operated and maintained the aircraft and provided trained airmen, and the Post Office Department attended to the sorting of the mail and its transportation to and from the airfield, and the loading and discharge of the aircraft at the airfields. This joint arrangement lasted until August 12, 1918, when the Post Office Department took exclusive responsibility for the development of the mail service on a larger scale

The Air Commerce Act: 1926–1938

The potential for growth of the airmail industry in particular, and in aviation activity in general, resulted in the need to have aviation managed, controlled, and regulated as a comprehensive system so that its potential for widespread growth would be met. On May 20, 1926, President Calvin Coolidge signed the Air Commerce Act of 1926 into law. The object of the Air Commerce Act was to promote the development and stability of commercial aviation in order to attract adequate capital into the business and to provide the fledgling industry with the assistance and legal basis necessary for its growth. The act made it the duty of the secretary of commerce to encourage air commerce by establishing civil airways and other navigational facilities to aid aerial navigation and air commerce. Under the act, the Department of Commerce was charged with encouraging local and municipal development of airfields, for the purpose of economic growth, and to contribute to the infrastructure that would allow the growth of airmail service, as well as to provide safe landing facilities for the newly formed U.S. Army Air Service.

The Civil Aeronautics Act: 1938–1939

On June 23, 1938, the **Civil Aeronautics Act of 1938** was approved by President Franklin Delano Roosevelt. This act substituted a single federal statute for the several general statutes that had up to this time provided for the regulation of civil aviation. The act placed all regulation of aviation and air transportation into one authority. The act created an administrative agency consisting of three partly autonomous bodies. The five-man **Civil Aeronautics Authority** was principally concerned with the economic regulation of the new passenger air carrier industry. The Air Safety Board was an independent body for the investigation of accidents. The administrator of civil aviation was concerned with construction, operation, and maintenance of the airway system as a whole. The transfer of responsibilities, personnel, property, and unexpended balances of appropriations of the Bureau of Air Commerce to the Civil Aeronautics

Authority, effected in August 1938, under the provisions of the act, brought to a close a 12-year period during which the development and regulation of civil aviation was under the jurisdiction of the Department of Commerce.

During the first year and half of its existence, a number of organizational difficulties arose within the Civil Aeronautics Authority. As a result, President Roosevelt, acting within the authority granted to him in the Reorganization Act of 1939, reorganized the Civil Aeronautics Authority by creating two separate entities. The five-man authority initially known as the Civil Aeronautics Authority remained an independent operation and became known as the **Civil Aeronautics Board (CAB)**. The Air Safety Board was abolished and its functions given to the CAB. The administrator of the old Civil Aviation Authority became the head of an office within the Department of Commerce known as the **Civil Aeronautics Administration (CAA)**. The duties of the original five-man authority were unchanged, except that certain responsibilities, such as accident investigation, previously handled by the Air Safety Board, were added. The administrator, in addition to retaining the function of supervising construction, maintenance, and operation of the airways, was required to undertake the administration and enforcement of safety regulations, and the administration of the laws with regard to aircraft operation. Subsequently, the administrator became directly responsible to the secretary of commerce. The term CAA, which originally identified the Civil Aeronautics Authority, became the common moniker of the Civil Aeronautics Administration.

Airport modernization: The early jet age The Airways Modernization Act of 1957

Recognizing that the demands on the federal government in the years ahead would be substantial, the director of the Bureau of the Budget requested a review of aviation facilities problems in 1955, William B. Harding was appointed as a consultant to the director. Harding, in turn, solicited the help of a number of prominent individuals in aviation to form his committee. In late December 1955, Harding submitted his report. Reporting that the need to improve air traffic management had already reached critical proportions, the group recommended that an individual of national reputation, responsible directly to the president, be appointed to provide full-time, high-level leadership in developing a program for solving the complex technical and organizational problems facing the government and the aviation industry.

The Federal Aviation Act of 1958

On May 20, 1958, a military jet trainer and a civilian transport plane collided over Brunswick, Maryland, killing 12, the third major air disaster within a period of 31_2 months. This tragedy spurred governmental action to establish a comprehensive Federal Aviation Agency. Instead of taking a predicted 2 or 3 years to create a single aviation agency, Congress immediately took action to enact legislation. As a result, the **Federal Aviation Act of 1958** was signed by the president on August 23, 1958. Treating comprehensively the federal government's role in fostering and regulating civil aeronautics and air commerce, the new statute repealed the Air Commerce Act of 1926, the Civil Aeronautics Act of 1938, the Airways Modernization Act of 1957, and those portions of the various presidential reorganization plans dealing with civil aviation.

The law provided for the retention of the Civil Aeronautics Board as an independent office including all its functions except the safety rule-making powers, which were transferred to the

new **Federal Aviation Agency**. The Federal Aviation Agency was created with an administrator responsible to the president.

The agency incorporated the function of the Civil Aeronautics Administration and the Airways Modernization Board. Section 103 of the act concisely stated the administrator's major powers and responsibilities:

1. The regulation of air commerce in such manner as to best promote its development and safety and fulfill the requirements of national defense.
2. The promotion, encouragement, and development of civil aeronautics.
3. The control of the use of the navigable airspace of the United States and the regulation of both civil and military operations in such airspace in the interest of the safety and efficiency of both.
4. The consolidation of research and development with respect to air navigation facilities, as well as the installation and operation thereof.
5. The development and operation of a common system of air traffic control and navigation for both military and civil aircraft.

The Department of Transportation: 1967

For many years it was argued that there had been unrestrained growth and considerable duplication of federal activities regarding transportation. In 1966, President Lyndon Johnson chose to deliver a special transportation message to Congress. He focused in on the need for coordination of the national transportation system, reorganization of transportation planning activities, and active promotion of safety. In his address, President Johnson contended that the U.S. transportation system lacked true coordination and that this resulted in system inefficiencies. He advocated the creation of a federal department of transportation to promote coordination of existing federal programs and to act as a focal point for future research and development efforts in transportation.

Congressional hearings were held on several bills involving most of President Johnson's recommendations. Although some opposition was expressed to specific proposals, there was general support for creation of the **Department of Transportation (DOT)**. The legislation creating the DOT was approved on October 15, 1966. DOT commenced operations on April 1, 1967, and Alan S. Boyd was appointed the first secretary of transportation.

The agencies and functions transferred to the DOT that related to air transportation included the Federal Aviation Agency in its entirety and the safety functions of the Civil Aeronautics Board, including the responsibility for investigating and determining the probable cause of aircraft accidents and safety functions involving review on appeal of the suspension, modification, or denial of certificates or licenses. The Federal Aviation Agency was placed under the DOT and renamed the Federal Aviation Administration (FAA). The administrator of the FAA was still appointed by the president but from then on reported directly to the secretary of transportation.

The act also created within the new department a five-member **National Transportation Safety Board (NTSB)**. The act charged the NTSB with (1) determining the cause or probable cause of transportation accidents and reporting the fact, conditions, and circumstances relating to such

accidents; and (2) reviewing on appeal the suspension, amendment, modification, revocation, or denial of any certificate or license issued by the secretary or by an administrator.

Airport legislation after airline deregulation

The Deregulation Acts of 1976 and 1978

The passage of the Air Cargo Deregulation Act of 1976 and, more important, the Airline Deregulation Act of 1978, signaled an end to the 40-year history of economic regulation of the airline industry. Deregulation of airlines was part of a general trend gaining momentum in the 1970s to reduce government regulation of private industry. By this time, many observers in Congress and elsewhere had begun to doubt that federal regulation was encouraging orderly competition and had come to suspect that the regulatory process was imposing unnecessary costs and creating distortions in the marketplace. Even before Congress passed the deregulation acts, the CAB itself had conducted a number of experimental reductions of certain types of regulation in order to encourage competition. With the 1978 act, the market was opened to new entrants, and carriers gained much greater freedom to enter or leave markets, to change routes, and to compete on the basis of price. The 1978 act also called for the “sunset” of the CAB by the end of 1984, with transfer of its few remaining essential functions to the DOT and other departments.

UNIT II

AIRPORT OPERATIONS MANAGEMENT

The components of the airport

An airport is a complex transportation facility, designed to serve aircraft, passengers, cargo, and surface vehicles. Each of these users is served by different components of an airport. The components of an airport are typically placed into two categories

The Airside

The landside

The **airside** of an airport is planned and managed to accommodate the movement of aircraft around the airport as well as to and from the air. The airside components of an airport are further categorized as being part of the local airspace or the airfield. The airport's **airfield** component includes all the facilities located on the physical property of the airport to facilitate aircraft operations. The **airspace** surrounding an airport is simply the area, off the ground, surrounding the airport, where aircraft maneuver, after takeoff, prior to landing, or even merely to pass through on the way to another airport.

The **landside** components of an airport are planned and managed to accommodate the movement of ground-based vehicles, passengers, and cargo. These components are further categorized to reflect the specific users being served. The airport **terminal** component is primarily designed to facilitate the movement of passengers and luggage from the landside to aircraft on the airside. The airport's **ground access** component accommodates the movement of ground-based vehicles to and from the surrounding metropolitan area, as well as between the various buildings found on the airport property.

No matter what the size or category of an airport, each of the above components is necessary to properly move people from one metropolitan area to another using air transportation. The components of an airport are planned in a manner that allows for the proper "flow" from one component to another. An example of a typical "flow" between components is illustrated in Fig. In Figure further identifies some of the facilities located on the airfield and ground access components of the airport.

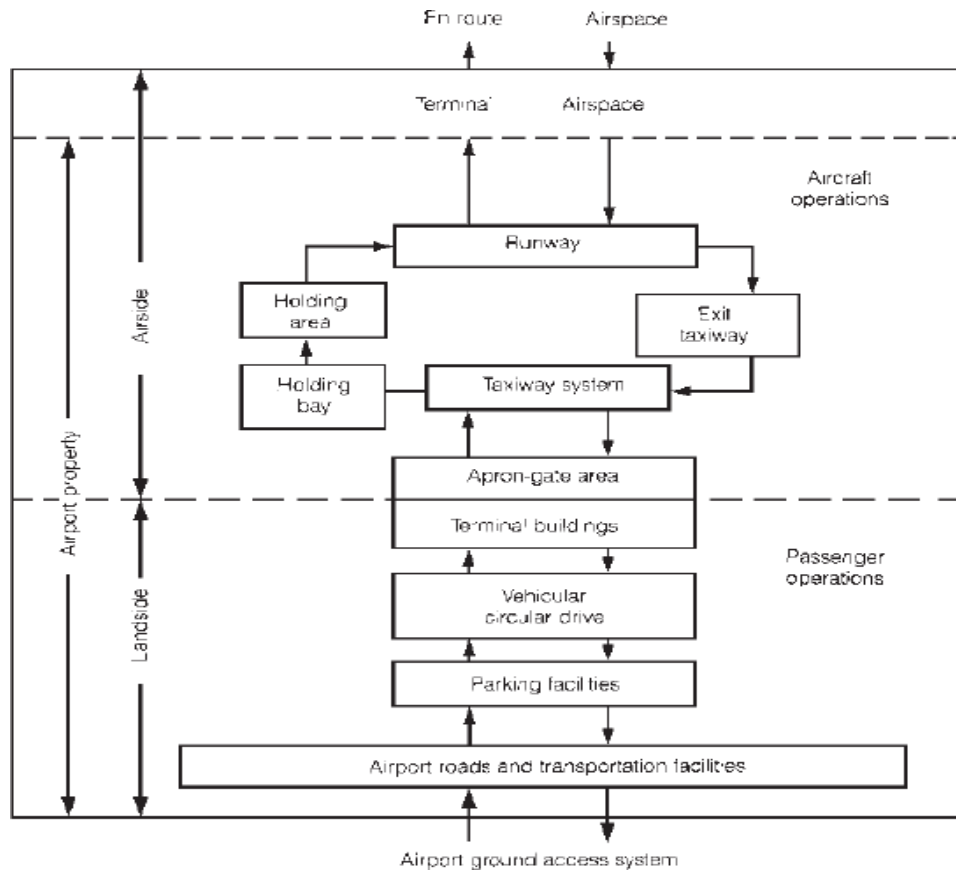


Fig. The components of an airport

The complexity of the Airport operation:

Until the deregulation & privatization of the air transport industry in the late 1970s & 1980s, it had been seen in many countries almost as a public service industry that required support from the Public purpose.

Airports such as Shannon in republic & Amsterdam in Netherlands, were among the first to develop income from commercial activities. By 1970s commercial revenues had become very inplerns of total income. The larger airports became complex business with functions that extended well beyond the airfield or “traffic” side of operations. It is also clear that in most countries, airports maintain economic viability by developing a broadly based reveere capability. As the relative and alxobute sizes of the non traffic element of the airports revenue increase, much more attention must be paid to developing commercial expertise, some of the largest airports have developed considerable in-house expertise in maximizing commercial revenues.

The non aeronautical activities found at airports are (ICAO) 2006;

Aviation fuel suppliers

Food & beverage sales (i.e restaurants, bars cafeterias etc)

Duty paid shopping

Banks / Foreign exchange

Airline catering services

Taxi services

Car rentals
Advertising
Airport /City transport services (i.e buses, limousines etc.
Duty free shopping (eg alcohol, tobacco, perfume, watches, optical)
Petrol/automobile service stations
Hair dressing/barber shop
Internet services
Casinos/gaming machines
Cinema
Vending machines for other than food
Freight consolidators
Art concerts
Music concerts
Souvenir shops

The degree to which airports go to a non aeronautical activity is likely to depend on the destination of the revenues generated from such activities. These go directly to the airport and add to the airports profitability. There are number of situations that can act as disincentive to the airport company. Where income from non aeronautical sources goes directly to the national treasury. Where the government gives the dut-free franchise to the government-owned airline. Where the U. S airport is operated on a residual cost basis, and income from non aero

Airport terminals and ground access

The airport terminal area, comprised of passenger and cargo terminal buildings, aircraft parking, loading, unloading, and service areas such as passenger service facilities, automobile parking, and public transit stations, is a vital component to the airport system. The primary goal of an airport is to provide passengers and cargo access to air transportation, and thus the terminal area achieves the goal of the airport by providing the vital link between the airside of the airport and the landside. The terminal area provides the facilities, procedures, and processes to efficiently move crew, passengers, and cargo onto, and off of, commercial and general aviation aircraft.

The term *terminal* is in fact somewhat of a misnomer. Terminal implies ending. Although aircraft itineraries begin and end at an airport's terminal area, the itineraries of passengers and baggage do not.

The historical development of airport terminals

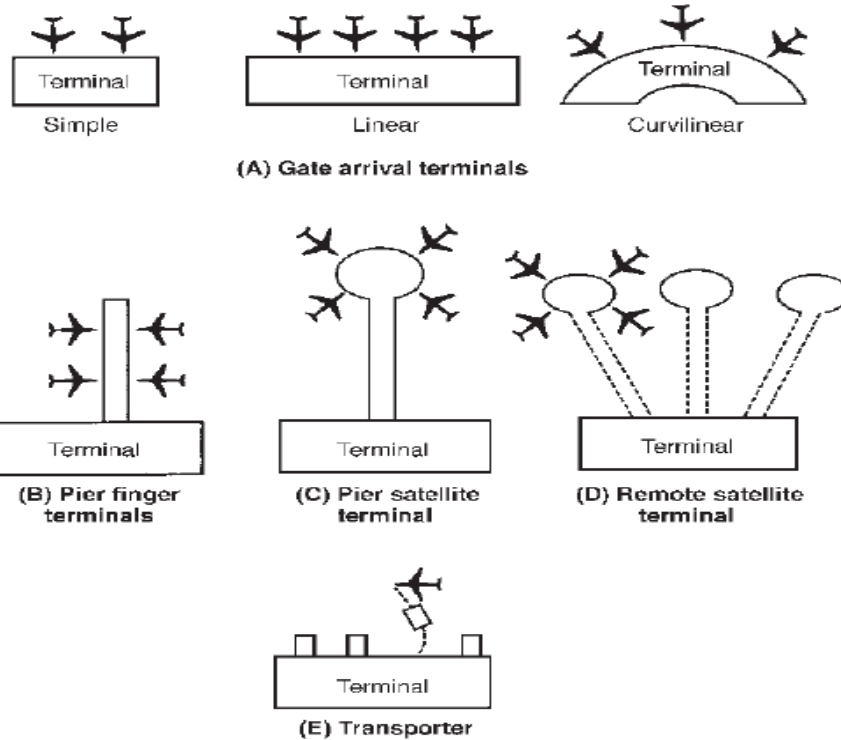
Just as there were no runways or other airfield facilities during the very earliest days of aviation, there certainly were no terminals, at least the way they are recognized today. The first facilities that could be remotely considered airport terminal areas evolved in the early 1920s with the introduction of airmail service. Airmail operations required small depots in order to load and unload mail, fuel aircraft, and perform any required maintenance. Little in the way of formal passenger or cargo processing was required, and hence, airport terminal facilities were little more than single-room structures with the most basic of infrastructure.

Unit terminal concepts

These first terminals were the earliest **centralized facilities**, centralized meaning that all passenger processing facilities at the airport are housed in one building. These first centralized facilities became known as the earliest **simple unit terminals**, because they contained all required passenger processing facilities for a given air carrier in a single-unit building. In addition to passenger processing facilities, the airport's administrative offices, and even air traffic control facilities, were located within the unit terminal building. As air service became more popular, particularly in the 1940s and 1950s, airport terminals expanded to accommodate increasing volumes of aircraft, passengers, and cargo. As multiple airlines began to serve single communities, airport terminals expanded in two ways. In smaller communities, two or more airlines would share a common building, slightly larger than a simple unit terminal, but have separate passenger and baggage processing facilities. This configuration became known as the **combined unit terminal**. In larger metropolitan areas, separate buildings were constructed for each airline, each building behaving as its own unit terminal. This terminal area configuration became known as the **multiple-unit terminal** concept (Fig. 6-3). Even though the multiple-unit terminal area consisted of separate facilities for each airline, it is still considered an individual *centralized* facility because all passenger and cargo processing required for any given passenger or piece of cargo to board any given flight still exists in one facility.

Linear terminal concepts

As airports expanded to meet the growing needs of the public, as well as the growing wingspans of aircraft, simple-unit terminals expanded outward in a rectangular or *linear* manner, with the goal of maintaining short distances between the vehicle curb and aircraft parking that existed with unit terminals. Within linear terminals, ticket counters serving individual airlines were introduced and loading bridges were deployed at aircraft gates to allow passengers to board aircraft without having to be outside on the apron, thereby improving convenience and safety for passengers. In some instances airports were extended in a **curvilinear** fashion, allowing even more aircraft to park "nose-in" to the terminal building while maintaining short walking distances from the airport entrance to the aircraft gate (Fig. 6-5). In many respects, the linear and curvilinear terminal concepts are mere extensions of the simple unit terminal concept. More sophisticated linear terminals particularly those that serve high volumes of passengers, often feature two-level structures where enplaning passengers are processed on one level and deplaning passengers on the other level. Passenger walking distances from the "curb to the gate" are typically short, on the order of 100 feet. The linear configuration also lends itself to the development of automobile parking that is close to the terminal building, and provides extended curb frontage for loading and unloading of ground transportation vehicles. One of the main disadvantages of linear terminals becomes evident as the length of the terminal building increases. Walking distances between facilities, particularly distantly separated gates, become excessive for the passenger whose itinerary requires a change in aircraft at the airport.



Terminal design concepts. (Source: FAA)

Off-airport terminals

In the 1980s the airside-landside concept formed the basis for a series of experimental concepts known as off-airport terminals. With the notion that certain passenger processes, such as ticketing and baggage check-in, and certainly automobile parking, did not need to be within any proximity of aircraft, such processes weren't necessarily required to be performed on airport property. As a result, facilities located miles away from the airport itself were introduced whereby passengers could park their personal vehicles, check themselves and their baggage in for their flights, and then take a shuttle bus to the airport. With the use of these off airport terminals, passengers would avoid the often significantly more crowded passenger processing facilities at the main terminal. Also the passenger would not be required to find parking at the often more crowded and expensive parking facilities at the main terminal.

Present-day airport terminals

With over 650 million passengers traveling annually, each with different agendas, itineraries, needs, and desires, airport terminals have become complex systems in their own rights, incorporating both necessary passenger and baggage processing services as well as a full spectrum of customer service, retail shopping, food and beverage, and other facilities to make the passengers' transition between the airside and landside components of the airport system as pleasant as possible. It is clear that no single airport terminal configuration is best for all airports. The airfield, schedules of airlines, types of aircraft, volumes of passengers, and local considerations, such as local architecture, aesthetics, and civic pride, dictate different choices from airport to airport and from one time to another. The airport terminal planner has the dubious task of anticipating conditions up to 10 years in the future in an environment that seems to change by the day. To ensure that present-day airport terminal plans will be effective

in the future, the airport planner must rely on the fundamental requirements of airport terminals and behaviors of passengers, and also must plan with the idea of flexibility in mind, such as considering facilities that can be expanded modularly or can provide the opportunity for relatively low-cost, simple modifications that future circumstances might demand. For airport management, airport terminal areas, when properly planned and managed, have provided significant sources of revenue from airline leases to retail concessions.

Components of the airport terminal

The airport terminal area is in the unique position of accommodating the needs of both aircraft and the passengers that board them. As such, the component systems of the airport terminal area may be thought of as falling into two primary categories: the **apron and gate system**, which is planned and managed according to the characteristics of aircraft, and the *passenger and baggage handling systems*, which are planned and managed to accommodate the needs of passengers and their baggage in their transition to or from the aircraft.

The apron and gate system

The apron and gates are the locations at which aircraft park to allow the loading and unloading of passengers and cargo, as well as for aircraft servicing and preflight preparation prior to entering the airfield and airspace.

Aircraft gate management

One of the most important and sometimes most challenging aspects of planning and managing the apron concerns the number of aircraft parking areas, or gates, that are required for efficient operations. The number of commercial aircraft gates required at an airport, for example, over any given operating day is dependent on a series of factors, including: the number and type of aircraft scheduled to use a gate, each aircraft's scheduled *turnaround time* (also known as *gate occupancy time*), and the type of *gate usage agreement* that each air carrier has with the airport.

Airport ground access

Access to the airport from the surrounding community is an integral part of the overall passenger and baggage processing system. The *access/egress link* of an airport's passenger handling system includes all of the ground transportation facilities, vehicles, and other modal transfer facilities required to move the passenger to and from the airport. Included in the access/egress link are highways, intercity and metropolitan rail service, autos, taxicabs, buses, shuttles, limousines, and transfer stations, including off- and on-airport parking sites and rail stations.

Airport access is usually divided into two major segments:

- Access from the CBD (central business district) and suburban areas via highway and rapid transit systems to the airport boundary
- Access from the airport boundary to parking areas and passenger unloading curbs at the terminal building

Access modes

Unless the ultimate destination of any travel itinerary is the airport itself, every trip on a commercial aircraft and nearly every trip on a general aviation aircraft includes an additional

mode of transportation. A *mode* of transportation is defined as a type of vehicle used to travel from one point to another.

The Transportation Research Board defines the most common modes of airport access as:

- *Private vehicles*: Vehicles used to transport airline passengers or visitors (e.g., family members, employees, friends, or clients), without payment of a fare by the passenger, which are privately owned and privately operated.
- *Rental cars*: Vehicles used to transport airline passengers or visitors, which are leased by the passenger or visitor from an agency doing business at or near the airport and rented for the duration of the passenger's or visitor's trip. Vehicles rented under a long-term lease (i.e., greater than 3 months) are considered private vehicles, not rental cars.
- *Courtesy vehicles*: Door-to-door, shared-ride transportation provided for customers of hotels, motels, rental car agencies, parking lots (both those privately operated and airport operated), and other services. Typically, no fare is charged because the transportation service is considered part of (or incidental to) the primary service being provided. Service is provided using a variety of vehicles, including full-size buses, minibuses, vans, and station wagons.

Factors influencing demand for ground access

Demand for ground access, that is, the volume of people that wish to have access between the airport and their respective origins and destinations at commercial service airports, is primarily generated by the number of enplaning and deplaning passengers using the airport. These volumes are generated in part by the provision of air service by the air carriers that serve the airport. Characteristics of this air service include destinations served, the type of aircraft used, and the daily departure and arrival schedules of the air carriers.

In addition to passengers themselves, airports are accessed by those people seeing off or meeting passengers at the airport. These people are known as *meeters/greeters*. The demand for airport access by meeters/greeters is dependent on similar characteristics as that of passengers themselves.

A significant proportion of trips made to and from airports are generated by the workforce in place at each airport, including airport, airline, and government employees, as well as employees of the many private companies that do business at the airport, including concessionaires, contractors, and suppliers. These trips are less dependent on available flight service. They are more associated with the travels that occur during any business day, including morning and evening commutes and trips associated with business delivery. In addition, as many functions in the airport operate as much as 24 hours per day, there are a number of trips to the airport that occur outside normal business hours.

Airport security

Introduction

One of the most significant issues facing airports in the early twenty-first century is that of airport security. Most users of commercial service airports are subjected to security

infrastructure, policies, and procedures within the airport terminal area. Airport security is not limited to the terminal area, however. Airport security concerns all areas and all users of the airport.

Airport security procedures are designed to deter, prevent, and respond to criminal acts that may affect the safety and security of the traveling public. Criminal activity includes the hijacking of aircraft, known as air piracy, damaging or destroying aircraft with explosives, and other acts of terrorism, defined as the systematic use of terror or unpredictable violence against governments, publics, or individuals to attain a political objective. Criminal activity also includes acts of assault, theft, and vandalism against passengers and their property, aircraft, and all airport facilities.

The Transportation Security Administration

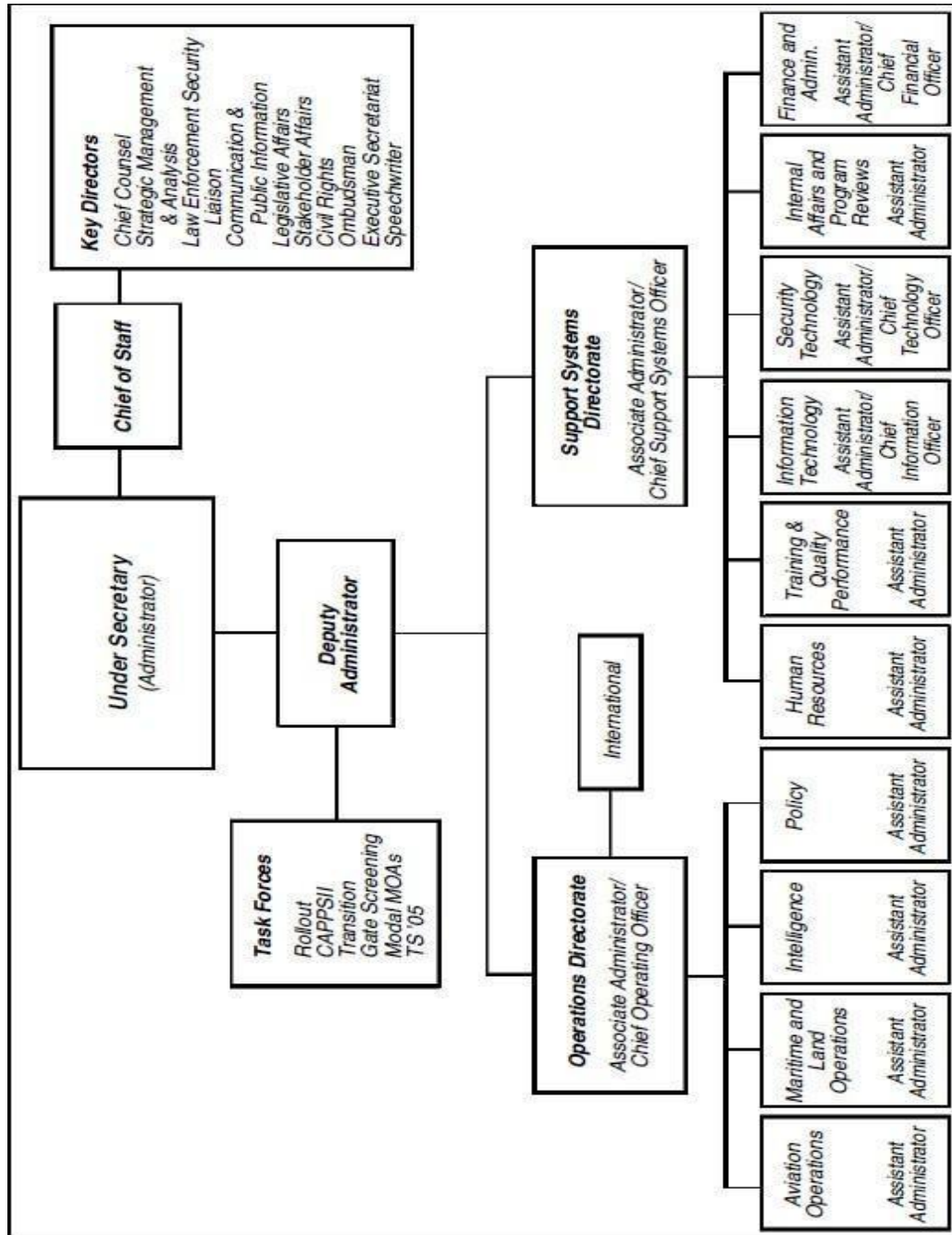
As a result of the events of September 11, 2001, and the subsequent signing of the **Aviation and Transportation Security Act (ATSA)**, the practice of airport security began to undergo radical changes, beginning with the creation of the Transportation Security Administration. With the signing of the ATSA, the **Transportation Security Administration (TSA)** was incorporated into the organizational structure of the U.S. Department of Transportation, to be operated in close coordination with all other transportation administrations, including the FAA, and headed by an undersecretary of transportation security. On December 10, 2001, Secretary of Transportation Norman Mineta announced the appointment of then Chief of the Bureau of Alcohol, Tobacco, and Firearms, and former Secret Service agent, John Magaw, as the TSA's first undersecretary of transportation.

In May 2002, Undersecretary Magaw resigned his post, amid feelings by airport operators that the TSA was not sympathetic to the transportation-related needs of airport management that was necessary to create an efficient security system. Admiral James Loy, former administrator of the United States Coast Guard, was appointed temporary undersecretary of the TSA.

In March of 2003, the TSA, along with the Coast Guard, Customs Service, and Immigration and Naturalization Service, was formally moved into the newly formed United States Department of Homeland Security, led by Secretary Tom Ridge. At the same time, James Loy was appointed the first administrator of the TSA.

As of March 31, 2003, the TSA employed a workforce of over 55,200 passenger and baggage screeners (to be reduced to 54,600 by September 30, 2003) at 429 commercial service airports in the United States, supervised by a team of 155 **federal security directors (FSD)** each assigned to one or more airports, along with an administrative staff of over 600 regional and national managers. The administrative structure of the TSA is organized according to the organizational chart depicted in Fig .

The mission of the TSA is to protect all of the nation's transportation systems to ensure freedom of movement for people and commerce. Since its inception in 2001, the TSA has concentrated the vast majority of its efforts on securing the transportation of passengers on commercial air carriers traveling through the nation's airports through the implementation of passenger and baggage screening requirements set forth in the ATSA.



Security at commercial service airports

The events of September 11, 2001, the associated legislative action of the ATSA, and the formation of the TSA have all contributed to the changing rules, regulations, policies, and procedures associated with airport security. In addition, state and local governments, along with organizations representing members of the aviation industry, from the Air Line Pilots Association, to the American Association of Airport Executives, to the Aircraft Owners and Pilots

Association, have made major contributions to the potential future security for the users of the nation's commercial service and general aviation airports.

At commercial service airports, areas of airport security are commonly categorized as passenger screening, baggage screening, employee identification, and controlled access and perimeter security.

Passenger screening

The processing of passengers and baggage for the purpose of ensuring the security of the civil aviation system has undergone a virtual overhaul following the terrorist attacks on the United States on September 11, 2001. As of 2003, passenger and baggage security screening is managed and operated by the Transportation Security Administration (TSA). Even though the TSA has ultimate authority of the facilities and procedures that comprise the security screening processes, airport managers and planners should be keenly aware of the security screening process, because the process has presented the most significant impacts on airport terminal planning and operations in recent years. As of 2003, policies surrounding passenger and baggage security screening remained in a high state of flux. Despite this, certain fundamentals of the passenger and baggage screening process remain.

Passenger screening facilities include an automated screening process, conducted by a magnetometer that attempts to screen for weapons potentially carried on by a passenger that are metallic in content. As a passenger walks through a magnetometer, the presence of metal on the passenger is detected. If a sufficient amount of metal is detected, based on the sensitivity setting on the magnetometer, an alarm is triggered. Passengers who trigger the magnetometer are then subject to a manual search by a TSA screener. Manual searches range from a further check of metal on the passenger's person with the use of a handheld wand, to a manual pat down, to the inspection of the passenger's shoes explosive detection equipment prior to being loaded onto air carrier aircraft (known as the 100 percent EDS rule). As of 2003, the primary piece of equipment used to perform checked-baggage screening, the **explosive detection system (EDS)**, uses computed tomography technology, similar to the technology found in medical CT scan machines, to detect and identify metal and trace explosives that may be hidden in baggage

Checked-baggage screening

Facilities to conduct screening of checked baggage for explosives have been placed at airports to adhere to the requirement implemented by the TSA on January 1, 2003, to have every piece of checked baggage screened by certified

Employee identification

TSA regulations require any person who wishes to access any portion of an airport's security identification display area (SIDA) must display appropriate identification. This identification, known typically as a *SIDA badge*, is usually in the form of a laminated credit card-sized identification badge with a photograph and name of the badge holder. Persons typically

requiring a SIDA badge include airport employees, air carrier employees, concessionaires, contractors, and government employees such as air traffic controllers and airport security staff.

Prior to obtaining an identification badge, persons must complete an application and undergo a fingerprint-based criminal history records check. Any of the following criminal histories within a 10-year period prior to the date of application will result in the disqualification for obtaining an SIDA badge:

- 1.** Forgery of certificates, false marking of aircraft, and other aircraft registration violation
- 2.** Interference with air navigation
- 3.** Improper transportation of a hazardous material
- 4.** Aircraft piracy
- 5.** Interference with flight crew members or flight attendants
- 6.** Commission of certain crimes aboard aircraft in flight
- 7.** Carrying a weapon or explosive aboard aircraft
- 8.** Conveying false information and threats
- 9.** Aircraft piracy outside the special aircraft jurisdiction of the United States
- 10.** Lighting violations involving transporting controlled substances
- 11.** Unlawful entry into an aircraft or airport area that serves air carriers or foreign air carriers contrary to established security requirements
- 12.** Destruction of an aircraft or aircraft facility
- 13.** Murder
- 14.** Assault with intent to murder
- 15.** Espionage
- 16.** Sedition
- 17.** Kidnapping or hostage taking
- 18.** Treason
- 19.** Rape or aggravated sexual abuse
- 20.** Unlawful possession, use, sale, distribution, or manufacture of an explosive or weapon
- 21.** Extortion
- 22.** Armed or felony unarmed robbery
- 23.** Distribution of, or intent to distribute, a controlled substance
- 24.** Felony arson
- 25.** Felony involving a threat
- 26.** Felony involving:
 - i.** Willful destruction of property
 - ii.** Importation or manufacture of a controlled substance
 - iii.** Burglary
 - iv.** Theft
 - v.** Dishonesty, fraud, or misrepresentation
 - vi.** Possession or distribution of stolen property
 - vii.** Aggravated assault
 - viii.** Bribery

ix. Illegal possession of a controlled substance punishable by a maximum term of imprisonment of more than 1 year.

27. Violence at international airports

28. Conspiracy or attempt to commit any of the criminal acts listed above

Controlled access

A variety of measures are used around airports to prevent, or more appropriately, control the movement of persons and vehicles to and from security-sensitive areas of the airport property.

At most commercial service airports, **controlled access** through doors that provide access to the AOA, secure areas, sterile areas, and other areas within the SIDA, as well as many employee-only restricted areas, is enforced by the use of control systems. These systems range from simple key locks to smart-access technologies, such as keypad entry systems requiring proper pass code.

In many cases, pass codes are calibrated with a person's SIDA badge, requiring both a presentation of the person's badge and proper pass code entry to gain access. One weakness associated with door entry to security-sensitive areas, regardless of their access control measures, is the ability to allow unauthorized persons to enter through the door after an authorized person has opened the door. This situation is known as *piggybacking*, and is almost always a violation of security policies.

In some instances, revolving turnstiles with a one-rotation limit per access, rather than typical door systems, have been used to restrict the number of persons achieving access through these areas.

Biometrics

Advanced identification verification technologies, including those that employ biometrics, are continuously being developed to enhance access control at airports. **Biometrics** refers to technologies that measure and analyze human body characteristics such as fingerprints, eye retinas and irises, voice patterns, facial patterns, and hand measurements, especially for identification authentication purposes.

Biometric devices typically consist of a reader or scanning device, software that converts the scanned information into digital form, and a database that stores the biometric data for comparison.

For the most part, biometric technologies have initially been found to be most applicable when controlling the access of those with SIDA badges at the airport. Controlling the access of the general public using biometrics proves more difficult, because previously recorded data are required to authenticate the identification of the person. If anything, however, biometrics provides another technology to prevent unauthorized access to security-sensitive areas

Perimeter security

An important part of an airport's security plan is its strategy for protecting the areas that serve as the border between secured and unsecured areas of the airport, known as the airport perimeter. Four of the most common methods for securing the airport's perimeter are perimeter fencing, controlled access gates, area lighting, and patrolling of the secured area.

Perimeter fencing is one of the most common methods of creating a barrier in otherwise easily accessible areas of an airport's secured area boundary. Fencing can vary in design, height, and type, depending on local security needs. Generally, however, the following standards, as recommended by FAA Advisory Circular 107-1, Aviation Security, Airports, are followed.

Security at general aviation airports

The Federal Aviation Administration focused virtually all of its aviation security programs toward the commercial aviation sector of the industry. As such, the vast majority of regulations created for airport security are those for airports that serve the flying public using certificated carriers or regularly scheduled aircraft with more than 60 passenger seats. The FAA's justification for this strategy was that nearly 100 percent of all passenger air travel takes place at commercial airports using the airlines or other large aircraft. However, general aviation airports have a number of characteristics that make them prone to potential security risks. In many cases, aircraft owners, pilots, and passengers have access to the airfield with relatively little outside supervision. What supervision is preferred is done so by the users of the airport themselves, including aircraft owners, fixed-base operators, and airport employees. Most other security measures in place at general aviation airports, such as fencing or controlled access gates, are designed more for deterrence rather than security measures.

The biggest threat for general aviation facilities, however, is the fact that the load-carrying capability of aircraft of general aviation airports, even if limited, enables the delivery of explosives, compensating for their relative lack of kinetic energy or fuel. Another potential risk is that general aviation aircraft could be used to strike ground-based targets. Given the ubiquity of general aviation aircraft and airports, such aircraft are never far from major urban centers, critical infrastructures, and other targets. Another important issue is the fact that most localities do not have the staff to assign someone to patrol the airport; therefore, patrolling is usually done on an infrequent basis which can range anywhere from once every few hours to weeks. An equally serious factor that reduces the security at general aviation airports is the fact that much of the equipment (i.e., fencing, gates, etc.) surrounding the airport is antiquated or undermaintained for supporting unauthorized access. In fact, the main purpose of gates and fencing at a number of general aviation airports is to keep out animals and/or deter people from accidentally walking/driving onto the airport.

Similar to commercial service airports, common security attributes that general aviation airports may be equipped with are:

- Personnel and vehicle identification procedures
- Perimeter fencing
- Controlled access gates
- Security lighting

- Locks and key control
- Patrolling

The future of airport security

Since the first criminal threats to civil aviation, reactive policies to prevent further occurrences of current threats have been implemented. This reactive paradigm has resulted in two consequences: (1) the reduction in the number of attacks from a current type of threat and (2) the creation of new threats against civil aviation that the system has not been prepared to mitigate. This has been evidenced by the historical development of different threats, from nonviolent hijackings, to violent hijackings using firearms, the placing of unattended explosives on aircraft, suicide hijackings, attempted suicide bombings, and most recently, attempts to down aircraft using shoulder-fired missiles near airports where aircraft are at relatively low altitudes and speeds.

As a result, thoughts regarding the future of airport security suggest a shift of policy, from a reactive approach to screening for the placement of weapons or explosives on aircraft, to a proactive approach to protecting against violent or other criminal acts by persons in and around the entire airport environment. This proactive approach requires technological and human expertise to screen persons for suspicious activity, rather than simply screening them for unauthorized possessions. Two such programs in development that address this include the **Computer Assisted Passenger Pre-Screening System (CAPPS II)** and the **Trusted Traveler Program**.

CAPPS II

The Computer Assisted Passenger Pre-Screening System, known as CAPPS II, is an enhancement of a profiling system employed by the FAA that selected passengers for additional screening based on their air carrier itinerary and citizenship. CAPPS II, designed to be a nondiscriminatory selection system uses passenger information to verify identity and then determine risk, which is presented in a score and its corresponding color: red, yellow, or green. The system is designed to start with four pieces of passenger information, voluntarily given when passengers purchase airline tickets: name, address, phone number, and date of birth. CAPPS II then combs criminal activity and other databases to build a risk assessment score based on verified passenger information.

UNIT III

AIRPORT ADMINISTRATION AND FINANCIAL MANAGEMENT ,CAPACITY AND DELAY

Airport financial management**Airport financial accounting**

The nature of airport expenses depends upon a number of factors including the airport's geographic location, organizational setup, and financial structure. Airports in warmer climates, for example, do not experience the sizable snow removal and other cold weather–related expenses that airports in colder climates must face. Some municipalities, counties, or local authorities absorb the costs of certain staff functions, such as accounting, legal, planning, and public relations. Certain operating functions such as emergency service, policing, and traffic control might also be provided by local fire departments and local law enforcement agencies at some airports. In addition, the ever-changing demand characteristics of passengers, service characteristics of air carriers and other aircraft operators, as well as aircraft, navigation, communication, and information technologies affect the need to invest in projects involving airport capital improvements.

A good accounting system is needed for a number of reasons: Financial statements are needed to inform governmental authorities and the local community regarding details of the airport's operations.

- A good accounting system can assist airport management in allocating resources, reducing costs, and improving control.
- Negotiating charges for use of airport facilities can be facilitated.
- Financial statements can influence the decisions of voters and legislators.

Planning and administering an operating budget Planning an operating budget is an integral part of airport financial management. Every airport must make short-term decisions about the allocation and scheduling of its limited resources over many competing uses; it must make long-term decisions about rates of expansion of capital improvements and funding sources. Both short-term and long-term decisions require planning. Planning is important because it:

- Encourages coordinated thinking. No one department can act independently. A policy decision in a particular department affects the airport as a whole.
- Helps develop standards for future performance. Without plans, the airport's measure of financial performance can be based only on historical standards. Although past operating statements help to set these standards for the future, they should not necessarily serve as standards themselves.
- Assists management in controlling the actions of subordinates. By planning, employees are provided a goal or standard to achieve.
- Might help reveal potential problems for which remedial measures can be taken earlier.
- Promotes smoother-running operations. For example, new equipment can be ordered in advance of its anticipated usage. With smooth, uninterrupted operations, the overall efficiency of the airport can be increased.

Pricing of airport facilities and services

Major commercial airports are diversified enterprises that provide a wide range of facilities and services for which fees, rents, or other user charges are assessed. The facilities and services

provided to users generate the revenues necessary to operate the airport and to support the financing of capital development. Smaller commercial airports and GA airports typically offer a much narrower range of facilities and services, for which only minimal fees and charges often are assessed. Revenue bases shrink as airports decrease in size, and many of the smallest airports do not generate sufficient revenue to cover their operating costs, much less capital investment. Among GA airports, those that lease land or facilities for industrial use generally have a better chance of covering their costs of operation than do those providing only aviation-related services and facilities.

Airport financing

Since the mid-1990s the largest source of funding for capital improvements at airports has been through bond financing. In the years 1999–2001, for example, a total of \$12 billion was funded for capital improvements at the nation's commercial service airports, \$6.9 billion of which (59 percent) was issued through airport bonds.

The role of bond financing in overall investment varies greatly according to an airport's size and type of air traffic served. In terms of total dollar volume of bond sales, large and medium airports are by far the most prominent in the bond market. Of the total amount of municipal debt sold for airport purposes during the last two decades, 90 percent was for large and medium airports, in contrast to only 9 percent for small commercial airports. GA airports accounted for a little more than 1 percent of total airport bond sales.

The economic, political, and social role of airports

The economic role of airports

It is well understood that a viable and efficient transportation system is a fundamental and necessary component to the economy of any region. Transportation, by definition, provides the ability for people and goods to move between communities. This movement leads to trade and commerce between markets, which, in turn, leads to jobs, earnings, and overall economic benefit for a community's residents.

Transportation role

Even though there are a variety of transportation modes, such as automobiles, trucks, ships, and railroads, perhaps no other mode has as significant an impact on intercity trade and commerce than aviation. Travel in the aviation system allows for intercontinental travel of large volumes of passengers and cargo in relatively short periods of time. Access to markets around the world has resulted in the largest of communities reaping extraordinary economic benefit. Airports are the gateways to the nation's aviation system, providing access to air transportation for the surrounding community. Commercial air carriers provide access to air transportation between many major metropolitan areas of the country. Thousands of smaller cities, towns, and villages have access to aviation by way of airports serving general aviation.

Political roles

A major commercial airport is a huge public enterprise. Some are literally cities in their own right, with a great variety of facilities and services. Although the administration of these facilities is generally the responsibility of a public entity, such as a department of city government or aviation authority, airports also have a private character. Commercial airports must be operated in cooperation with the air carriers that provide air transportation service

and all airports must work with tenants, such as concessionaires, FBOs, and other firms doing business on airport property. This combination of public management and private enterprise creates a unique political role for airport management.

Airport planning

Airport planning may be defined as the employment of an organized strategy for the future management of airport operations, facilities designs, airfield configurations, financial allocations and revenues, environmental impacts, and organizational structures. There are various types of airport planning studies, including:

- Facilities planning
- Financial planning
- Economic planning
- Environmental planning
- Organizational planning
- Strategic planning

Defining the planning horizon

The planning of airport operations, or any activities for that matter, is defined in part by the length of time into the future management considers in its planning. The length of time into the future that is considered is termed the **planning horizon**. Different planning efforts require different planning horizons. For example, the organizational planning of staffing levels per shift for airport operations may require a 3-month planning horizon, but certainly not a 20-year planning horizon. On the other hand, facilities planning of an airfield which may include runway construction, requires at least a 5-year planning horizon, and certainly not a planning horizon of less than 1 year.

Airport system planning

Airport **system planning** is a planning effort that considers a collection of airports, either on a local, state, regional, or national level, expected to compliment each other as part of a coordinated air transportation system. Through airport system planning, the objectives of individual airports are set in accordance with the needs of the community by, for example, setting the mission of each airport to serve certain segments of the demand for aviation, such as targeting one airport in a region to handle international commercial air travelers and another airport to handle primarily smaller general aviation aircraft operations.

The airport master plan

At the local level, the centerpiece of airport planning is the airport **master plan**, a document that charts the proposed evolution of the airport to meet future needs. The

magnitude and sophistication of the master planning effort depends on the size of the airport. At the largest commercial service airports, master planning is a formal and complex process that has evolved to coordinate large construction projects (or perhaps several such projects simultaneously) that can be carried out over a period of up to 20 years. At smaller airports, master planning might be the responsibility of a few staff members with other responsibilities, who depend on outside consultants for expertise and support. At very small airports, where capital improvements are minimal or are made infrequently, the master plan might be a very simple document, perhaps prepared locally but usually with the help of consultants.

An airport master plan presents the planner's conception of the ultimate development of a specific airport. It effectively presents the research and logic from which the plan was evolved and artfully displays the plan in a graphic and written report. Master plans are applied to the modernization and expansion of existing airports and to the construction of new airports, regardless of their size or functional role. The typical airport master plan has a planning horizon of 20 years. The Federal Aviation Administration notes that for a master plan to be considered valid it must be updated every 20 years or when changes in the airport or surrounding environment occur, or when moderate and major construction may require federal funding.

Objectives of the airport master plan

- To provide an effective graphic presentation of the ultimate development of the airport and of anticipated land uses adjacent to the airport
- To establish a schedule of priorities and phasing for the various improvements proposed in the plan
- To present the pertinent backup information and data that were essential to the development of the master plan
- To describe the various concepts and alternatives that were considered in the establishment of the proposed plan
- To provide a concise and descriptive report so that the impact and logic of its recommendations can be clearly understood by the community the airport serves and by those authorities and public agencies that are charged with the approval, promotion, and funding of the improvements proposed in the airport master plan

Elements of the master plan

An airport master plan typically consists of the following elements: inventory, activity forecasts, demand/capacity analysis, facilities requirements, design alternatives, and financial plans. These elements provide a recipe for the airport in its effort to meet the demands of its users and the surrounding community over the airport's master plan. In addition, some master plans include environmental and economic assessments of plans associated with the future plans for the airport.

The airport layout plan

Even though a narrative description of the airport environment is a necessary part of an airport master plan inventory, a graphical representation is also required. This graphical representation is known as the **airport layout plan, or ALP**.

The airport layout plan is a graphic presentation to scale of existing and proposed airport facilities and land uses, their locations, and the pertinent clearance and dimensional information required to show conformance with applicable standards. It shows the airport location, clear zones, approach areas, and other environmental features that might influence airport usage and expansion capabilities

The airport layout plan also identifies facilities that are no longer needed and describes a plan for their removal or phase out. Some areas might be leased, sold, or otherwise used for commercial and industrial purposes. The plan is always updated with any changes in property lines; airfield configuration involving runways, taxiways, and aircraft parking apron size and location; buildings; auto parking; cargo areas; navigational aids; obstructions; and entrance roads. The airport layout plan drawing includes the following items: the airport layout, location map, vicinity map, basic data table, and wind information.

The airport layout is the main portion of the drawing. It depicts the existing and ultimate airport development and land uses drawn to scale and includes as a minimum the following information

- Prominent airport facilities such as runways, taxiways, aprons, blast pads, extended runway safety areas, buildings, NAVAIDs, parking areas, roads, lighting, runway marking, pipelines, fences, major drainage facilities, segmented circle, wind indicators, and beacons.
- Prominent natural and man-made features such as trees, streams, ponds, rock outcrops, ditches, railroads, power lines, and towers.
- Outline of revenue-producing non-aviation-related property, surplus or otherwise, with current status and use specified.
- Areas reserved for existing and future aviation development and services such as for general aviation fixed-base operations, heliports, cargo facilities, airport maintenance, and so forth.
- Areas reserved for non aviation development, such as industrial areas, motels, and so forth
- Existing topographic contours
- Fueling facilities and tiedown areas
- Facilities that are to be phased out
- Airport boundaries and areas owned or controlled by the sponsor, including aviation easements
- Airport reference point with latitude and longitude given on the basis of the U.S. Geological Survey grid system

- Elevation of runway ends, high and low points, and runway intersections
- True azimuth of runways (measured from true north)
- North point—true and magnetic
- Pertinent dimensional data—runway and taxiway widths and runway lengths, taxiway-runway-apron clearances, apron dimensions, building clearance lines, clear zones, and parallel runway separation

The **location map** shown in the lower-left-hand side of the airport layout plan drawing is drawn to scale and depicts the airport, cities, railroads, major highways, and roads within 25 to 50 miles of the airport. The **vicinity map** shown in the upper-left-hand side of the airport layout plan drawing shows the relationship of the airport to the city or cities, nearby airports, roads, railroads, and built-up areas

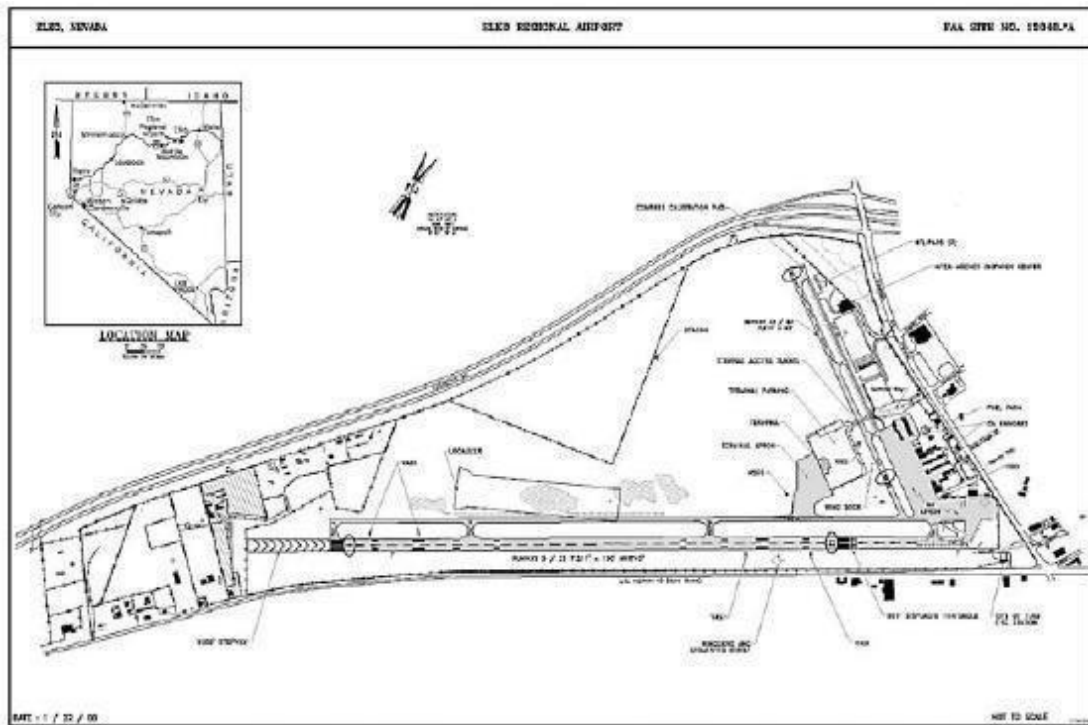


Fig. Example of ALP layout of airfield and facilities.

The **basic data table** contains the following information on existing and ultimate conditions where applicable:

- Airport elevation (highest point of the landing areas)
- Runway identifications
- Percent effective runway gradient for each existing and proposed runway
- Instrument landing system (ILS) runway when designated, dominant runway otherwise, existing and proposed
- Normal or mean maximum daily temperature of the hottest month

- Pavement strength of each runway in gross weight and type of main gear (single, dual, and dual tandem) as appropriate
- Plan for obstruction removal, relocation of facilities, and so forth

In addition, a wind rose (described in detail later in this chapter) is always included in the airport layout plan drawing with the runway orientation superimposed. Crosswind coverage and the source and period of data are also given. Wind information is given in terms of all-weather conditions, supplemented by IFR weather conditions where IFR operations are expected.

Airport layout plans also include to scale diagrams of all FAR Part 77 surfaces, noise impacted areas, and detailed-to scale drawings of major facilities at the airport, including terminal buildings, aircraft and automobile parking facilities, ground access roads, and public transit infrastructure, such as rail systems

Forecasting

Airport master plans are developed on the basis of forecasts. From forecasts, the relationships between demand and the capacity of an airport's various facilities can be established and airport requirements can be determined. Short-, intermediate-, and long-range (approximately 5-, 10-, and 20-year) forecasts are made to enable the planner to establish a schedule of development for improvements proposed in the master plan.

Two types of forecasting methods are available to assist planners in the decision-making process: qualitative and quantitative.

Qualitative forecasting methods

Qualitative forecasting methods rely primarily on the judgment of forecasters based on their expertise and experience with the airport and surrounding environment. Judgmental predictions of future airport activity tend not to be based on historical data, but by the foresight that certain experts have, based on their knowledge of the current and potential future environment. Qualitative forecasts may almost be thought of as “educated guesses,” opinions, or “hunches” of future activity, although they tend to be just as accurate as quantitative methods. Despite this, qualitative forecasts tend to require the support of some quantitative analysis to justify the forecasts to the public. Four of the more popular qualitative methods include: Jury of Executive Opinion, Sales Force Composite, consumer market survey, and the Delphi method.

Quantitative methods

Quantitative forecasting methods are those that use numerical data and mathematical models to derive numerical forecasts. In contrast to qualitative methods, quantitative methods are strictly objective. Because only numerical data are used, quantitative methods do not directly consider any judgment on the part of the forecaster. Quantitative methods are either used as stand-alone forecasting methods, or used to support forecasts made under qualitative methods.

Quantitative methods include *time-series* or *trend analysis models*, which forecast future values strictly on the basis of historical data collected over time, and *causal models*, which attempt to make accurate predictions of the future on the basis of how one area of historical data affects another.

A **causal model** is constructed by finding variables that explain, statistically, the changes in the variable to be forecasted. The availability of data on the variables, or more specifically their specific values, is largely determined by the time and resources the planner has available. For example, the number of aircraft operations forecast to occur at a general aviation airport may be statistically correlated to the strength of the economy, perhaps measured by the average income of residents in the area surrounding the airport.

Another reasonably sophisticated statistical method of forecasting is time-series or trend analysis, the oldest and in many cases still the most widely used method of forecasting air transportation demand. **Time-series** models are based on a measure of time (months, quarters, years, etc.) as the independent or explanatory variable. This method is used quite frequently where both time and data are limited, such as in forecasting a single variable, for example, cargo tonnage, where historical data are obtained for that particular variable.

Regression analysis

The most widely used mathematical method for performing both time-series and causal quantitative forecasts is regression analysis. **Regression analysis** applies specific mathematical formulas to estimate forecast equations. These equations may then be used to forecast future activity by applying the equations to independent variables that may occur in the future. Regression equations come in many forms. The most common regression equation is one that represents a straight line. The method used to estimate the equation of a straight line that best represents either historical trends or causal relationships is known as ordinary least-squares (OLS) linear regression analysis. Although based in sophisticated theories of statistics and calculus, OLS linear regression analysis tools are readily available on most personal computer spreadsheet software such as Microsoft Excel, Corel Quattro Pro, or IBM's mLotus 1-2-3. Other common statistical software tools available for personal computers include SPSS, SAS, and a variety programming languages that may be used to create custom regression models. All that is required of the forecaster is to collect appropriate data, enter the data into a software

program, and apply the regression tool. Although applying data to today's regression tools is quite simple, proper interpretation and use of regression results require at least a fundamental knowledge of regression modeling from a theoretical perspective. It is suggested that anyone who will actively participate in performing or interpreting quantitative forecast results, such as those found from regression analysis, seek additional knowledge in statistical modeling.

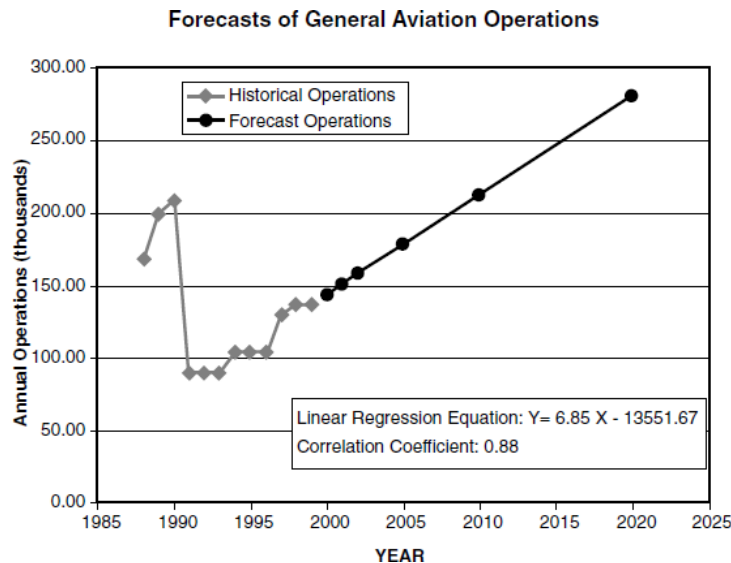


Fig. Example of time-series forecast using OLS linear regression.

Forecasts of aviation demand

Forecasts of aviation demand form the basis for facilities planning. There is a need to know the types of civil airport users, certificated air carriers, commuters, general aviation, and military services where applicable; the types and volume of operational activity, aircraft operations, passengers and cargo, based aircraft, and so forth; and the aircraft fleet mix, jet and large-capacity prop transport aircraft, smaller commercial, corporate, business, and pleasure aircraft, future vertical/short takeoff and landing (V/STOL) aircraft, and so forth.

Civil airport users

The FAA defines the various types of civil airport users as follows. **Air carriers** These airline aircraft operators holding Certificates of Public Convenience and Necessity issued by the former Civil Aeronautics Board and based on authorization from the Department of Transportation to perform passenger and cargo services. This general air carrier grouping includes the major, national, large, and medium regional air carriers. **Commuters** are non certificated small regionals that perform scheduled service to smaller cities and serve as feeders

to the major hub airports. They generally operate aircraft of less than 12,500 pounds maximum gross takeoff weight.

General aviation: General aviation is the segment of civil aviation that encompasses all facets of aviation except air carriers and commuters. General aviation includes air taxi operators, corporate-executive transportation, flight instruction, aircraft rental, aerial application, aerial observation, business, pleasure, and other special users.

Military This category encompasses the operators of all military (Air Force, Army, Navy, U.S. Coast Guard, Air National Guard, and military reserve organizations) aircraft using civil airports.

Operational activity: Six major types of operational activity forecasts are considered necessary to determine future facility requirements.

Enplaning passengers: This activity includes the total number of passengers (air carrier, commuter, and general aviation) departing on aircraft at the airport. Originating, stopover, and transfer passengers are identified separately.

Enplaning air cargo: Enplaning air cargo includes the total tonnage of priority, nonpriority, and foreign mail, express shipments, and freight (property other than baggage accompanying passengers) departing on aircraft at an airport, including originations, stopover, and transfer cargo. Where applicable, domestic and international are identified separately.

Aircraft operations: Aircraft operations include the total number of landings (arrivals) at and takeoffs (departures) from an airport. Two types of operations— local and itinerant—are separately identified: *local operations*, performed by aircraft that operate in the local traffic pattern or within sight of the tower and are known to be departing for or arriving from flight in local practice and flight test areas located within a 20-mile radius of the airport and/or control tower and execute simulated instrument approaches or low passes at the airport; and *itinerant operations*, all aircraft arrivals and departures other than local operations described above. Where applicable, domestic and international itinerant operations should be identified separately. Except for local training flights at some airports, air carrier aircraft movements are itinerant operations. The basic premise underlying the methodology for forecasting air carrier operations by an airport is that a relationship exists between the number of enplaned passengers and cargo shipments and the level of service provided. It is assumed that the number of aircraft seats for transiting and enplaning passengers and the number of flights by type of aircraft have been a function of the traffic demand and traffic characteristics of the community as well as the route structure and operating policies and practices of the individual

carriers. It is also assumed that these same factors will continue to determine the level of operations in the future.

Based aircraft: Based aircraft is the total number of active general aviation aircraft that use or might be expected to use an airport as “home base.” General aviation–based aircraft are separately identified as single-engine, multiengine, piston, or turbine, or vertical/short takeoff and landing (V/STOL) aircraft.

Busy-hour operations: Busy-hour operations is the total number of aircraft operations expected to occur at an airport at its busiest hour, computed by averaging the two adjacent busiest hours of a typically high-activity day. One definition of a typically high-activity day would be the average day of the busiest month of the year. The operations are identified by major user category, as applicable.

Aircraft fleet mix: **Fleet mix** is defined as the percentage of aircraft, by type or category, that operate or are based at the airport. Aircraft fleet mix is typically summarized as seating capacity groups for air carrier aircraft and operational characteristics groups for all four of the major airport user categories. By performing a comprehensive forecast of the above measures of airport activity, using both quantitative and qualitative methods, the airport planner has the ability to incorporate into the master plan airport facilities that will accommodate forecast activity.

Facilities requirements

After an inventory of current facilities has been compiled and future aviation activity has been forecast, the next step in the airport master planning process is the assessment of facility requirements. The study of the demand/capacity relationship involves an estimation of the need to expand facilities and the cost of these improvements. This type of analysis is done in consultation with the airlines and the general aviation community. The analysis is applied to aircraft operations versus airfield improvements, passenger enplanements versus terminal building improvements, cargo tonnage versus cargo facility development, airport access traffic versus access roads and rapid transit facilities, and other improvements as might be appropriate. Airspace in the vicinity of the master plan airport is also analyzed.

Demand/capacity analysis is normally applied to short-, intermediate-, and long-range developments (approximately 5, 10, and 20 years). The analysis is only an approximation of facility requirements, their costs, and savings that will result from reduced delays to airport users as well as anticipated revenues that might be obtained from proposed improvements;

thus, demand/capacity analysis will yield preliminary estimates of the number and configuration of runways, areas of apron, number of vehicle parking spaces, and capacities of airport access facilities. Preliminary estimates of economic feasibility may also be obtained. These approximations will provide a basis for developing the details of the airport master plan and for determining the feasibility of improvements considered in the plan.

Aircraft operational requirements

The forecasts of aviation activity will indicate the kinds of aircraft anticipated to use the master plan airport. The frequency of use, passenger/cargo load factors, and lengths of outbound nonstop flights will also be indicated. From this demand data, the planner can ascertain the required physical dimensions of the aircraft operational areas. Although a capacity analysis provides requirements in terms of numbers of runways/taxiways and so forth, the analysis of aircraft operational requirements allows the determination of runway/taxiway/apron dimensions, strengths, and lateral clearances between airport areas. Of course, both of these analyses are interrelated and are accomplished simultaneously in order to determine system requirements.

Capacity analysis

An analysis of the existing air traffic capacity of the area the master plan airport is to serve will help determine how much additional capacity will be required at the master plan airport. Four distinct elements require investigation, namely, airfield and airspace capacity, terminal area capacity, and ground access capacity.

Airfield capacity is the practical maximum rate of aircraft movements on the runway/taxiway system. Levels of demand that exceed capacity will result in a given level of delay on the airfield (see Chap. 12 for a detailed analysis of airfield capacity). The proximity of airports to one another, the relationship of runway alignments, and the nature of operations [IFR or visual flight rules (VFR)] are the principal inter airport considerations that will affect *airspace capacity* of the master plan airport. For example, it is not uncommon in a large metropolitan area to have major or secondary airports spaced so closely that they share one discrete parcel of airspace. In such cases there may be a reduction in the IFR capacity for the airports involved because of the intermixing of traffic within the common parcel of airspace. When this occurs, aircraft, regardless of destination, must be sequenced with the proper separation standards. This reduces the IFR capacity for a specific airport.

Terminal area capacity is the ability of the terminal area to accept the passengers, cargo, and aircraft that the airfield generates. Individual elements within terminal areas must be

evaluated to determine overall terminal capacity. Terminal elements included in the analysis are airline gate positions, airline apron areas, cargo apron areas, general aviation apron areas, airline passenger terminals, general aviation terminals, cargo buildings, automobile parking, and aircraft maintenance facilities. The establishment of capacity requirements for the master plan airport will determine the capacity required for airport ground access. A preliminary examination of existing and planned highway and mass transit systems allows a judgment as to the availability of ground access capacity. In determining the volume of people, it is necessary for the planner to establish the percentage relationship between passengers, visitors, and airport employees. This can vary from one urban area to another and from one site to another.

Facility requirements are developed from information obtained in demand/capacity analysis and from FAA advisory circulars and regulations that provide criteria for design of airport components. Demand/capacity analysis yields the approximate number and configuration of runways, number of gates, square footage of terminal buildings, cargo facilities, number of public and employee parking spaces, types of airport access roads, and the overall land area required for the airport. From the mix of aircraft and the number of aircraft operations, general requirements for length, strength, and number of runways; spacing of taxiways; layout and spacing of gates; and apron area requirements can be determined.

Design alternatives

When planning for an airport's future, airport planners develop a series of design alternatives to accommodate forecast levels of demand. These design alternatives are then brought to airport management, the local government, the surrounding community, and often the Federal Aviation Administration to reach a consensus on the recommended design alternative.

- The design alternatives for airports may include:
- The selection of an airport on a new yet undeveloped site
- The plans for design and operation of the airfield and local airspace
- The plans for design and operation of the terminal and ground access Systems

Site selection

One of the design alternatives for the future of an airport may be to design a new airport on an open, or *greenfield*, site. If this is the case, the first and perhaps most important step in this process is that of proper site selection. The major factors that require careful analysis in the final evaluation of airport sites include runway orientation and wind analysis,

airspace analysis, surrounding obstructions, availability for expansion, availability of utilities, meteorological conditions, noise impacts, and cost comparisons of alternative sites.

Runway orientation and wind analysis

Planning an airfield with respect to runway orientation is a nontrivial task. Runway orientation planning consists of three tasks:

1. Identifying the Airport Reference Code (ARC) on the basis of an airport's critical aircraft.
2. Analyze historical wind data for the airfield.
3. Apply the Airport Reference Code and historical wind data using a wind rose to find the appropriate orientation of the primary runway and any necessary crosswind runways.

Analyzing historical wind data for the airfield

At airports, wind is typically measured by its velocity (in knots), and direction (in degrees from north). Wind direction and velocity data have historically been recorded on an hourly basis at airports and other areas of interest by the National Oceanic and Atmospheric Administration.

Historical wind data are compiled, categorized, and illustrated by means of a graphical tool called a **wind rose**. A wind rose graphically represents wind speed, and direction by a series of concentric rings, which represent wind speed, and spokes, which represent direction. The center of the wind rose represents calm winds. Rings further out from the center of the wind rose represent winds of increasingly stronger velocity. The spokes represent direction from North. The percentage of time that the wind blows between certain directions and between certain speeds is placed in the cells created from the rings and spokes of the wind rose.

A wind rose is designed to provide the airport planner and manager a visual guide to the appropriate direction of the primary runway and any necessary crosswind runways. By overlaying a proposed runway direction over the wind rose, an airport planner can visually identify the direction of the prevailing winds and assess the approximate percentage of time that the runway orientation will provide less-than-maximum tolerable crosswinds. This is performed by adding up the percentages found within the "runway template." The "width" of the runway template is associated with the maximum crosswind component associated with the Airport Reference Code for the airport.

Airspace analysis

In major metropolitan areas, it is not uncommon for two or more airports to share common airspace. This factor might restrict the capability of any one airport to accept IFR traffic under adverse weather conditions. Airports too close to each other can degrade their

respective capabilities and create a serious traffic control problem. It is important to analyze the requirements and future needs of existing airports before considering construction sites for a new airport.

Surrounding obstructions

Obstructions in the vicinity of the airport sites, whether natural, existing, or proposed man-made structures, must meet the criteria set forth in Federal Aviation Regulations. The FAA requires that clear zones at the ends of runways be provided by the airport operator. **Runway clear zones** are areas comprising the innermost portions of the runway approach areas. The FAA requires that the airport owner have “an adequate property interest” in the clear zone area in order that the requirements of FAR Part 77 can be met and the area protected from future encroachments. Adequate property interest might be in the form of ownership or a long-term lease or other demonstration of legal ability to prevent future obstructions in the runway clear zone.

Availability for expansion

Available land for expansion of the airport is a major factor in site selection; however, it is not always necessary to purchase the entire tract at the start because adjacent land needed for future expansion could be protected by lease or option to buy. The Airport and Airway Development Act of 1970 first established funding for communities to acquire land for future airport development.

Noise

Noise is the most predominant objection raised by opponents to new airports and airport expansion projects. Numerous efforts are being made by industry and government to seek new and better ways to reduce aircraft sound levels. Many of the older jet aircraft are now being retrofitted with noise kits that are designed to reduce noise. Engine manufacturers are exploring new engineering concepts and designs that will reduce this source of noise to an absolute minimum. Pilots of airliners are required to maintain certain power settings and to fly prescribed routes that reduce noise levels in the vicinity of takeoff and landing areas. Noise certification standards have been established by the FAA for new aircraft.

Terminal area plans

The primary objective of the terminal area plans is to achieve an acceptable balance between passenger convenience, operating efficiency, facility investment, and aesthetics. The physical and psychological comfort characteristics of the terminal area should afford the passenger orderly and convenient progress from automobile or public transportation through

the terminal to the aircraft and back again. A detailed description of airport terminal geometries, along with the facilities that are found in airport terminals, is provided in Chap. 6 of this text. One of the most important factors affecting the air traveler is walking distance. It begins when the passenger leaves the ground transportation vehicle and continues on to the ticket counter and to the point at which he or she boards the aircraft. Consequently, terminals are planned to minimize the walking distance by developing convenient auto parking facilities, convenient movements of passengers through the terminal complex, and conveyances that will permit fast and efficient handling of baggage. The planner normally establishes objectives for average walking distances from terminal points to parked aircraft. Conveyances for passengers such as moving walks and baggage handling systems are also considered.

Airport access plans

The airport access plans are an integral part of the master planning process. These plans indicate proposed routing of airport access to the central business district and to points of connection with existing or planned ground transportation arteries. All modes of access are considered, including highways, rapid transit, and access by vertical and short takeoff and landing (V/STOL) aircraft. The estimated capacity requirement for the various modes considered is determined from forecasts of passengers, cargo, and aircraft operations. The airport access plans normally are general in nature because detailed plans of access outside the boundaries of the airport will be developed by highway departments, transit authorities, and comprehensive planning bodies

Financial plans

The financial plan is an economic evaluation of the entire plan of development. It looks at the master plan activity forecasts from the point of view of revenues and expenditures, analyzing the airport's balance sheet over the planning period to ensure that the airport sponsor can afford to proceed. A corollary activity in this phase is the consideration of funding sources and financing methods for the proposed development.

Economic evaluation

Although the primary objective of the airport master plan is to develop a design concept for the entire airport, it is essential to test the economic feasibility of the plan from the standpoints of airport operation and individual facilities and services. Economic feasibility will depend on whether the users of the airport improvements programmed under the plan can produce the revenues (as might be supplemented by federal, state, or local subsidies) required to cover annual cost for administration, operation, and maintenance. This must be determined

for each stage of development scheduled in the master plan. This consideration includes the cost of capital to be employed in financing the improvement, the annual operating costs of facilities, and prospective annual revenues.

This preliminary cost estimate for each of the proposed improvements provides the basic capital investment information needed for evaluating the feasibility of the various facilities. Estimated construction costs are adjusted to include allowance for architect and engineering fees for preparation of detailed plans and specifications, overhead for construction administration, allowance for contingencies, and allowance for interest expenses during construction. Estimated costs of land acquisitions as well as the costs of easements required to protect approach and departure areas are included. If the master plan provides for the expansion of an existing airport, the cost of the existing capital investment might be required to be added to the new capital costs. The airport layout plan also indicates the stage development of the proposed facilities. The drawings are normally written with appropriate legends to indicate staging shown on the plan, either on single or separate sheets. Charts that show the schedule of development for various items of the master plan are developed for inclusion in the master plan report.

Land use planning

The airport land use plan shows on-airport land uses as developed by the airport sponsor under the master plan effort and off-airport land uses as developed by surrounding communities. The work of airport, city, regional, and state planners must be carefully coordinated. The configuration of airfield runways, taxiways, and approach zones established in an airport layout plan provides the basis for development of the land use plan for areas on and adjacent to the airport. The land use plan for the airport and its environment in turn is an integral part of an area wide comprehensive planning program. The location, size, and configuration of the airport need to be coordinated with patterns of residential and other major land uses in the area, as well as with other transportation facilities and public services. Within the comprehensive planning framework, airport planning, policies, and programs must be coordinated with the objectives, policies, and programs for the area that the master plan airport is to serve.

Land uses on the airport

The amount of acreage within the airport's boundaries will have a major impact on the types of land uses to be found on the airport. For airports with limited acreage, most land uses will be aviation oriented. Large airports with a great deal of land in excess of what is needed for aeronautical purposes might be utilized for other uses. For example, many airports lease land to industrial users, particularly those who employ business aircraft or whose personnel travel extensively by air carrier or charter. In many cases, taxiway access is provided directly to the

company's facility. In some instances, railroad tracks serving the company's area, company parking lots, or low-level warehousing can be located directly under runway approaches (but free of clear zones). Companies that might produce electronic disturbances that would interfere with aircraft navigation or communications equipment or cause visibility problems because of smoke are not compatible airport tenants.

Some commercial activities are suitable for location within the airport's boundaries. Recreational uses such as golf courses and picnicking areas are quite suitable for airport land and might in effect serve as good buffer areas. Certain agricultural uses are appropriate for airport lands, but grain fields that attract birds are avoided. Although lakes, reservoirs, rivers, and streams might be appropriate for inclusion within the airport's boundaries, especially from the standpoints of noise or flood control, care is normally taken to avoid those water bodies that have in the past attracted large numbers of waterfowl. Dumps and landfills that might attract birds are also avoided.

Land uses around the airport

The responsibility for developing land around the airport so as to maximize the compatibility between airport activity and surrounding activities, and minimize the impact of noise and other environmental problems, lies with the local governmental bodies. The more political entities that are involved, the more complicated the coordination process becomes. In the past, the most common approach to controlling land uses around the airport was zoning. Airports and their surrounding areas become involved in two types of zoning. The first type of zoning is height and hazard zoning, which protects the airport and its approaches from obstructions to aviation while restricting certain elements of community growth.

The second type of zoning is land use zoning. This type of zoning has several shortcomings. First, it is not retroactive and does not affect preexisting uses that might conflict with airport operations. Second, jurisdictions with zoning powers (usually cities, towns, or counties) might not take effective zoning action. This is partly because the airport might affect several jurisdictions and coordination of zoning is difficult. Or the airport might be located in a rural area where the county lacks zoning powers and the sponsoring city might not be able to zone outside its political boundaries. Another problem is that the interest of the community is not always consistent with the needs and interests of the aviation industry. The locality might want more tax base, population growth, and rising land values, all of which are not often consistent with the need to preserve the land around the airport for other than residential uses.

Another approach to land use planning around the airport is subdivision regulations. Provisions can be written into the regulations prohibiting residential construction in intense noise-exposure areas. These areas can be determined by acoustical studies prior to development. Insulation requirements can be made a part of the local building codes, without which the building permits cannot be issued.

Finally, another alternative in controlling land use around the airport is the relocation of residences and other incompatible uses. Often urban renewal funds are available for this purpose.

Environmental planning

For any proposed airport planning project, a review of how such expansion would affect the surrounding environment must be performed. This requirement was first established in the Airport and Airway Development Act of 1970 and the Environmental Policy Act of 1969. The National Environmental Policy Act of 1969 requires the preparation of detailed environmental statements for all major federal airport development actions significantly affecting the quality of the environment. The Airport and Airway Development Act of 1970 directed that no airport development project may be approved by the Secretary of Transportation unless he or she is satisfied that fair consideration has been given to the communities in or near which the project may be located.

For every proposed project, an **Environmental Impact Review (EIR)** is performed. The results of the review may find that there will be no significant impact to the surrounding environment as a result of the project. If this finding is realized then a **Finding of No Significant Impact (FONSI)** statement is issued. If the EIR reveals that there is the potential for significant environmental impact as a result of the project, then a more comprehensive **Environmental Impact Statement (EIS)** must be developed. The EIS states specifically the areas of the environment that will be impacted and the degree of impact on the environment, and, most important, requires a plan on the part of the airport to mitigate those impacts.

Studies of the impact of construction and operation of the airport or airport expansion upon accepted standards of air and water quality, ambient noise levels, ecological processes, and natural environmental values are conducted to determine how the airport requirements can best be accomplished. An airport is an obvious stimulus to society from the standpoints of economic growth and the services it offers to the public; however, this generation of productivity and employment might be negated by noise and air pollution and ecological compromises if compatibility between an airport and its environs is not achieved; thus, the airport master plan must directly contend with these problems identified in the studies of

environmental qualities so that the engineering of airport facilities will minimize or overcome those operations that contribute to environmental pollution.

In line with the above guidelines and policy, an airport master plan (including site selection) must be evaluated factually in terms of any proposed development that is likely to:

- Noticeably affect the ambient noise level for a significant number of people
- Displace significant numbers of people
- Have a significant aesthetic or visual effect
- Divide or disrupt an established community or divide existing uses (e.g., cutting off residential areas from recreation or shopping areas)
- Have any effect on areas of unique interest or scenic beauty
- Destroy or detract from important recreational areas
- Substantially alter the pattern of behavior for a species
- Interfere with important wildlife breeding, nesting, or feeding grounds
- Significantly increase air or water pollution
- Adversely affect the water table of an area

The airport master plan is commonly thought of as a “living document” whose contents adapt to constant changes in community needs. A robust master plan is one that helps airport planners and management maintain and develop an airport that meets the needs of the community, surrounding environment, and the nation’s aviation and transportation system overall.

Airport Capacity and Delay

The efficient movement of aircraft and passengers between airports is highly dependent on two key characteristics of an airport’s operations: the demand for service by aircraft operators and passengers and the capacity at the airport, both in airspace and local environment. A major concern of airport planning and management is the adequacy of an airport’s airfield, specifically in relation to the layout of the airport’s runways, to handle the anticipated demand of aircraft operations. If air traffic demand exceeds airport or airspace capacity, delays will occur, causing expense to air carriers, inconvenience to passengers, and increased workload for the FAA air traffic control system as well as airport employees and administrators. At most airports in the United States, particularly those commercial service and general aviation airports serving smaller communities, the demand for service does not consistently exceed capacity. The Federal Aviation Administration estimates that airports with single runways have the capacity to serve approximately 200,000 operations annually, a demand level typically generated by metropolitan areas with approximately 350,000 inhabitants. Other airports, particularly those primary commercial service airports serving large metropolitan areas with populations exceeding 5,000,000 inhabitants, experience consistent periods of time where demand exceeds capacity, despite the fact that two or more such airports serve the area. Examples of these

metropolitan areas include Chicago, Los Angeles, South Florida, the San Francisco Bay Area, Washington, D.C., and New York City.

Defining capacity

Capacity, in general, is defined as the practical maximum number of operations that a system can serve within a given period of time. Capacity is, in fact a rate, similar to velocity. An automobile for example, might travel at a rate of 50 miles per hour, meaning that over an hour, traveling at this rate, the automobile will travel 50 miles. Traveling this rate for 30 minutes, the automobile will travel 25 miles, and so forth. Airport capacity is measured in aircraft operations per hour. A single runway at an airport, might have an operating capacity of 60 operations per hour, meaning, over the course of an hour, the airport will be able to serve approximately 60 aircraft takeoffs and landings; in 30 minutes, the airport can serve 30 such operations, and so forth.

There are actually two commonly used definitions to describe airport capacity: throughput capacity and practical capacity. **Throughput capacity** is defined as the ultimate rate at which aircraft operations may be handled without regard to any small delays that might occur as a result of imperfections in operations or small random events that might occur. Throughput capacity, for example, does not take into account the small probability that an aircraft will take longer than necessary to take off, or a runway must close for a very short period of time because of the presence of small debris. Throughput capacity is truly the theoretical definition \ of capacity and is the basis for airport capacity planning.

Practical capacity is understood as the number of operations that may be accommodated over time with no more than a nominal amount of delay, usually expressed in terms of maximum acceptable average delay. Such minimal delays may be a result of two aircraft scheduled to operate at the same time, despite the fact that only one runway is available for use, or because an aircraft must wait a short time to allow ground vehicles to cross. The FAA defines two measures of practical capacity to evaluate the efficiency of airport operations. **Practical hourly capacity (PHOCAP)** and **Practical annual capacity (PANCAP)** are defined by the FAA as the number of operations that may be handled at an airport that results in not more than 4 minutes average delay during the busiest, known as the peak, 2-hour operating period, hourly and annually, respectively.

Factors affecting capacity and delay

The capacity of an airfield is not constant. Capacity varies considerably based on a number of considerations, including the utilization of runways, the type of aircraft operating, known as the fleet mix, the percentage of takeoff and landing operations being performed, ambient climatic conditions, and FAA regulations which prescribe the use of runways based on these considerations. When a specific number is given for airfield capacity at an airport, it is usually an average number based either on some assumed range of conditions or on one specific set of conditions.

An understanding of the variability of capacity, rather than its average value, however, is crucial to the effective management of an airfield. Much of the strategy for successful management of an airfield involves devising ways to compensate for a number of factors that, individually or in combination, act to reduce capacity or induce delays.

The physical characteristics and layout of runways, taxiways, and aprons, for example, are basic determinants of the ability to accommodate various types of aircraft and the rate at which they can be handled. Also important is the type of equipment, particularly the presence of instrument landing systems, installed on the airfield as a whole or on a particular segment.

Estimating capacity

The art of estimating the capacity of an airfield is a challenging one. Significant investments are made on the part of airport management, the FAA, and air carriers to estimate as accurately as possible the capacity of an airfield under varying conditions and operating characteristics. However, if the basic fundamentals of aircraft operations are understood, initial estimates of runway capacity may be established with little effort. The FAA categorizes the wide variety of aircraft types by their maximum certified takeoff weights (MTOW). Aircraft with MTOW less than 41,000 pounds are considered *category A/B* or *small* aircraft, aircraft with MTOW between 41,000 and 255,000 pounds are considered *category C* or *large* aircraft, and aircraft with MTOW greater than 255,000 pounds are considered *category D* or *heavy* aircraft (see Table 12-1). For the purposes of estimating runway capacity, an airport's fleet mix is defined by the percentage of small, large, and heavy aircraft that perform takeoff and/or landing operations over a given period of time on the runway.

Defining delay

Delay is defined as the duration between the desired time that an operation occurs and the actual time the operation occurs. When aircraft depart and arrive "on time," according to their respective schedules, for example, the aircraft is said to have experienced no delay. If, however, an aircraft actually departs an hour after its scheduled departure time, that aircraft is said to have suffered 1 mhour of delay. This delay may have been the result of any number of factors. A mechanical repair may have been required, luggage may have been slow in being loaded, weather may have required the aircraft wait until conditions improve, or perhaps the aircraft was one in a large number of aircraft that were scheduled to depart during a high-demand period time of day when the capacity of the airfield was insufficient to accommodate such high demand.

Estimating delay

As with estimating capacity, various methods exist to estimate delay from fundamental analytical models, FAA tables and graphs, and computer simulation models. Similar to capacity estimation, analytical models allow an airport planner to estimate delays using fundamental estimations for aircraft demand and airport capacity. FAA tables provide cursory estimations of delay for more complex operating conditions, whereas computer simulation models provide detailed estimations of delay under a full variety of operating conditions, from the very simple to the highly complex.

Approaches to reducing delay

Many commercial service airports, particularly those in large metropolitan areas, have experienced significant operating delays on their airfields, and also in their terminals, and on ground access systems around the airports, as well as between the airport and the associated area. The strategies that may be employed to reduce delays fall into two categories: increasing system capacity and managing system demand. Increasing capacity includes the addition of new infrastructure, such as additional runways, terminal facilities, and ground access roads.

Increasing capacity also includes provision of technologies and policies to make existing infrastructures operate more efficiently. For example, it reduces the amount of processing time required at any given facility to allow more operations over a given period of time. Managing demand focuses more on changing the behavior of system users that in turn will lead to better use of existing system capacity.

UNIT-4

INTRODUCTION TO AIRLINE PLANNING

An *industry* can be defined as a number of firms that produce similar goods and services and therefore are in competition with one another. In this sense, the airline industry is a segment or part of the broader air transportation industry. Several hundred U.S. companies engage in the carriage of persons or goods by air. For example, American Airlines earns revenues in excess of \$20 billion a year, while the smallest may operate a single plane only several months a year. Broadly defined, the airline industry consists of a vast network of routes that connect cities throughout the country, and indeed, the world. Over this network, a large number of airlines carry passengers and cargo on scheduled service

STRUCTURE OF THE AIRLINE INDUSTRY

Growth and Regulation

To clarify the structure of the industry at the outset, it is useful to define the industry.

When the Civil Aeronautics Act was passed in 1938, only a handful of air carriers operated regular schedules over prescribed routes, and when they received government certification, they became known as *certificated route, scheduled air carriers*, a term that is used to this day. The act empowered the Civil Aeronautics Board (CAB) to structure the interstate airline industry through regulation of passenger fares, air mail rates, route entry and exit, mergers and acquisitions, and intercarrier agreements. The CAB immediately “grandfathered” the routes of 23 existing airlines, which later became known as **trunk carriers** (a term borrowed from the trunk railroads of the day). By definition, trunk carriers were airlines certified to operate on medium-and long-haul interstate routes. These carriers came under Section 401 of the board’s regulations and thus were sometimes referred to as **401 carriers**. To be exempt from 401 certification, a carrier could not exceed a takeoff weight of 12,500 pounds (roughly the weight of a DC-3), which effectively limited aircraft to 19 passengers. Typically, two or three carriers provided service in a given market, although in some instances routes were covered by only one carrier. The CAB set standard fare levels to ensure cross-subsidization between profitable and unprofitable routes. Carriers were required to charge equal fares for equal

distances. Cost increases were passed along to customers, and the CAB allowed the airlines to earn a reasonable rate of return.¹ Originally, there were two general classes of common-carrier air transportation: (1) the trunk airlines, which provided scheduled service on fixed routes, and (2) small nontransport carriers, principally operating from a fixed base, which furnished service on request, without schedules. For the nonscheduled carriers, transportation services were incidental to the principal business activities of sale and service of aircraft and flight instruction.

After World War II, a number of enterprising aviation entrepreneurs purchased war surplus DC-3s (C-47s) and DC-4s (C-54s) and began to transport people and cargo for compensation or hire with no fixed routes or schedules, much in the manner of tramp steamers. These operations, usually cutthroat in the worst sense of the term, became known as nonscheduled, or “nonsked,” air carriers to the public and as “large irregular air carriers” to the CAB, which was powerless to regulate them until the Civil Aeronautics Act was amended by Congress. The act was amended after World War II to create *supplemental air carriers* and *supplemental air transportation*² so that such operations also required certificates of public convenience and necessity. Originally designed to supplement the capacity provided by the trunk carriers, by the 1960s the **supplemental air carriers** had truly become competitive carriers, and by the 1970s the name supplemental had lost all meaning. Some carriers provided scheduled passenger and cargo services, whereas others concentrated on cargo only.

In the postwar period, there were also many feeder routes to be granted. The trunk lines claimed that they had grandfather rights (original certification) to provide such service feeding into the trunk routes, but their pleas were to no avail; the CAB chose instead to certificate a whole new level of service. The CAB assured the trunks that the feeders would be carefully watched and not permitted to provide service between the major metropolitan areas. The CAB awarded each local-service carrier a regionally centered route system that fed the trunks with additional passengers. These **localservice carriers**, which provided intrastate service to small communities, were exempt from CAB economic regulation, and many were eligible for government subsidies

to cover operating losses. The charter services charged lower fares, did not operate published schedules, and were also exempt from CAB regulations.

Deregulation

In response to the criticism, the CAB reversed its policies, beginning with the approval of new route applications. In 1977, it consented to American Airlines' request for "super saver" discounts some 45 percent below existing coach fares. When American Airlines' traffic grew as much as 60 percent in response, the solution to overcapacity seemed at hand. Other carriers quickly filed and received CAB approval for similar discounts. De facto deregulation was under way. In 1978, now with the active encouragement of new CAB Chairman Alfred Kahn, Congress passed the Airline Deregulation Act. The act mandated that the CAB phase out its route approval authority over three years and its regulation of fares over five years, and that it pass its remaining functions to the Department of Transportation. The CAB ceased operation at the end of 1984.

MAJOR AND NATIONAL CARRIERS

That deregulation was a landmark event in the history of the U.S. airline industry is illustrated by the fact that 5 of the top 12 airlines of 1978, as measured by revenue passenger miles (RPMs), no longer exist (see Table 5-1). Eastern (no. 4) and Braniff (no. 8) went bankrupt; Western (no. 7) was absorbed by Delta; National (no. 10) was absorbed by Pan Am; Pan Am (no. 6) broke itself up for parts, with most going to Delta and United; the remnant of Pan Am then dissolved in bankruptcy. Deregulation fueled a trend toward concentration of business with a new cluster of "mega-carriers," with a number of small and midsize airlines being absorbed in the process. By the end of 2004, the top five carriers accounted for 74 percent of the business (see Table 5-2). In contrast, in 1978, under CAB control, the top five airlines accounted for 68 percent of the RPMs of the top 12. The immediate consequence of deregulation was that the established carriers faced competition on many fronts. First, they competed vigorously among themselves, motivated in part by the belief that market share

would determine the ultimate survivors in a restructured industry. This meant new routes and lower prices, which led to more available seat miles but lower load factors, as capacity outstripped new passenger traffic, and to lower passenger revenue yields because of the reduced fares. The competition within the established industry was intensified by three innovations pioneered by the major carriers in the early 1980s that collectively represent a radical change from the regulated era. Although each of the measures offered initial competitive advantage to the first movers, in the aggregate these innovations appear to have contributed to the very high volatility of industry revenues. First, airlines established “hub-and-spoke” route structures, designed to funnel traffic from outlying regions for further transit, at very high load factors, to major destinations. But hubs are very expensive to establish and maintain because of the high infrastructure costs; the high fixed costs hinder easy adjustment of route structures in response to changing patterns of demand, and the overall route structure produces more connections on long-distance routes, which is disfavored by full-fare business travelers. The hub-and-spoke structure also left the airlines vulnerable in the 1990s to low-fare carriers that fly point to point between destination city-pairs. Among other factors, the point-to-point carriers gain the advantage of higher aircraft utilization than do the hub-and-spoke carriers, which have to provide time in their schedules of long-distance routes for the arrival of feeder flights. Second, the airlines adopted frequent-flier programs designed to enhance brand loyalty among business travelers and to exploit the differences between regional and national (or international) airlines in terms of more desirable destinations. The frequent-flier programs proved to be expensive to administer, and the potential liability of accruing free travel credits was an unwelcome overhang on an airline's financial statement. Moreover, the frequent-flier programs came to play a somewhat perverse role in the design of route structures, in which destinations were added or retained to avoid the potential loss of frequent fliers.

Third, the airlines developed sophisticated reservations systems that they used for at least two purposes: (1) to skew in their favor the display of scheduling information on the screens that were used in travel agents' offices and (2) to establish yield management programs. The airlines are an example of an industry sector subject to exogenous shocks that have undermined many of its previous ways of doing business. Not only did deregulation expose the airlines to powerful

competitive forces that undermined profitability, but it also eliminated the implicit protection under government regulation against collapse and bankruptcy. As a result, the industry is making a transition to a new structure (see Figure). At the top of the pyramid shown in Figure 5-1, and foremost among the carriers that make up the airline industry, are the major and national carriers. The 54 carriers that were included in these two categories at the beginning of 2004 hold certificates of public convenience and necessity and operate scheduled and nonscheduled or charter services over medium- and long-range national and international routes serving large population centers. Airlines are now classified as **major air carriers** if their annual gross revenues are over \$1 billion.

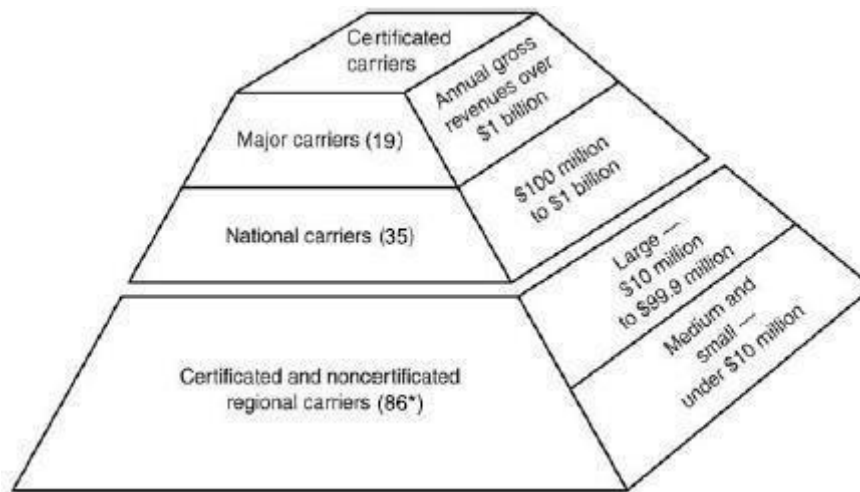


FIGURE The structure of the airline industry—2004. (*74 certificated)

REGIONAL CARRIERS

Regional air carriers are classified as large, medium, or small, depending on their annual gross revenue and whether they hold a certificate of public convenience and necessity from the DOT. Large regionals are certificated carriers with annual gross revenues between \$10 million and \$99.9 million. Medium regionals are certificated carriers with annual gross revenue less than \$10 million. The small regionals, commonly referred to as commuters, are noncertificated carriers.

Early Growth

AERONAUTICAL ENGINEERING – MRCET (UGC – Autonomous)

Out of several thousand air taxi operators in January 1964, only 12 offered scheduled services, all to non certificated points. By the end of 1968, there were over 200 scheduled air taxi operators. This explosive early growth in what became the regional/commuter airline industry resulted in part from the economic opportunity created by the service gap left by the withdrawing local-service carriers. Another important factor was the availability of new aircraft that were small enough to be exempt from CAB economic regulation yet large enough to carry profitable loads in scheduled short-haul operations.

Regulatory and economic changes in the 1960s improved the climate for the growth of scheduled air taxis. In 1964, the FAA promulgated Federal Aviation Regulation (FAR) Part 135, which defined the operational and safety rules of the industry. In 1965, the CAB amended its regulations to allow these carriers to transport mail and to provide service between certificated points, open as replacements for trunk or local-service airlines. In 1964, American Airlines contracted with Apache Airlines to replace it in serving Douglas, Arizona; this was the first “air taxi replacement agreement.” In 1968, Allegheny Airlines (now US Airways) greatly expanded this concept by contracting its unprofitable routes to 12 independent commuters operating under the name “Allegheny Commuter”; this network continues today. The CAB officially recognized the commuter industry in 1969, defining a commuter air carrier as an air taxi operator that either performs at least five round-trips per week between two or more points and publishes flight schedules that specify the times, days of the week, and origins and destinations of such flights, or transports mail by air under contract with the U.S. Postal Service. By August 1978, 26 commuter airlines were providing replacement service for certificated carriers at 59 points, mostly without direct financial assistance.

During the 1970s, passenger enplanements on commuter carriers grew at an annual rate of slightly over 13 percent, compared with a 7 percent growth rate for the combined trunk and local-service airlines and a 3 percent annual growth rate in real gross national product.

As part of airline deregulation in 1979, the trunk and local-service carriers began their second stage of withdrawal from smaller communities. The commuters saw yet another opportunity to

serve the traveling public and eagerly moved to provide service. Under congressional mandate, communities that stood to lose service as part of deregulation were placed under the Essential Air Service (EAS) program. As of early 2006, more than 114 communities were served by the program in the continental United States, Alaska, Hawaii, and Puerto Rico.

Role of the Regional Air Carrier

Today, the regional/commuter airline segment is an integral part of the nation's air transportation system. Regional carriers provide regularly scheduled passenger or cargo service on aircraft predominantly seating fewer than 60 passengers or holding cargo with an 18,000-pound or less payload. Regionals fly pursuant to schedules published in widely used airline schedule guides.

A typical regional flight operates over a trip distance of 100 to 400 miles and at lower altitudes than flights of the long-haul carriers. Regionals operate well-timed frequent flights from outlying communities to the associated hub airports to interline, or connect, passengers and cargo with other scheduled flights. Seventy percent of all regional passengers make such connections.

Although the growth period of regionals has been relatively short and not without problems, continuing efforts by the industry principals are playing a significant role in helping to forge an integrated and complete air transportation system. Today, 9 out of every 10 airports in the United States receiving scheduled air transportation are served by a regional air carrier. By year-end 2005, regionals provided frequent and timely air service to 664 airports, with 664 of these communities depending exclusively on regional airlines for scheduled air transportation. By contrast, the major airlines served approximately 32 percent of the total.

Economic Characteristics of the Airlines

Economists usually describe the certificated airline industry as closely approximating an oligopolistic market structure. An **oligopoly** (from the Greek *oli*, meaning "few") is an industry composed of a few firms producing either similar or differentiated products. A "few" can be 5 or 10 or 100 firms. A large percentage of our nation's output of goods and services is produced by oligopolistic industries: steel, automobiles, oil, and aluminum, to mention a few. Oligopolistic

industries typically are characterized by high **barriers to entry**. These usually take the form of substantial capital requirements, the need for the technical and technological know-how, control of patent rights, and so forth.

In addition to few sellers, a similar product, and high obstacles to entry, oligopolistic industries tend to share several other characteristics.

1. *Substantial economies of scale.* By **economy of scale**, economists mean decreases in a firm's long-term average costs as the size of its operations increases. Firms in oligopolistic industries typically require large-scale production to obtain low unit costs. Large-scale production is afforded by intensive labor and management specialization of job responsibilities, utilization of the most efficient technology available, and effective use of by-products. If total market demand for the product or service is sufficient to support only a few large firms of optimum size, competition generally ensures that only a few such firms will survive.

2. *Growth through merger.* Many of the oligopolies that exist today have resulted from mergers of competing firms—in mergers that may date back to the late 19th or early 20th century. In 1901, for example, the U.S. Steel Corporation was formed from a merger of 11 independent steelproducers. Or think of the number of U.S. automobile manufacturers back in the 1930s, 1940s, and 1950s. Well-known companies like LaSalle, Hudson, Packard, and Studebaker have long since gone. The purpose of most mergers is to gain a substantial increase in market share, greater economies of scale, more buying power in the purchase of resources, and various other advantages that smaller firms do not possess to the same extent.

3. *Mutual dependence.* When there are only a few firms in a market, it matters very much to each firm what its rivals do. Economists call this situation **mutual dependence**. The small number of sellers in an oligopolistic industry makes it necessary for each seller to consider the reactions of competitors when setting prices. In this sense, the behavior of oligopolists in the marketplace may be somewhat similar to the behavior of players in such games of skill as chess, checkers, or bridge. In these games, the participants try to win by formulating strategies that anticipate the possible counterreactions of their opponents.

4. *Price rigidity and nonprice competition.* In an oligopolistic industry, firms find it more comfortable to maintain constant prices and to engage in various forms of nonprice competition, such as advertising and customer service, to hold, if not increase, their market shares. Price reductions, when they occur, are sporadic and usually come about only under severe pressures resulting from weakened demand or excessive capacity.

- One paying passenger transported 1

mile Yield = Revenue per RPM

- Average fare paid by passengers, per mile flown
- Airline Supply ASM = Available Seat Mile
- One aircraft seat flown 1 mile Unit Cost = Operating Expense per ASM (“CASM”)
- Average operating cost per unit of output
- Average Load Factor = RPM / ASM • Unit Revenue = Revenue/ASM (“RASM”)

Example: Airline Measures

- A 200-seat aircraft flies 1000 miles, with 140 passengers: RPM = 140 passengers X 1000 miles = 140,000 ASM = 200 seats X 1000 miles = 200,000
- Assume total revenue = \$16,000; total operating expense = \$15,000: Yield = \$16,000 / 140,000 RPM = \$0.114 per RPM Unit Cost = \$15,000 / 200,000 ASM = \$0.075 per ASM Unit Revenue = \$16,000 / 200,000 ASM = \$0.080 per ASM
- Average Load Factor = RPM / ASM ALF = 140,000 / 200,000 = 70.0%
- For single flight, also defined as passengers / seats

Airline Supply Terminology

- Flight Leg (or “flight sector” or “flight segment”) – Non-stop operation of an aircraft between A and B, with associated departure and arrival times

- **Flight**

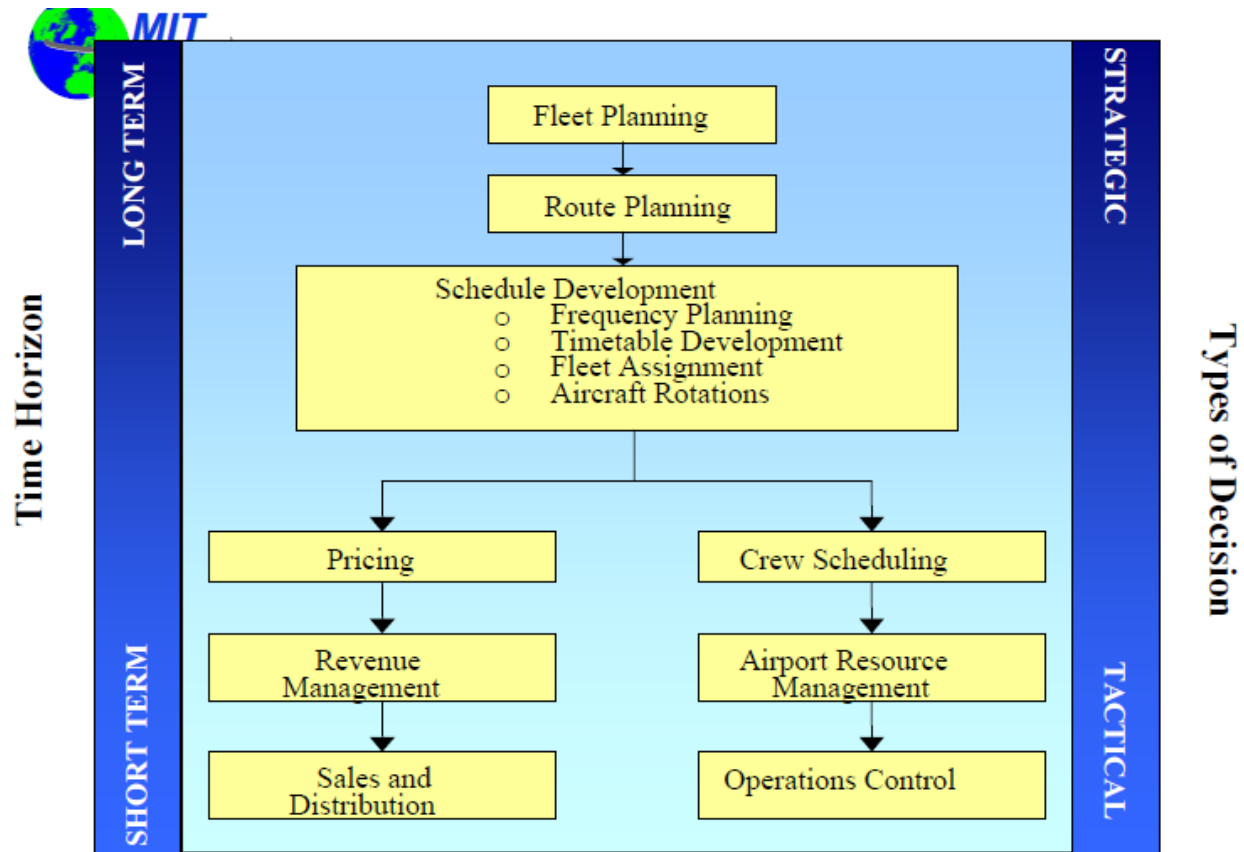
- One or more flight legs operated consecutively by a single aircraft (usually) and labeled with a single flight number (usually)
- NW945 is a two-leg flight BOS-MSP-SEA operated with a B757

- **Route**

- Consecutive links in a network served by single flight numbers
- NW operates 2 flights per day on one-stop route BOS-MSP-SEA

- **Passenger Paths or Itineraries**

- Combination of flight legs chosen by passengers in an O-D market to complete a journey (e.g., BOS-SEA via connection at DTW)



FLEET PLANNING

• Long-term strategic decision for an airline:

–Affects financial position, operating costs, and especially the ability to serve specific routes.

• Huge capital investment with lasting impacts:

–US \$40-60 million for narrow-body aircraft

–\$200+ million for wide-body long-range 747-400

–Depreciation impacts last 10-15 years

–Some aircraft have been operated economically for 30+ years

Fleet Planning Decisions

• Fleet planning is an optimal staging problem: – Number and type of aircraft required – Timing of deliveries and retirement of existing fleet – Tremendous uncertainty about future conditions

• Aircraft evaluation criteria for airlines include: – Technical and performance characteristics –

Economics of operations and revenue generation – Marketing and environmental issues – Political and international trade concerns

ROUTE PLANNING

- Given a fleet, selection of routes to be flown
- Economic considerations dominate : – Forecasts of potential demand and revenues – Airline's market share of total forecast demand – Opportunity cost of using aircraft on this route – Network implications for costs, revenues and "profit"
- Practical considerations just as important: – Aircraft with adequate range and proper capacity – Performance and operating cost characteristics – Operational constraints and aircraft/crew rotation issues – Regulations, bilaterals, and limited airport slots

"Route Profitability Models"

- **OR models designed to perform such route evaluations, used by some airlines:** – Demand, cost and revenue forecasts for specific route, perhaps for multiple years into the future – Select routes to maximize profits, given set of candidate routes and estimated demands – Subject to fleet and capacity constraints – Assessments should be based on total network impacts
- **Built on highly simplified assumptions:** – Profit estimates entirely dependent on accuracy of demand estimates and market share models – Ability to integrate competitive effects is limited

SCHEDULE DEVELOPMENT

- **Involves several interrelated decisions, which to date have not been fully integrated:**
Frequency Planning: Number of departures to be offered on each route, non-stop versus multi-stop

Timetable Development: Flight departure and arrival times, including connections at airline hubs

Fleet Assignment: Aircraft type for each flight, based on demand and operating cost estimates

Aircraft Rotation Planning: Links consecutive flights to ensure balanced aircraft flows on the network.

OR Models in Airline Scheduling

- Airline scheduling problems have received most operations research (OR) attention
- Use of schedule optimization models has led to impressive profit gains in:
 - Aircraft rotations; fleet assignment – Crew rotations; maintenance scheduling •

Current focus is on "solving" larger problems:

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PRICING DECISIONS

- “Differential pricing” by airlines is universal:
 - Classes of service (First, Business, Coach)
 - Different “fare products” within the coach cabin, with different restrictions, at different prices
 - Virtually every airline in the world offers multiple price points (even low-fare carriers with “simplified” fare structures)
- Economic trade-off in pricing decisions: – Stimulation of new demand; increased market share for airline
 - Diversion of existing demand to lower fares; reduced revenues
 - Recent pricing difficulties of network airlines due in part to greater diversion of revenues than stimulation of demand

Pricing Models

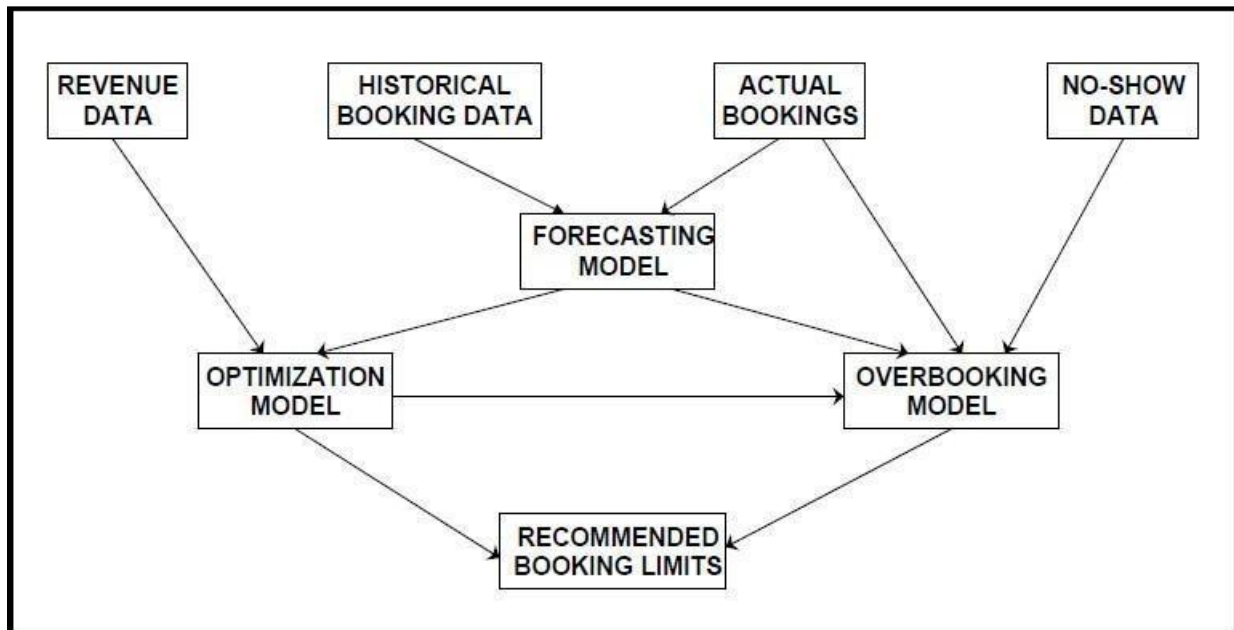
- Pricing theory has not kept pace with airline competitive pricing practices
 - Difficult to estimate price elasticity, willingness to pay, potential for stimulation and diversion
 - No practical tools for airlines to determine “optimal” prices
- Some airlines are now implementing “Pricing Decision Support Systems”
 - Primarily monitoring of price changes
 - Little competitive modeling of pricing impacts
- Dominant practice is to match low fares to fill planes and retain market share.

REVENUE MANAGEMENT

- “Inventory control” for airlines:
 - Given a scheduled flight, capacity and prices, how many bookings to accept by fare type
 - Objective is to maximize revenue
- fill each seat with highest possible revenue
- Computerized RM systems used by airlines to increase revenues by 4-6%:
 - Generate forecasts by flight date and fare class
 - Optimize seat allocations to different fare classes
 - Overbooking models to minimize costs of denied boardings and “spoilage”



Example of Third Generation RM System



Integrated Airline Planning Models

- As described, current practice is to perform scheduling, pricing and RM *sequentially*.
- Integrated models would *jointly* optimize schedules, capacity, prices, and seat inventories:
 - Better feedback from pricing and RM systems can affect optimal choice of schedule and aircraft
 - Better choice of schedule and capacity can reduce need for excessive discounting and “fare wars”

The Ultimate Challenge

- Joint optimization and planning is a big challenge, both theoretically and practically:
 - Few airlines have “corporate databases” with consistent and detailed demand/cost data
 - Research is still required to identify models that can capture dynamics and competitive behaviors
 - Organizational coordination within airlines and willingness to accept large-scale

decision tool – Might never be possible to integrate all subtleties of airline planning decisions into a useful tool.

UNIT-5

FLEET PLANNING AND ROUTE EVALUATION

One of the most difficult decisions airline managements must make is whether to buy new or used aircraft and what type. Alternatively, they must consider whether it makes better financial sense to modernize older aircraft already in their fleet or to acquire aircraft from the outside.

Many additional factors, including the costs associated with engineering and maintenance, must be weighed. The factors are constantly changing, and their relative importance at each airline depends on the carrier's individual situation

FACTORS IN FLEET PLANNING

Purchasers of new aircraft can generally get by for 7 to 10 years without having to make any major structural repairs. Furthermore, maintenance costs as a percentage of total costs have been steadily decreasing since the 1960s. However, percentages do not necessarily present a true picture. If one set of costs, such as for maintenance, rises less steeply than others, its percentage of the total may drop although the cost in absolute dollars may be rising. In this context, a set of figures from American Airlines is worth noting. Over the 20-year life of a 707, American found that maintenance costs rose 10 percent but that improvements in reliability more than compensated for the rise. This was in terms of current dollars. When translated into constant dollars, which take inflation into account, the situation was even better: maintenance costs actually dropped.

It would be quite simple if maintenance were the only, or the most important, factor to consider in fleet decisions. But besides maintenance costs, many other factors must be balanced against one another: the price of fuel; the availability and price of used aircraft; resale value; the price of new aircraft; terms of purchase; cash flow; debt/equity ratio; the availability of money from lenders; the receptivity of Wall Street to the issuance of stocks, bonds, and debentures; interest rates; route structure; competitive situation; strategy; and labor costs. All are even more important than before in today's deregulated environment.

The Hub-and-Spoke System

In the quest to achieve the lowest possible unit cost, U.S. airlines have come to stress hub-and-

spoke route systems where practical. This, too, has had a profound influence on new aircraft requirements. Load capacity has tended to be greater in smaller aircraft with shorter full-payload ranges, such as American's MD-80s, United's fleet of 737s of various models, and US Airways' ERJs and CRJs. Hub-and-spoke networks have influenced airlines in other ways. Although the air carrier community has long recognized economies of scale (as reflected in the preference for a large number of identical aircraft), it has also come to appreciate that, with deregulation, economies of scope are perhaps as important as economies of scale. This has led carriers to serve not only more city-pair markets but more varied markets than ever before.

This, in turn, has caused the largest airlines to require a wider variety of aircraft than ever before. Indeed, the range of attributes embodied in such aircraft appears to be broadening as economies of scope are pursued, partially through airline consolidation. Hubs have also influenced carriers' decisions with regard to larger aircraft, such as the Boeing 767 and Airbus A330. As the hubs become increasingly congested and slot limitations more constraining, there is a natural tendency to schedule larger aircraft rather than smaller ones through the hub, especially during periods of peak activity. This, too, has led to a proliferation of certain types of aircraft in the fleets of the larger carriers reliant on hub-and-spoke networks. Here, also, there has been a happy conjunction of events: changes in the so-called two-engine rule have increasingly enabled airlines to operate larger twin-engine aircraft inter continentally and internationally as well as on shorter hauls.

Fleet Rationalization

Consolidation of the industry during the 1980s as a result of mergers has led to a proliferation of specific aircraft types operated by any particular carrier. No doubt, much of this proliferation will be reduced as fleet rationalization becomes both practical and possible. Although fleet rationalization may well be a first order of business for consolidated airlines, such carriers still need to acquire new aircraft not only to address new markets but also to enable them to enjoy the benefits of maximum practical fleet commonality in the long run. What will influence the acquisition process involving new aircraft is the economic organization of the airline industry as consolidation proceeds. The issue is the behavior of the airline industry under conditions of oligopoly.

Fleet Commonality

One of the main reasons for aircraft purchases in large numbers is fleet commonality. The

Boeing 757 and 767 have common type-rating requirements, a distinct advantage to the carriers operating both types, as well as a strong inducement for airlines that are operating either model.

The new generation of the 737 family provides various models with identical cockpits and seating from 100 to 180 passengers, which offers airlines using such models greater flexibility for planning new routes. Commonality is also apparent in the Airbus series. The A320/321 and the A330/340 share many of the same component parts and flight deck instrumentation. Engine choice is offered on almost all new transports having 200 or more seats, an important factor in decisions to buy a particular type. Usually, the selection is based on power plant commonality

with other aircraft in the operator's fleet. Sometimes, it is a politically motivated decision, especially when the air carrier involved is government owned or heavily subsidized.

Long-Range Aircraft

The Boeing 777, launched in 1990, is aimed at markets between the 767 and 747. It competes directly with the A330/340 series and the MD-11. The 777 is the first commercial airliner with the option of folding wings, allowing it to fit its otherwise long wings (for required range) in most existing airport gates. However, as of early 2006, no aircraft operator had ordered a 777 with this option due to high costs (\$2 million per aircraft. In 2008, Boeing will launch the 787 Dreamliner, a mid-sized twin-engine wide body aircraft that will carry between 250 and 300

passengers. This aircraft will compete against Airbus' 350, a 250- to 300-passenger long-range aircraft that will be available in 2010.

Because of the hub-and-spoke system's drawbacks, airlines are currently rethinking route structures and are considering new aircraft that can economically bypass hubs and provide point-to-point service. This would certainly win friends among the traveling public. Point-to-point service has always been popular, but the concept has even more appeal for travelers today because of their increasing frustration with air traffic delays and mounting congestion at major hub terminals. Bombardier's Canadair CRJ series and Embraer's EMB-135 and EMB-145 regional jets are aiming at this market niche. Since the events of September 11, 2001,

many airlines have refocused on point-to-point services to cut costs. In most cases, the regional jet is used because of efficient operational costs and reduced load-factor requirements compared to other aircraft .

Noise Restrictions

Most early orders for new-generation aircraft were conceived as direct replacements of older planes—usually with models of roughly the same size. But as it became obvious that air travel was increasing beyond early projections, the carriers started looking for larger aircraft with more seats to obviate the need to add more flights. This led to orders for models such as the Boeing 757 to replace the 727s and the McDonnell-Douglas MD- 80 to supplant the DC-9s. More than 2,000 new jet transports were on order for delivery during the 1990s, indicating that the days for aging airliners in the fleet were undoubtedly numbered. Higher maintenance costs, higher noise levels, and higher fuel consumption make them candidates for replacement by newer-generation models. What will happen to these planes that have served the public so well for so many years? Some old 727s have, in fact, found a new home with Federal Express; hushkits have been developed so that they can meet the new noise rules. However, FedEx can absorb only so many; other aging units may be headed for South America or Africa, where noise is not yet a major issue. Additionally, Valsan offered a re-engining program especially for the 727. But the retrofit's high cost might discourage most prospects, who would still be left with an older airplane. UPS and Rolls-Royce planned to re-engine 727 freight haulers to meet Stage 3 noise standards.

Table 13-1 lists the number of aircraft that ATA member airlines had on order as of December 31, 2002. As of early 2006, no updated data was available from ATA.

DESIGN AND DEVELOPMENT—THE MANUFACTURER'S

VIEWPOINT

The Boeing Approach

The design and development stages for a new jetliner can take from five to six years. In the case of the Boeing 757 and 767 models, the concept of a more fuel-efficient aircraft was born in the mid-1970s with the skyrocketing price of fuel. When the 757 was being planned, engineers for Boeing, working with the airlines, were hoping for a 10 percent reduction in operating costs

compared to the 727 jetliner that the new aircraft was designed to replace. In fact, Boeing had very modest ambitions for the 757. The original plan was essentially to modify the 727 to operate with two highly efficient engines instead of the three less efficient engines used on the

727. But as the months passed, Boeing's engineers kept making changes, and they finally decided to build the airplane more along the lines of the 767. About 60 percent of the parts in the 757 are interchangeable with parts in the 767; only 6 percent of the parts in the 757 are the same as those used in the 727. It should be noted, production of the 757 ended in October 2004 after 1,050 had been built.

The use of electronic monitoring devices and navigational aids allows the 757 to be flown by two pilots, as opposed to three for the 727, another improvement in operating costs. In the 757 cockpit, many of the common mechanical gauges and control systems are replaced by video screens and computers. The flight control systems are so advanced that, beginning shortly after takeoff, the plane can fly and even land by itself.

Designing and developing an appropriate family of aircraft to meet a majority of the airlines' needs has become even more difficult since deregulation. With new competition from other established carriers and from the newcomers, most of the large carriers are still in the process of rationalizing their current and future route structures in an attempt to determine where they want to be in 5 or 10 years. The major carriers have been dropping low-density routes and concentrating on their high-density, long-haul routes with more standardized fleets, the motivation being to improve efficiency (load factors and utilization). This specialization among the different levels of carriers presents a problem for the manufacturer that tries to develop an aircraft whose users' needs vary considerably. The custom of prederegulation days, when each carrier had various models of aircraft from different manufacturers, seems to be over.

Another important step in the process of designing and developing a new aircraft is taking an objective look at the company's product in comparison with its competition. It is important to select those characteristics for comparison that are of particular concern to the potential airline customer. Figure 13-1 shows a few of the characteristics of competing commercial aircraft of concern to a particular manufacturer. Here, we see comparative data on block

speed, payload, unit operating cost, and return on investment. With comparative data such as these, the manufacturer can make judgments as to the relative importance in the eyes of the customer of, say, differences in speed and range and return on invested capital.

Other Factors in Design and Development

Another important factor in the design and development stage is the ability of individual carriers to finance the proposed new aircraft. There is a direct relationship between aircraft orders and airline profitability. Although airline profitability is a key element in the design and development

of any new aircraft, forecasting earnings and orders for some future period is a difficult task. Furthermore, forecasting the breakdown of orders by manufacturer and by type of aircraft for each manufacturer becomes an even more difficult task. Yet this important step must be taken before plans can be made to invest millions of dollars in the design and development of a new aircraft. Finally, manufacturers must be concerned with the proliferation of government regulations regarding the design and development of a new aircraft through the certification stage. These regulations cover everything from safety to noise and emission standards. Consequently, manufacturers work closely with government regulatory agencies, including the FAA, throughout all of the production stages.

THE FLEET-PLANNING PROCESS

From an individual airline's standpoint, the aircraft selection process is an ongoing function coordinated by a generalist group, such as corporate planning, with major help from technical, or specialist, administrations such as finance and property, marketing, line maintenance, engineering and maintenance, and flight operations. The existing fleet of an operator also is a significant factor in an operator's fleet-planning decisions. Substantial savings in terms of training, spares inventories, and operations can be achieved by operating a common fleet of aircraft.

Information Needed

Basically, corporate planning is interested in information on four different areas in the fleet-planning process: the carrier's current resources, corporate objectives, projected industry environments, and marketing strategy.

Current Resources. The carrier's **current resources** include its present fleet inventory by type of aircraft, use, and month. Also included are financial and technical data on aircraft on order. Financial data include acquisition costs (purchase or lease), startup costs (primarily maintenance and flight training), and unit operating costs. Technical data on aircraft currently on order include payload-range figures, cruise performance information, runway requirements, noise levels, parts and service availability, and flight characteristics. Labor resources are also included under current resources. Maintenance capability in terms of type and availability of personnel to be trained on the new equipment must be considered, and lead times must be established. Similarly, flight crews must be prepared in advance of delivery dates of aircraft currently on order. In short, the corporate planning unit must completely analyze the carrier's current resources—what it has now, what it has on order—as a starting point in the aircraft selection process.

Corporate Objectives. Top management's objectives for the company, or **corporate objectives**, include forecasted profitability (operating revenues and expenses, operating income, net earnings, earnings per common share, and return on investment), systemwide load factors, acceptable levels of cash on hand, market share on prime routes, debt/equity ratio, and general guidelines regarding new-aircraft acquisition. Other objectives include labor productivity improvement targets and cost-saving goals. Corporate objectives are broad and emphasize what is to be achieved, but not necessarily how it is to be done.

Projected Industry Environments. **Projected industry environments** include the outlook for the national economy, the outlook for the industry, and the carrier's performance within the industry. First and foremost, corporate planning is concerned with the national economic outlook: the gross national product, national income, personal income, disposable income, and level of consumer income in the next 1-year, 5-year, and 10-year periods. Next to be considered is the air transport industry forecast within the overall economy, including such items as revenue passengers and cargo tonnage, RPMs, ASMs, cargo tonmiles, revenue block hours, and so forth.

This is followed by a forecast of the carrier's traffic statistics within the industry. In addition, the carrier makes certain assumptions regarding passenger traffic mix (business versus pleasure), cargo directionality, and price elasticity of demand in selected long- and short-haul markets.

Marketing Strategy. This is a key piece of information, requiring considerable interplay among corporate planning and other administrations, primarily marketing. Given the company's current resources and corporate objectives and the projected industry environments, how is the carrier to implement its plan, or marketing strategy? Significant items to be considered include how much service to provide between key city-pairs, how much emphasis to place on long-haul or short-haul markets or both, which weak markets to penetrate now or later or to eliminate, and in which markets to trade off profit for market share or vice versa. A critical area of consideration is fare and rate structure levels in various markets for both passenger and cargo service.

The Fleet-Planning Model

Computer models have been developed to translate this information into a fleet planning model that is used in determining future aircraft acquisition requirements, aircraft assignment requirements, financial requirements, and operating conditions over various planning periods (2 and 3 years ahead for order versus option decisions, 4 and 5 years ahead to ensure that the purchases made in years 2 and 3 were consistent with long-term developments, and possibly 7 to 10 years ahead to ensure consistency and to gain insight into financial and facility needs in the long term). This fleet planning model is commonly referred to as the *unconstrained operating plan*, because it ignores system constraints in order to ensure a full range of opportunities to be considered. Computer-generated fleet-planning models provide corporate planning with the basic output—the number and type of aircraft to be acquired, the times of acquisition, and the timing of trade-in or phase out of existing fleet. But they also allow management to assess the impact of altering the information fed in, primarily corporate objectives, industry environment, and marketing strategy.

Aircraft Evaluation

The aircraft evaluation process can be broken down into five areas: consideration of design characteristics, physical performance, maintenance needs, acquisition costs, and operating economics.

Design Characteristics. Design characteristics include such factors as the aircraft's dimensions, weight profile (including maximum zero-fuel weight and operator's empty weight), fuel capacity, type of power plants, systems (electrical, hydraulic, and environmental), seating configuration, containers and pallets, bulk volume, and total volume. It is difficult to compare these various characteristics for competing aircraft, and the problem is compounded by the

many options available on each aircraft. For example, Boeing's high-cruise-speed 747-300 with the upper-deck extension has many seating arrangements. In the upper deck, on the economy side, with seats at 34-inch pitch, 69 passengers can be carried. At the same pitch, so can 81, 85, or 91. At 32-inch pitch, the maximum number of economy passengers is 96. Either 42, 52, or 63 business-class passengers can be carried at 36-inch pitch. On the first-class side, 38 passengers at 40- or 42-inch pitch or 26 first-class sleepers at 62-inch pitch can be carried. Varied lower-deck forward arrangements include 18 first-class sleepers at 62-inch pitch plus 63 business passengers, or 41 first-class sleepers at 57-inch pitch. There also are arrangements for 40 first-class sleepers at 60-inch pitch or 36 first-class sleepers at the same pitch.

Route Planning and Evaluation

Given a fleet plan, the process of route planning and evaluation involves the selection of routes to be flown. Economic considerations dominate route evaluation: – Forecasts of potential passenger and cargo demand (as well as expected revenues) for planned route are critical to evaluations – Origin-destination market demand is primary source of demand and revenues for a given route, but far from the only source – In large airline hub networks, traffic flow support to the new route from connecting flights can make it profitable – Airline's market share of total forecast demand for the new route depends on existence of current and expected future competition – The fundamental economic criterion for a planned route is potential for incremental profitability in the short run, given the opportunity cost of taking aircraft from another route

Route Evaluation Issues

- Practical considerations can be just as important: – Technical capability to serve a new route depends on availability of aircraft with adequate range and proper capacity – Performance and operating cost characteristics of available aircraft in the airline's fleet determine economic profitability – If the route involves a new destination, additional costs of airport facilities, staff re-location, and sales offices must be considered – Regulations, bilaterals, and limited airport slots can impose constraints on new route operations, to the point of unprofitability
- Strategic considerations can overlook lack of route profit: – Longer term competitive and market presence benefits of entering a new route even if it is expected to be unprofitable in short run.

Route Planning Models

- Route planning requires a detailed evaluation approach: – Demand, cost and revenue forecasts required for specific route, perhaps for multiple years into the future – Assumed market share of total demand based on models of passenger choice of different airline and schedule options – Depends to a large extent on presence and expected response of competitors to route entry

- “Route Profitability Models” – Computer models designed to perform such route evaluations, but ability to integrate competitive effects is limited – Profit estimates entirely dependent on assumptions used.

Review: Basic Airline Hub Economics

- Routing flights and passengers through a hub is more profitable for the airline if: COST SAVINGS from operating fewer flights with larger aircraft and more passengers per flight IS GREATER THAN REVENUE LOSS from passengers who reject connecting service and choose a non-stop flight instead, if it exists
- Passenger preference for multiple connecting departures vs. 1 or 2 non-stops per day: – Large multiple hub network operated by Delta, for example, provides over a dozen daily connections Boston-San Diego

Hub Impacts on Route Planning

- New routes to smaller spoke cities become much easier to justify in an established hub network: – An airline needs only 1 or 2 passengers per flight to each of 30+ connecting destinations to make a 100-seat aircraft “profitable” – However, such incremental analysis leads to a tendency to overlook potential displacement of other traffic on connecting legs – Same “incremental” logic makes it more difficult to stop service to a potentially unprofitable destination, which provides connecting traffic support to other flights

- Difficult to justify a new non-stop service to by-pass the hub, as it might steal traffic from hub flights: – However, large number of departures in a connecting market can allow airline to build market share and perhaps introduce a nonstop flight supported by many connecting opportunities

Recent Trends: Hub Strengthening

- Despite forecasts of more non-stop flights, a trend toward bigger and stronger hubs has re-emerged: – Largest US and European airlines have cut virtually all flights that do not originate or terminate at their hubs – Several smaller, weaker US hubs have been shut down

- Factors that continue to reinforce hub growth: – Liberalized bilateral agreements have

allowed airlines to fly even low-density international routes from their hubs (e.g., CVG-MUC) – Small regional jets are being used to increase frequency of service to small spoke cities, not to over-fly the hub with non-stop service – Airline alliances focus on linkages between major hub networks

- With recent economic downturn, importance of hub operations will likely continue

Measuring Route “Profitability”

- Airline costs are driven by fleet and flight schedule – Fleet drives fixed costs (capital costs) and variable cost rates (fuel burn rates, maintenance rates) – Flight schedule drives utilization and thus variable costs – Costs are incurred on a flight basis and on a network basis
- Airline revenues are driven by O-D markets – Prices are set by competitive considerations or by regulation – Revenues are earned on a passenger itinerary basis
- Scheduling decisions are often made at the route and flight departure level – Airline managers must decide which flight legs to remove so that other flight legs can be added

Approaches to Flight Profit Measurement

- Ideally, add/change/remove a flight leg and then measure the profitability given that the rest of the network can be re-optimized – Captures interactive or network effects of both costs and revenues – Not easy as it requires a good model of the entire operation
- Another approach – allocate all costs and revenues on a flight leg basis and then treat each leg as being independent of the rest of the network – Allocation schemes are always subjective – Does not capture network effects, very important in most cases – But, much easier to conceptualize.

Flight-Level Profitability

- Incremental Revenues
- Incremental Costs
- Measures of Profitability
- Network Contributions and Costs

Incremental Revenues (SYR-OMA)

- Two sources of incremental passenger revenues – Passengers boarding in SYR and deplaning in OMA (Local Revenue) – Passengers boarding in SYR and connecting in OMA to LAX or SFO (Connecting Revenue)

AERONAUTICAL ENGINEERING – MRCET (UGC – Autonomous)

- Connecting O-D revenues allocated to each flight leg – Proration methodology needed to split O&D fare into component parts (e.g. mileage, ratio of full fares) – Or, assign total connecting O-D fare to flightleg being analyzed
- Implicit assumption is that all revenues from a flight segment will be lost if the segment is cancelled – Reality is that airline might recapture some of this revenue

Incremental Costs

- Variable Operating Costs
 - Aircraft Ownership Costs – Equivalent leasing costs based on duration of flight segment
 - Overhead and Non-Operating Costs – Equivalent share of other fixed costs based on duration of flight segment
- Fully allocated flight costs equals the variable operating costs plus the aircraft ownership costs plus the allocated overhead and non-operating costs.

Network Contributions and Costs

- Contributions to Rest of Network – Additional revenue on other segments due to presence of SYR-OMA segment
- Costs to Rest of Network – Cost of processing SYR connecting passengers at OMA – Incremental cost of having more passengers on the connecting segments out of OMA – Opportunity Costs of selling seats beyond OMA, which could have been occupied by passengers from other O-D markets (known as “network displacement costs”).