## Chapter 8

# FORECASTING AND TRENDS

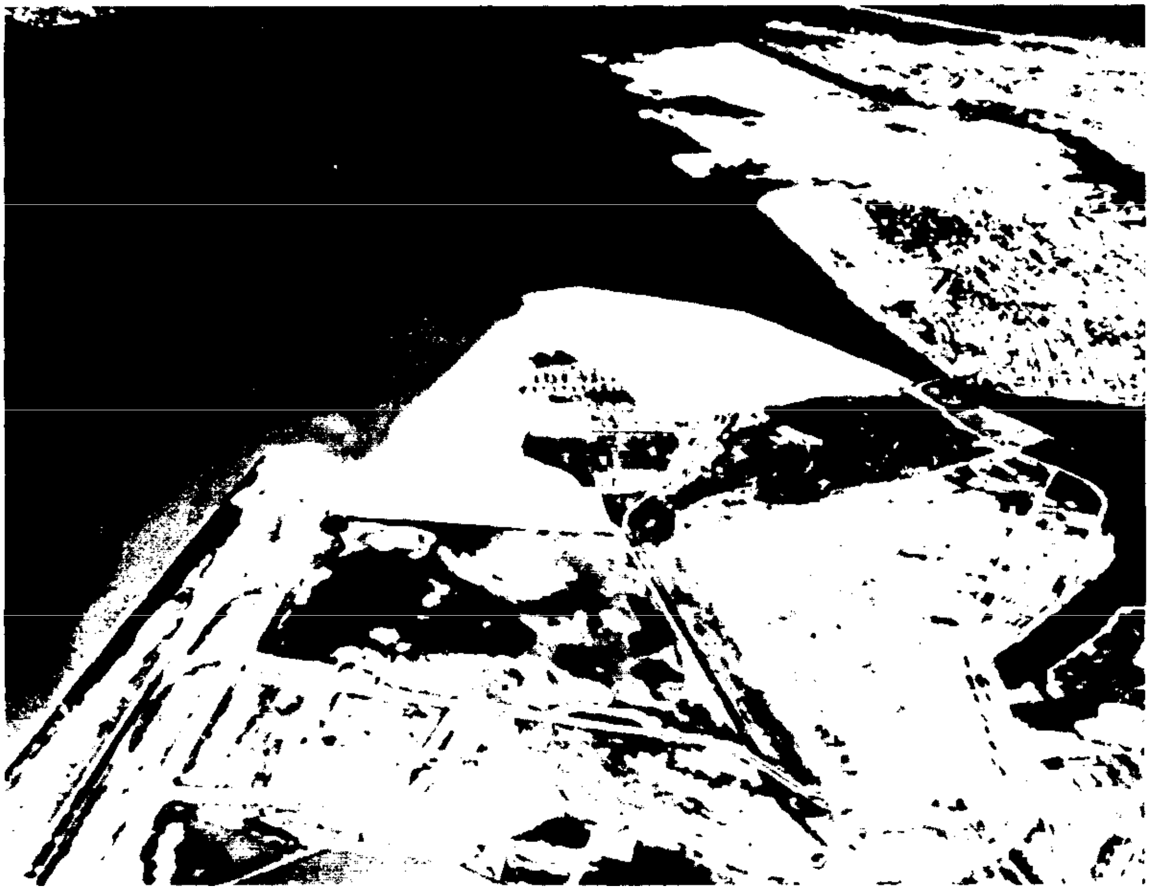

*Photo cradt: Dorn McGrath, Jr.*

# Contents

Page
Aviation Demand Forecasting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 159
  Methods of Forecasting . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 159
  The FAA Aviation Forecasting System. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 163
  Limitations of Aviation Demand Models.. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 166

Recent Trends in the Airline Industry. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 169
  Changes in Airline Industry Composition . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 170
  Changes in Route Networks . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 172
  Formation of New Hubs . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 174
  Aircraft Equipment . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 178

Implications for Airport Development . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 184

## List of Tables

*Table No.* *Page*
38. FAA Forecasts of Aviation Activity . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 164
39. Summary of FAA Forecasts, 1959-83 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 165
40. Domestic Airlines by Class of Carrier . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 171
41. Changes in Stations Served by Air Carriers, 1978-81 . . . . . . . . . . . . . . . . . . . . 173
42. Comparison of Hubs Served by Selected Carriers, 1978 v. 1982 . . . . . . . . . . . 173
43. Aircraft Departures by Hub Size. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 174
44. Weekly Departures and Seats, by Hub Size, 1978-83 . . . . . . . . . . . . . . . . . . . . 175
45. Changes in Weekly Departures Between Major Categories of Airports . . . . . 176
46. Present and Future Commercial Jet Aircraft . . . . . . . . . . . . . . . . . . . . . . . . . . . 182
47. Aircraft Operated by Commuter and Regional Airlines, 1970-81 . . . . . . . . . . 184

## List of Figures

*Figure No.* *Page*
19. Hub and Spoke Route System . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 177
20. Western Airlines Activity at Salt Lake City . . . . . . . . . . . . . . . . . . . . . . . . . . . . 179
21. Composition of U.S. Commercial Jet Fleet, 1982 . . . . . . . . . . . . . . . . . . . . . . . . 180
22. Age of Aircraft in Service in U.S. Commercial Jet Fleet . . . . . . . . . . . . . . . . . . 181
23. Composition of Commuter Aircraft Fleet, 1981 . . . . . . . . . . . . . . . . . . . . . . . . . 183

## Chapter 8
# FORECASTING AND TRENDS

Prudent management must take into account future events and conditions. Often their nature can be anticipated by analyzing events of the recent past and applying techniques to project the effects of these trends into the future. The first part of this chapter reviews forecasting techniques commonly used in aviation planning and describes their use by airport operators, air carriers, and government agencies. The second part discusses recent events and emerging trends in the aviation industry that will color future forecasts. These include the effects of deregulation, changes in route and service patterns, and the lingering effects of the air traffic controllers' strike. The final part of the chapter speculates on how these trends may affect the future needs of airports.

## AVIATION DEMAND FORECASTING[1]

### Methods of Forecasting

An aviation demand forecast is, in essence, a carefully formed opinion about future air traffic. Its primary use is in determining future needs or estimating when they must be met. Any of several methods may be used, with results that will vary widely in terms of scope, time scale, structure, and detail; but they have certain common features. Chiefly, forecasts are derived from assumptions about the relationship of the past and the future in that they postulate that certain measurable historical events or conditions have a causal or predictive relationship with events or conditions that will be of interest in the future, Analysis of these historical factors—usually by some sort of mathematical manipulation of data—allows the forecaster to express expectations in terms of some measure or index of aviation activity. From this initial product (e. g., expected passenger travel, cargo volume, or aircraft operations) the forecaster can derive further estimates of the nature, magnitude and timing of future needs for equipment, facilities, manpower, funding, and the like. Even though the method used may be quite rigorous and mathematically complex, forecasting is inherently a judgmental process where uncertainty abounds. The best that the forecaster can achieve is to be aware of his biases, to identify the sources of uncertainty, and to estimate the probable magnitude of error.

In setting out to prepare a forecast, the forecaster has at his disposal two basic types of input data. He may choose data on aviation activity itself and use historical performance trends to project future activity. In effect, this approach assumes that the best predictor of future aviation demand is past aviation demand. Alternatively, the forecaster may choose data related to underlying economic, social, and technological factors that are presumed to influence aviation demand, treating them as independent variables that can be used to predict demand as a dependent variable. Among the factors that may be so used are:

- basic quantitative indicators, such as population, gross national product (GNP), activity of certain sectors of the economy, personal consumption expenditures, or retail sales;
- derived socioeconomic and psychological indexes, such as propensity to travel, income classifications, employment categories, educational levels, or family lifestyles; and
- supply factors, such as fare levels, aircraft characteristics (size, speed, and operating costs), schedule frequency, or structure of the air carrier industry.

The outputs of the forecast are measures of aviation activity—passenger enplanements, revenue passenger-miles, freight ton-miles, number of aircraft in the fleet, or number of aircraft operations. Other output measures, such as air carrier revenue, air traffic control (ATC) workload, and demand for airport facilities can be derived from these estimates.

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[1] **This section is based in part on a paper prepared for OTA by David W. Bluestone, John Glover, Dorn McGrath, Jr., and Peter Schauffler.**

The range and scope of forecasts can vary greatly, depending on the purpose they are to serve. They might include all aviation or be limited to a particular type of traffic (passenger or cargo) or a particular type of operator (scheduled air carrier, charter, or general aviation). The geographical scope may be international, nationwide, regional, or limited to a particular market or airport.

The forecasting horizon may range from a few months to 20 years, again depending on the purpose of the forecast. Airlines, for example, tend to use very short-term projections of traffic in order to estimate their financial or staffing needs on a quarterly or semiamual basis. Airport planners, on the other hand, use very long-range forecasts, on the order of 20 years, as a basis for major decisions relating to land acquisition and airport development. Between these extremes, forecasting horizons of 1,5, or 10 years are common for planning changes and improvements of airport facilities, estimating ATC workload, projecting air earner fleet requirements, and financial planning.

There are two basic approaches to aviation demand forecasting—“top-down” or “bottom-up.” The top-down approach begins with the largest aggregates of economic and statistical data (usually national totals) and seeks to provide a general picture of aviation demand spanning the country and the entire system of air travel routes and facilities. Once the aggregate forecast has been developed, portions of the total volume of traffic can be allocated to specific industry segments or geographical regions based on historical shares or assumed growth rates.

The bottom-up approach, in contrast, begins with data for a specific geographic area and develops a forecast of aviation demand at a particular airport or in a metropolitan region, typically as an indicator of need for building or expanding local facilities. Where good data are available and the economy of the region is developing in an orderly way, this approach can closely approximate the reality of the area under study. In some cases, a number of such bottom-up forecasts may be combined to make a composite forecast for a larger area, but this approach of building up a regional or national aggregate from many local forecasts can lead to difficulties. For example, forecasts for some areas may be overly optimistic —often a defensive strategy designed to assure adequate future capacity. It is not unusual to find that the sum of many such bottom-up forecasts exceeds the top-down forecast for the region by a wide margin.

Whether “top-down” or “bottom-up,” aviation demand forecasting as practiced today uses a wide variety of methods. The attributes, limitations, and typical applications of these methods are discussed below.

## Time Trends

A simple forecasting method is the extrapolation from the past, where the forecaster assumes that major trends, such as traffic growth or market share, will continue uninterrupted and that the future will be like the recent past. Historical data for some base period are gathered and analyzed to determine a trend line, which is then extended to some point in the future, using either sophisticated mathematical procedures or simple estimation of the most likely course. This method is often used for short-term projections (1 or 2 years) where basic conditions are unlikely to change much. It is also better than no forecast at all in cases where a data base suitable for more sophisticated methods is not available. However, a basic shortcoming of trend extrapolation is that it does not take into account underlying economic, social, and technological factors that affect aviation and that are themselves subject to change.

## Econometric Models

The econometric model is by far the most frequently used method for forecasting aviation demand. It is a mathematical representation of air traffic or its constituent parts and those independent variables of the national economy which are thought to influence traffic growth. Econometrics is the statistical technique used to quantify these relationships. The mathematical equations of the model relate economic factors to the level of aviation activity, based on observation of past behavior of both the economy and the aviation industry. The equations may also be constructed so as to reflect the effects of specific factors within

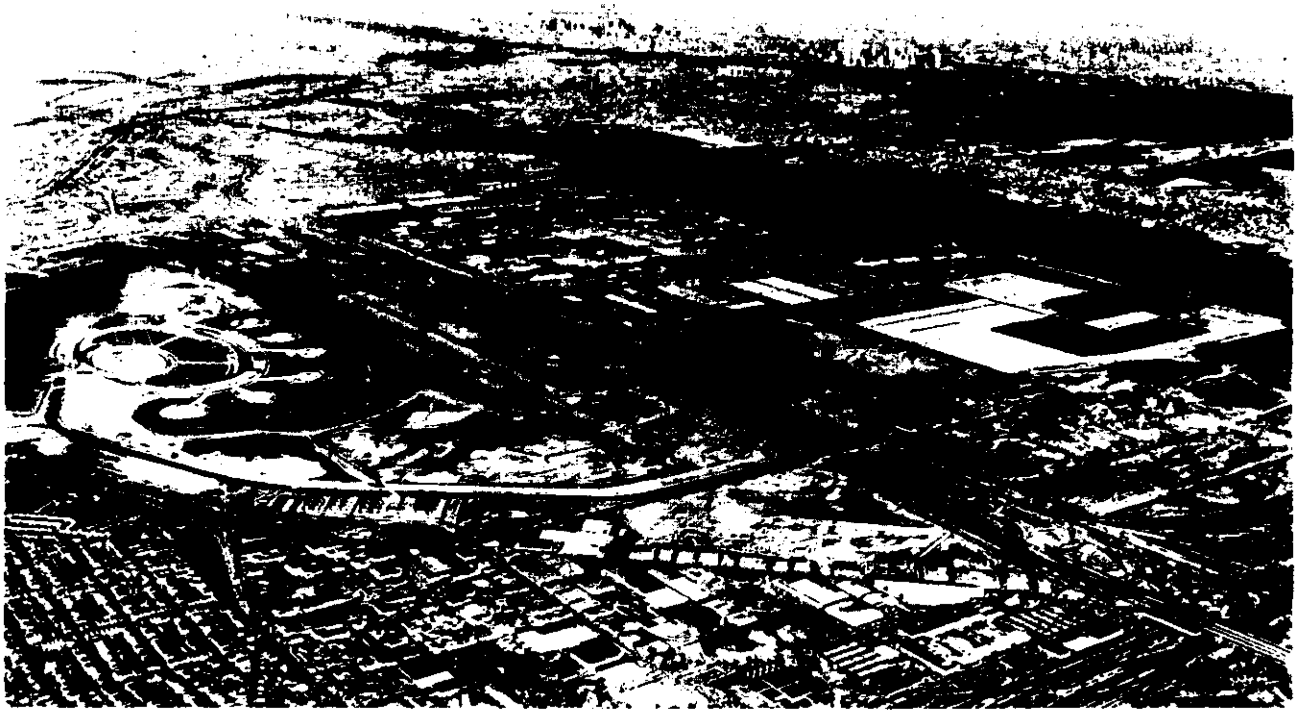

Photo credit: Federal Aviation Administration

Newark: the alternative to La Guardia and Kennedy

the air transportation industry itself, such as fare levels, route configurations, fuel costs, etc.

Among Federal Government agencies, both the Federal Aviation Administration (FAA) and the Civil Aeronautics Board make extensive use of econometric forecasting methods. Econometric models are also used by airlines, industry associations, and aircraft manufacturers. TWA, for example, employs a set of econometric models to forecast passenger travel industrywide and, from that, TWA's prospective market share. The Association of European Airlines uses a mathematical model in which traffic varies directly with gross domestic product and inversely with average revenue per passenger. McDonnell Douglas, Boeing, and Lockheed all have their own versions of econometric models to project future sales of aircraft. The equations for the McDonnell Douglas model, for instance, include the ratio of long- to short-term interest rates since the cost of borrowing money has an effect on the ability of airlines to purchase aircraft.

## Gravity Models

The gravity model was first developed in the sociological and marketing fields to describe various forms of human interaction. The technique was later adapted by traffic engineers to describe travel behavior. It is predicated on the assumption that travel behavior obeys a law analogous to the law of gravity, in that attraction between cities varies directly with population and inversely with distance. Thus, two large cities located near one another have a strong mutual attraction and form a very dense transportation market; small cities located far apart have little travel between them. The gravity model uses socioeconomic data for each pair of metropolitan areas to predict the level of transportation activity between them. The equations often contain terms to describe the special attractiveness of each city for different types of personal and business trips.

Although gravity models have been used extensively in highway planning, their use for aviation forecasting is limited. The State of California uses a gravity model in its State Airport System Plan in an effort to give a statewide “system view” of air transportation. The California gravity model takes into account changes in population, employment level, and income of major metropolitan areas to produce estimates of the travel that will be generated between various parts of the State. To provide consistency among plans for all transportation modes, a similar gravity model incorporating the same socioeconomic variables is used for other transportation forecasting within the State.

## Scenarios

The scenario method is often used to demonstrate the variation due to differing assumptions about future conditions, thus bracketing the-range of uncertainty. The values of input variables in an econometric model, for example, are in themselves simply guesses about the future behavior of the economy. Rather than depend on a single “best” estimate of GNP in future years, the forecaster may elect to construct several scenarios to predict the behavior of the aviation industry under a range of likely economic conditions. FAA began using this method in 1976 in an attempt to describe conditions that could affect the future of air transportation, and most FAA forecasts since that time have included different scenarios incorporating divergent assumptions about the economy and the airline industry.

One of the drawbacks of the scenario method is that the range between high and low estimates can be so large that the forecast loses practical value as a guide to planning. For example, in the initial 1976 FAA study, where five scenarios were used, the high estimate of revenue passenger-miles was 2.3 times the low estimate, and the ratio of high to low forecasts of aircraft operations was 2.9.

## Ratios

Some local aviation authorities and industry groups make forecasts by the relatively simple expedient of assuming a ratio between national “top-down” traffic forecasts and their own segment of traffic. This method is often used by airports that lack the funds or expertise to make independent econometric forecasts. A notable application was in 1969, when the major U.S. air carriers developed a national forecast on a consensus basis and then allocated portions of the traffic to each of 22 major air transportation hubs. The allocation, based on the historical share of national traffic captured by each hub, was adjusted by expert judgment to account for shifting patterns of airport use.

## Market Surveys

This method has been used extensively by the Port Authority of New York and New Jersey for the past 25 years. The Port Authority uses in-flight passenger surveys to gather information on point of origin, choice of airport in the metropolitan area, choice of ground access mode, ground access travel time, destination, purpose of trip, and other factors that can be used to predict travel behavior and consequent demands on aviation facilities. These data are classified in a travel market model made up of over 100 socioeconomic “cells” defined by age, occupation, income, and trip purpose. The growth rate for each cell is projected by straightforward econometric ”techniques.

The market survey method, while it produces a highly detailed forecast of travel, has some significant drawbacks. Data collection is complicated, time-consuming, and expensive. Since the sample is collected in a relatively brief period, it may not be truly reflective of long-term travel patterns and preferences. Airlines, which serve as collectors of the data, are reluctant for competitive reasons to relinquish control of survey results which they consider proprietary.

## Judgment

To some degree, judgment enters into all forecasting. Even the most formal and scientific forecasting methods require that assumptions be made about future conditions and events. These assumptions, which represent the forecaster’s basic outlook, are simply informed judgments, and they can have a powerful effect on the outcomes. Judgment also enters into the forecasting process in other ways: on the methodology to be employed, on the trends to be assumed, on the selection of years to use as a base period, on the choice of data

*Photo* **credit: federal Aviation Administration**

Commuter airline in Alaska

sources, and on likely changes in specific factors such as fuel availability, cost, and technology. At the completion of a forecast it is not uncommon to subject the results to the test of expert judgment and to adjust them in the light of what seems "reasonable."

Application of judgment has, in at least two cases, become institutionalized as part of the forecasting process. U.S. airlines generally use econometric models for traffic forecasts and fleet planning; but since they do not agree on method and initial assumptions, the Air Transport Association (ATA) develops a consensus forecast based on the judgment and practical experience of airline personnel and the ATA forecasting working group. The International Air Transportation Association (IATA) uses a modified "Delphi" technique to produce forecasts for international passenger and freight traffic. Delphi is a method for attaining consensus among experts, in this case the forecasters from participating IATA member airlines. Using this technique, initial estimates are obtained from each expert. These estimates are arranged in a composite that shows each participant how his forecast compares to the group as a whole, and each is invited to submit another forecast based on this information. After one or more rounds of comparison and feedback, judgments begin to converge, and a consensus forecast is reached.

## The FAA Aviation Forecasting System

The most elaborate aviation demand forecasts produced in this country are those of the Federal Aviation Administration. They consist of national, regional, and individual airport forecasts that typically cover a 12-year period, although 20-year forecasts are sometimes prepared. These forecasts, updated and issued annually, provide the basic context for aviation demand forecasting in the United States. They are used, with a variety of specialized interpretations, by all elements of the aviation community.

In addition to the basic annual forecasts, FAA also publishes special studies and forecasts from time to time. Subjects covered recently have included air cargo activity (1979), commuter airline activity (1977 and 1981), and forecasting needs at the State level (1979). FAA has also published special "profile" reports on hourly airport activity, air carrier operations, and international passengers. In 1978, FAA began a series of individual forecasts for 24 large hub airports. These are adaptations of other FAA forecasts, with special sections on local economic growth, passenger enplanements, cargo and mail enplaned, general aviation (GA) and air carrier aircraft operations, and traffic handled by FAA towers.

### FAA National Forecasts

Each year FAA publishes a national forecast entitled ***FAA Aviation*** Forecasts. The most recent edition (released in February 1984) includes detailed year-by-year forecasts from 1984 to 1995 for air carriers, air taxis and commuters, GA, and military aviation. It also contains workload forecasts for airports with FAA control towers, air route control centers, and flight service stations.

The 1984 forecasts anticipate that enplanements by major airlines will grow at an average annual rate of 4.6 percent. Larger aircraft and higher load factors will minimize actual increases in operations to accommodate this growth, with the result that FAA projects air carrier operations to grow by no more than 1.7 percent per year. Larger gains are expected for commuter carriers, whose enplanements are expected to increase by 7.4 percent per year and operations by 4.7 percent per year. GA operations are expected to increase by 6.0 percent annually. The current FAA forecasts are summarized in table 38.

## Table 38.—FAA Forecasts of Aviation Activity (fiscal years)

| Aviation activity | Historical | | | Forecast | | | Percent average annual growth | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 979 | 1982 | 198 | 1984 | 1985 | 1995 | 1979-82 | 1982-83 | 1983-84 | 1984-85 | 1983-95 |
| Aircraft operations (millions): | | | | | | | | | | | |
| Air carrier | 10.4 | 9.0 | 9.7 | 10.1 | 10.2 | 11.9 | (4.3) | 6.9 | 4.1 | 1.0 | 1.7 |
| Air taxi and commuter | 4.4 | 5.1 | 5.9 | 6.1 | 6.5 | 10.2 | 5.0 | 14.9 | 3.4 | 6.6 | 4.7 |
| General aviation | 51.7 | 34.2 | 35.3 | 38.5 | 42.4 | 71.0 | 10.2) | 3.4 | 9.1 | 10.1 | 6.0 |
| Military | 2.5 | 2.3 | 2.5 | 2.5 | 2.5 | 2.5 | (2.6) | 4.9 | — | | |
| Total | 69.0 | 50.6 | 53.3 | 57.2 | 61.6 | 95.6 | (8.2) | 5.3 | 7.3 | 7.7 | 5.0 |
| ir carrier, domestic: | | | | | | | | | | | |
| Revenue passenger enplanements (millions) | 283.4 | 272.8 | 290.3 | 312.7 | 330.0 | 497.8 | (1.2) | 6.4 | 7.7 | 5.5 | 4.6 |
| Revenue passenger-miles (billions) | 203.7 | 207.8 | 223.5 | 240.8 | 255.1 | 399.7 | 0.7 | 7.6 | 7.7 | 5.9 | 5.0 |
| Commuter carriers: | | | | | | | | | | | |
| Revenue passenger enplanements (millions) | 12.5 | 17.1 | 19.5 | 21.5 | 23.4 | 46.1 | 11.0 | 14.0 | 8.8 | 9.0 | 7.4 |
| Revenue passenger-miles (billions) | 1.5 | 2.3 | 2.7 | 3.1 | 3.4 | 7.9 | 15.8 | 16.2 | 2.8 | 0.6 | 9.3 |
| Fleet: | | | | | | | | | | | |
| Air carrier | 2,237 | 2,483 | 2,556 | 2,657 | 2,633 | 3,329 | 3.6 | 2.9 | 4.0 | (0.9) | 2.2 |
| Commuter | 1,413 | 1,494 | 1,500 | 1,606 | 1,682 | 2,537 | 1.9 | 0.4 | 7.1 | 4.7 | 4.5 |
| General aviation (thousands) | 199 | 213 | 210 | 207 | 211 | 287 | 2.4 | (1.6) | (1.3) | 1.9 | 2.6 |
| Hours flown (millions): | | | | | | | | | | | |
| Air carrier | 6.4 | 6.3 | 6.6 | 6.8 | 6.8 | 8.5 | (0.5) | 5.1 | 2.4 | 0.7 | 2.1 |
| General aviation | 42.3 | 37.8 | 36.6 | 37.6 | 39.1 | 58.4 | (3.4) | (3.2) | 2.7 | 4.0 | 4.0 |

SOURCES: 1979-83 CAB and FAA data. 1984-95 FAA forecasts.

As part of the documentation for these annual forecasts, FAA sets forth the basic assumptions concerning the industry, government, and economic environment for the forecast period. The principal indicators—gross national product, Consumer Price Index, and fuel price index—are composites of estimates obtained from four leading nongovernmental economic forecasting organizations: Chase Econometrics, Data Resources, Evans Economics, and Wharton Econometrics Associates. FAA believes that this consensus approach to formulating input assumptions lends greater credibility to the forecasts.

The air carrier portion of the forecast is developed in several steps. For airline travel, FAA first forecasts passenger yield (cost per passenger-mile) based on estimates of three independent variables: jet fuel prices, average airline wages, and available seat-miles per aircraft. The next step is to forecast passenger demand, based on GNP and yield. Third, FAA develops forecasts of aircraft operations based on load factor, average seats per aircraft, and passenger trip length, all of which are estimated in consultation with industry experts. Forecasts for itinerant operations, instrument operations, and other FAA workload measures are developed from the basic forecast of total aircraft operations, using empirically derived relationships.

Past FAA forecasts have often been criticized for inaccuracy or unrealistic assumptions about future growth of aviation. An examination of this question was made in a recent Congressional Budget Office study of FAA forecasts since 1959.[2] CBO divided the forecasts into three distinct periods (see table 39). CBO found that the forecasts performed between 1959 and 1965 were consistently low by an average of almost 19 percent. From 1966 to 1973 the forecasts swung sharply the other way and consistently overestimated the growth of aviation activity by nearly a third. From 1974 on, which coincides with the time that FAA has been using more sophisticated econometric modeling techniques, the results have been mixed, sometimes too high and sometimes too low. Overall error has averaged about 21 percent, somewhat smaller than in the previous period but still rather large for this type of forecasting. FAA forecasts for the GA sector have been especially unreliable and consistently high, sometimes by as much as 50 percent. On balance, CBO concludes that FAA's forecasts have improved substantially in the past 10 years, showing a reasonably small random error instead of the constant high or low bias that characterized forecasts of the earlier two periods.

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[2] *Improving the Air Traffic Control System: An Assessment of the National Airspace System Plan* (Washington, DC: Congressional Budget Office, August 1983), app. C, p. 65.

### Table 39.–Summary of FAA Forecasts, 1959-83

| Periods in which forecasts made | Method | Performance 5 years ahead | Market environment |
|---|---|---|---|
| 1959-65 | Trend forecasting: unspecified links to economy, business cycle, population, fares, competition from other modes | Average error – 18.7 percent<br>Worst year –32.5 percent | Expanding, prosperous economy. Rapidly growing population. Declining first-class and coach fares, (declining unit costs because of increasing use of jets). |
| 1966-73 | Trend forecasting: unspecified links to economy, business cycle, population, fares, competition from other modes | Average error +32.5 percent<br>Worst year +58.4 percent | Softening trends in aviation activity. Increasing ticket taxes, rising fares. Forecasts made in 1969 (published January 1970) assumed 4.25 percent growth rate in 1973, to continue at that rate through decade. Inflation 2 percent per year from 1973. |
| From 1974 | Linear econometric models | Average error +21.2 percent<br>Worst year +34.7 percent | Airline deregulation, economic recession, fare wars, and depressed airline revenues. |

SOURCE: Congressional Budget Office, *Improving the Air Traffic Control System: An Assessment of the National Airspace System Plan*, August 1983.

## Terminal Area Forecasts

FAA Terminal Area Forecasts (TAFs), like FAA national forecasts, are developed annually. The TAF data base contains descriptive information and forecasts for about 4,000 airports-the 3,200 eligible for Federal aid and about 800 other public-use airports. Each airport record includes at least 5 years of historical data and a 12-year forecast of aircraft operations, broken down into air carrier, commuter, GA, and military categories. The projections for individual airports can also be aggregated to form State and regional forecasts.

The TAFs constitute a subroutine of the basic FAA "top-down" forecasts of national aviation demand. The process for developing TAFs has been refined in recent years, and they now serve as the basic frame of reference for other types of "bottom-up" forecasts undertaken by many local airport authorities and State and regional agencies. Not all local airport authorities, however, accept the validity of TAFs, which they believe do not adequately take into account the factors affecting aviation demand at the local and regional level and which are not, in their view, developed through appropriate consultation with local authorities.

## The Special Problem of GA Forecasting

FAA forecasts GA demand in two segments—business aviation and personal flying. For business aircraft, the forecast is based on the real price of aircraft, interest rates, and measures of business activity such as manufacturing and retail sales. For personal flying, the factors used are aircraft price, interest rates, and GNP as a measure of income. Itinerant operations are forecast as a function of the size of the fleet and the real cost of fuel. Instrument operations are a function of fleet size. Local operations, predominantly training operations, are a function of the number of student pilots and the number of aircraft in the fleet. FAA has concluded that because of large and somewhat unpredictable oscillations in all these variables, econometric models do not produce reliable forecasts of general aviation. As a pragmatic approach, FAA uses modeling only as a point of departure to produce first approximations that are subsequently adjusted with data from periodic surveys and estimates from FU regional offices and industry representatives.

Some observers are of the opinion that FAA's general aviation forecasts are unrealistically high. For example, recent FAA forecasts estimate that the GA fleet will grow at a rate of 3.3 percent per year for the remainder of this century.[3] This means an expansion of the GA fleet from about 210,000 aircraft in 1983 to 269,000 in 1990 and 385,000 in 2000. Such a growth rate is extremely optimistic, and realizing it would require an unprecedented level of manufacture and sale in the GA aircraft industry. An increase of 175,000 aircraft in the GA fleet by the end of the century is equivalent to adding 10,000 new aircraft per year—13,000 if allowance is made for replacement of existing aircraft at the rate of 1 percent annually. When foreign aircraft sales are taken into account, the FAl forecast implies that U.S. firms would manufacture and sell about 16,000 aircraft per year between now and 2000. This seems unlikely in light of performance over the past 15 years in the GA aircraft manufacturing industry where sales (including exports) have averaged only two-thirds of this amount. A

## Limitations of Aviation Demand Models

Aviation demand models can be very useful forecasting tools, but it is important to recognize their limitations. First, all models are necessarily incomplete. They attempt to reduce a large and complex system to a relatively few mathematical equations that describe the most important interactions. Many factors must be left out, either because they are difficult to formulate mathematically or because including them would make the model cumbersome and too complicated to use. There are other factors excluded not by design but by inadvertence because, with the present state of knowledge about the relationship between aviation and underlying economic and social forces, we are simply unaware of all the factors that drive demand for air transportation.

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[3] *National Airspace System Plan* (Washington, DC: Federal Aviation Administration, April 1983, revised edition), p. II-2.

[4] *Aerospace Facts and Figures, 2983/84* (Washington, DC: Aerospace Industries Association, 1984), p. 33.

To guard against such structural weakness, the model builder calibrates and tests the model by inserting data from past years to see if the historical record can be accurately reproduced. If the model is well constructed and its mathematical relationships are a good representation of reality, using data from some past year in the equatiorls will yield a forecast of the aviation activity that actually occurred. Such testing ***gives*** the forecaster confidence that for some future **year** the model will correctly predict aviation activity if the correct ***values of input variables are used.*** Unfortunately, the correct values of input variables such as GNP or interest rates for any future year are themselves unknown, and uncertainty is simply transferred from the behavior of the aviation industry to behavior of the economy at large.

Models tend to assume that the future will be very much like the past. If the real world situation changes substantially, the model is correspondingly less accurate. Such changes might include sudden economic perturbations, such as the fuel crisis of 1973, or longer term restructuring of the market or the economy. For example, aviation models constructed to predict the behavior of a regulated industry with stable fares and routes tend to be less accurate now that price competition and freer entry into new markets are permitted. Further, because models are, at best, only partial representations of the world, it is not easy to predict which changes in travel behavior or economic conditions will be important in the future or how they should be incorporated in a model. A major problem among forecasters is discriminating among relationships that will persist and those that will not.

From this, it is clear that aviation demand models are highly influenced by underlying assumptions about economic and social trends and future conditions. The model itself may accurately depict relationships between air transportation and the state of the economy or the structure of the aviation industry, but if the assumed states of these variables at some future time are too optimistic, too pessimistic, or simply inconsistent with the course of events, the resulting forecasts can go far astray. It is probably fair to conclude that, even with the present limitations of the model builder's art, the inaccuracies due to the structure of forecasting models are generally smaller than those induced by erroneous input assumptions. An aviation demand model is no more robust than the assumptions on which it rests, and assumptions (usually a matter of expert judgment) are the most fragile part of the process.

The limitations, biases, and characteristics of a forecast may depend as much on who is doing the forecast as on the particular method being used. Airport authorities, aviation agencies, airlines, and industry associations all make forecasts to help them plan for the future and to help them justify plans and programs. There is, in many cases, a natural inclination to err on the side of optimism in order to protect the future interests of the agency producing the forecast. Thus, local airport authorities planning an expansion project may tend toward an unduly high appraisal of the overall growth prospects in the local economy and, hence, future passenger and ***cargo*** traffic. As a consequence, basing decisions to construct or expand facilities on these forecasts may lead to excess capacity or premature investment of capital. However, this may be less detrimental than relying on a forecast which is too low. Slight overcapacity and anticipation of demand is viewed by most airport planners as preferable to congestion, delay, and perhaps deterioration of service and safety.

Local forecasting may not take into account broader regional trends and conditions. The current shifts in population and economic activity

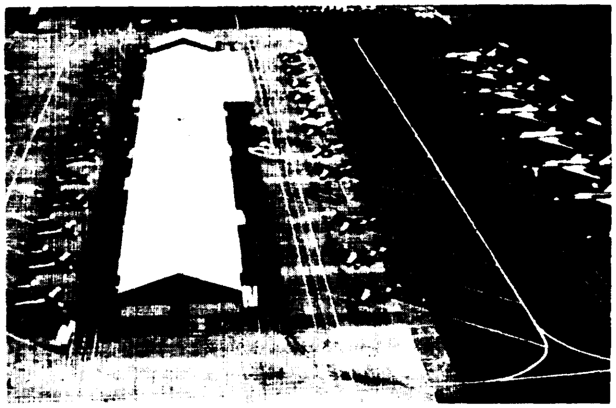

*Photo credit: Federal Express*

Air cargo hub

from the “Frost Belt” to the “Sun Belt” area case in point. States in the South and West are expected to experience much greater growth in aviation activity in the next few decades while communities in the North and East will tend to decline. However, this trend—with its consequences for airport planning and development—is not yet generally recognized in the forecasts prepared by “Frost Belt” communities, perhaps because they are unwilling (or find it politically unwise) to go on public record as predicting their own decline.

The tendency of the aviation community to organize categorically—air carriers, commuters, general aviation, helicopters, etc.—also influences aviation demand forecasting, both the forecasts prepared by such groups themselves and those prepared by others who seek to anticipate the demands that each sector will place on the airport and air traffic control system. All of these groups compete in some measure for the scarce resources of airspace and airport facilities, and none is prepared to concede that its own requirements are less pressing than those of others or to admit any scenario other than continued growth. As a result, each sector tends to publicize its own aspirations lest it lose out in the general competition and find its access foreclosed. With sufficient repetition and vigorous advocacy, such declarations become accepted as the reality of future demand.

For example, the President of the National Business Aircraft Association, Inc., asserted in mid-1982 that “a great pent up demand for aircraft is building all the while the recession continues. Once the general economic climate begins to improve and the price of borrowing money declines even modestly on a long-term basis, we will witness marketplace activity on a scale never before known.”[5] While this bold prediction may be arguable, it reflects a natural defensive strategy. If the forecast turns out to be true, general aviation, especially business aviation, will soon become the majority user of the airport and ATC system. In this event, business aircraft operators would be unwise to allow air carriers to preempt landing slots or to accept restriction or diversion of their activities to accommodate air carriers. On the other hand, if the forecast proves too optimistic, decisions based on it could result in serious overcapacity or misallocation of resources.

No forecast is any better than its input data, and a little foreseen consequence of deregulation is that forecasting may become more difficult and less accurate in the future because of the lack of a detailed and adequately maintained data base. The Airline Deregulation Act of 1978 calls for a gradual phaseout of the Civil Aeronautics Board (CAB) by 1985. At that time, all functions of the CAB will either be eliminated or transferred to other agencies. It is still not clear how much of CAB’s extensive data collecting activities will be transferred and continued. Since nearly everyone in the aviation community makes use of CAB data for forecasting purposes, the prospective loss of this resource is now the focus of extreme concern in industry and government. Not all parties agree on which parts of the CAB data base should be maintained and who should be responsible, but there is apparent consensus on at least four major points:

- CAB data have become a crucial part of the aviation forecasting process.
- Continued collection of at least the basic data on air carrier and commuter operations is vital to intelligent analysis, interpretation, and forecasting of regional and local aviation demand.
- Without such data, the reliability of forecasting for air carrier and commuter activity could decline, perhaps to a level no better than current general aviation forecasting.
- Forecasting aviation demand could become much more difficult after 1985.

The prospective loss or drastic reduction of the widely used and respected CAB data base looms as only the latest example of an unexpected major event in the uncertain world of aviation demand forecasting.

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[5] John H. Winant, President, National Business Aircraft Association, Inc., remarks at a meeting of the Western Michigan Business Aircraft Association, Grand Rapids, MI, June 25, 1982.

# RECENT TRENDS IN THE AIRLINE INDUSTRY[6]

Of all the forces acting on civil aviation at the present time, that which has the most profound effect—and which is perhaps the least understood in all its ramifications—is the recent deregulation of the airline industry. For 40 years, from 1938 to 1978, CAB exercised broad powers over the airline industry, controlling entry and exit of carriers, markets served, and fare structures. Although this was a period of great growth in the airline industry, the pace of change in patterns of service and airline route structure was slow because it was tempered by the regulatory process. CAB proceedings on route awards or fare changes took months or years to complete. The CAB often interpreted "public convenience and necessity" in light of the need to maintain financial stability among existing carriers. Although CAB progressively increased the level of competition, this process was usually accomplished by extending the overlap of routes and services among existing carriers.

The Airline Deregulation Act set a timetable for phasing out CAB statutory authority over a 4-year period. The major provisions of the act, effective immediately, relaxed CAB authority over routes and fares and made it easier for carriers to enter new markets or to reactivate dormant routes. Except in localities qualifying for essential air service, airlines became free to terminate service to a community by means of a simplified notice procedure. In addition, carriers were allowed to change fares within a broad "zone of reasonableness" determined by airline costs. Deregulation thus set the stage for a wide variety of changes in the way air services are offered.

While some of the effects of deregulation are now apparent, the full impact of these regulatory changes on the market cannot yet be evaluated. Air carriers have been operating in a deregulated environment for only a little over 5 years, and they are still in a "shake-down" period of adjusting to new freedoms and competitive pressures. At the same time, other major factors—escalating fuel prices, the recession, and the Professional Air Traffic Controllers Organization (PATCO) strike–have had their own effects on the airline industry, thus distorting the view of what *deregulation* has actually produced.

In general, the period 1978-81 marked a sharp increase in all airline costs, but no other cost escalated as much as fuel, which rose from $0.39 per gallon in 1978 to $1.04 in 1981. Fare flexibility provided by deregulation enabled some carriers to blunt the effects of increased fuel costs by quickly passing on the resulting higher costs to consumers. However, the deep recession, beginning with the first quarter of 1980, compounded the problem as the industry was caught in the position of needing to raise fares at a time of general economic decline.

The full effects of airline deregulation were muted if not altered by the recession, which began about 15 months after deregulation and has continued to disturb the U.S. economy. The recession has had a major effect on the airline industry, whose health has always been closely linked to GNP. In the period 1976-78, before the recession, real GNP increased by 6.7 percent per annum. During the period immediately following deregulation, GNP grew at less than 1 percent and

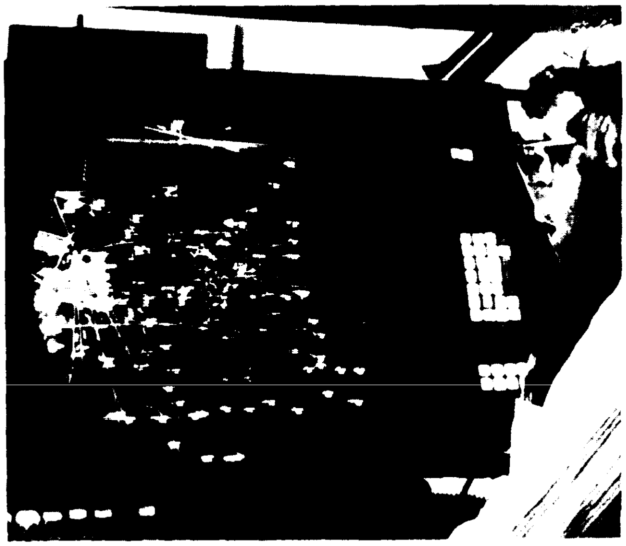

Photo credit: Federal Aviation Administration

Controller's view of a hub

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[6] This section is based in part on a report prepared for OTA by Simat, Helliesen & Eichner.

actually declined during 1982. The overall economic performance of the airlines showed a corresponding slump, although some airlines fared better than others and a few even managed to increase their profitability.

Some analysts argue that service and fare stimulation following deregulation, combined with the ability to drop unprofitable routes, cushioned the effects of the recession on the air carriers. High interest rates and poor business conditions clearly blocked the start of several new carriers and indirectly provided a measure of protection for existing carriers.

In effect, the air traffic controllers' strike in August 1981 reintroduced regulatory limits on the industry. The strike led FAA to close 58 ATC towers at small airports and to impose a cap on operations at the 22 busiest airports. To allocate the hardship equitably, FAA required each airline to reduce operations proportionately at those 22 airports. An airline could exercise full latitude to select routes, so long as it had operating rights (slots) at the capped airports. Slots could be traded and, for a limited time, even sold. But if an airline did not use a slot, it was forfeited. These strike-related restrictions have since been lifted, but their effects linger. Because operating rights had considerable value in a depressed, strike-ridden market, FAA restrictions forced many carriers to hold on to slots and postpone or cancel planned route changes. Equally important, the cap on operations limited opportunities for new carriers to enter many of the major markets.

In many respects, the strike slowed the process of deregulation, but it also stimulated formation of new hub-and-spoke patterns of operation as air carriers sought to increase the number of passengers handled by using larger aircraft at the constrained airports or by transferring operations to new regional hubs at less crowded airports.

The ultimate outcome of deregulation is not yet clear. The effects apparent so far—although blurred by the impacts of increased airline costs, the recession, and the air traffic controllers' strike—suggest that profound changes are taking place in the structure and economics of the airline industry, with repercussions that may persist for several years.

## Changes in Airline Industry Composition

Since deregulation, the number of airlines holding CAB operating certificates has increased tenfold. At the end of 1978, there were only 36 certificated carriers; now there are 355. To accommodate these changes, CAB has devised a new classification system that categorizes airlines as major carriers, national carriers, and large or medium regional carriers on the basis of their operating revenue. This system is not wholly compatible with two-way classification of trunk and local service carrier in use before 1978. (Table 40 compares the new and old classification systems. ) For purposes of this discussion, it is more convenient to use the pre-1978 categories, augmented by two additional groups (startup jet carriers and commuter airlines) in order to show the changes that have taken place in air carrier routes and services since deregulation.

Before deregulation, the 10 trunk carriers dominated major domestic U.S. air service markets. Even today, these airlines account for about 60 percent of total domestic enplanements and an even greater proportion of revenue passenger-miles, revenue, and fleet capacity. The trunk airlines operate large fleets of jet aircraft, of which nearly 20 percent are widebody. Trunk carriers are equipped to serve primarily the long-haul markets, emphasizing direct service between most major domestic markets.

Six local service airlines operate short-haul jet service in domestic markets. In 1982, these carriers enplaned 19 percent of all domestic air passengers. Through expansion and mergers, locals have grown substantially in size and now three of these—USAir, Republic, and Frontier—are larger than some trunk carriers. Still, there are substantial differences between local service and trunk carriers. Local service carriers operate predominantly narrowbody jet aircraft, typically with 100 to 125 seats. The average stage length and passenger trip length for local service airlines is less than half that of trunk carriers.

The "startup jet carriers" include former intrastate carriers that have expanded to nationwide service since deregulation, as well as new firms that began operation since 1978. Previously, there were four intrastate carriers that provided short-

### Table 40.—Domestic Airlines by Class of Carrier

| New CAB classification[a] | Older classification |
|---|---|
| ***Major carriers (all):*** | ***Trunk carriers (all):*** |
| American | American |
| Braniff | Braniff |
| Continental | Continental |
| Delta | Delta |
| Eastern | Eastern |
| Northwest | Northwest |
| Pan American | Pan American |
| Trans World | Trans World |
| United | United |
| Western | Western |
| Republic | ***Local service carriers (all):*** |
| USAir | Republic |
| ***National carriers (all):*** | USAir |
| Frontier | Frontier |
| Ozark | Ozark |
| Piedmont | Piedmont |
| Texas International | Texas International |
| Air California | ***Intrastate jet carriers (sample):*** |
| Air Florida | Air California |
| Capitol | Air Florida |
| Pacific Southwest | ***Charter carriers (sample):*** |
| Southwest | Capitol |
| World | World |
| ***Large regionals (sample):*** | ***New-start jet carrier (sample):*** |
| Midway | Midway |
| Muse | Muse |
| New York Air | New York Air |
| Air Midwest | Pacific Southwest |
| Air Illinois | Southwest |
| Air Wisconsin | People Express |
| People Express | ***Commuters (sample):*** |
| ***Medium regionals (sample):*** | Air Midwest[b] |
| Aspen | Aspen[b] |
| Cascade | Wright[b] |
| Empire | Empire |
| Golden West | Air Illinois |
| Mississippi Valley | Air Wisconsin[b] |
| Wright | Golden West |
|  | Mississippi Valley |

[a] Classifications are based on carriers' annual operating revenues.
[b] Certificated before deregulation.

SOURCE: Federal Aviation Administration.

haul jet services entirely within the boundaries of California, Texas, or Florida. After deregulation, these airlines obtained CAB certification and now fly interstate routes. Even though they have expanded their operations to new out-of-State markets, they retain certain pre-1978 characteristics in that they continue to serve highly competitive short-haul markets with emphasis on frequency of flights and low fares.

Several other new jet airlines have begun operation since deregulation. Some—e. g., New York Air, Midway, People Express, and Muse—are new ventures. One—Empire Airlines—is a former commuter airline that has successfully introduced jet service. Capitol Air and World Airlines are former charter operations that have inaugurated scheduled service. Typically, the startup carriers serve high-density, long-haul markets where they compete with trunk carriers, principally on the basis of low fares.

Commuter airlines usually do not operate jets, but propellor-driven aircraft with up to 30 seats. Before 1978, most commuter airlines were exempt from CAB fare and route regulation, but they were restricted to the use of aircraft no larger than 30 seats. A few—e.g., Air Midwest, Air New England, and Wright-obtained CAB certification in order to use larger aircraft or to receive subsidies for air service to small communities. As local service and trunk carriers have withdrawn from smaller markets, commuters have moved in to fill the gap. One of the earliest and most successful examples is Allegheny Airlines (now USAir), which transferred certain of its services to 12 smaller independent airlines (known collectively under the name "Allegheny Commuter") that operate under contract to USAir.

Since 1978, over 300 commuters have obtained CAB certification. They are becoming progressively integrated into the national air transportation system, providing local point-to-point service and linking small communities with the larger airport hubs. Passenger enplanements on commuters have grown rapidly, from 4.2 percent of passenger enplanements in 1979 to 6.3 percent in 1983.[7]

## Changes in Route Networks

Airline deregulation has changed the national air service network from a stable system of routes served by established carriers to a fluid marketplace where carriers frequently adjust routes, level of service, and fares. The older airlines have abandoned some markets and begun service to others. New entrants have taken over some of these abandoned routes and established themselves in the dense markets where they see a competitive opportunity.

The course of the industry since deregulation has been one of uneven expansion and contraction. The principal effect on airports is that sudden and less predictable changes have taken place in the air carriers serving the airport, the level of service provided, and the facilities needed to accommodate them. Some communities have experienced a general improvement in air service since deregulation, but not all have benefited from an unregulated environment, and some have suffered almost complete loss of air service.

Table 41 shows changes in points served by a sample of carriers between 1978 and 1981; table 42 shows the changes in service by size of city. The designations large, medium, small, and nonhub are FAA and CAB classifications based on number of passengers enplaned. Large hubs are the top 24 cities, medium hubs the next 39. There are 61 small hubs and 461 nonhubs. s

Most of the established carriers added and deleted service points frequently during this period. Air California and Air Florida, no longer restricted to intrastate traffic, expanded the number of points served. The Allegheny Commuter system of USAir abandoned 23 stations and added 30. American Airlines moved into Braniff's market, adding 12 stations in the Texas, Louisiana, and Alabama markets. Frontier Airlines discontinued service to 28 nonhubs and small hubs and branched out to other small cities and a few large hubs. Piedmont pursued the same strategy, adding seven large cities and two high growth areas in Florida, while deleting 16 small hubs and nonhubs.

Competition has been intense in certain high growth markets. For example, cities like Phoenix with substantial population growth have attracted new carriers. Traffic growth at Orlando, which is now served by 10 carriers as opposed to 4 before deregulation, is a product of both economic development (Disney World and Epcot) and a surge of discretionary travel stimulated by lower fares.

For the most part, trunks and local service carriers dropped short-haul markets. Between 1978 and 1981, the number of trunk airline flights to markets with stage lengths under 200 miles dropped by 44 percent. Local carriers followed suit by reducing short-haul departures by 35 percent and more than doubling flights in the range of 500 to 1,000 miles. Some of the short-haul market has been picked up by the commuter carriers.

The emerging pattern is one of increased activity at large and medium airports and eroding service at the smallest nonhub airports, as shown in table 43. Confirmation of this pattern can be found in data on changes in aircraft departures

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[7] *FAA Aviation Forecasts, Fiscal Years 1984-1995* (Washington, DC: Federal Aviation Administration, FAA-APO-84-1, February 1984).

[8] *FAA Statistical Handbook* of *Aviation, Calendar Year 1982* (Washington, DC: Federal Aviation Administration, December 1982).

## Table 41.—Changes in Stations Served by Air Carriers, 1978-81

| Carrier | Stations served in: 1978 | Stations served in: 1981 | Stations Added | Stations Deleted |
|---|---|---|---|---|
| Air California | 10 | 14 | 7 | 3 |
| Air Florida | 11 | 18 | 9 | 2 |
| Allegheny Commuter.. | 49 | 56 | 30 | 23 |
| American Airlines | 45 | 61 | 24 | 8 |
| Braniff Airways | 37 | 34 | 5 | 8 |
| Capitol International Airways. | 0 | 4 | 4 | 0 |
| Continental Airlines. | 30 | 46 | 17 | 1 |
| Delta Air Lines | 71 | 71 | 10 | 10 |
| Eastern Airlines | 66 | 70 | 15 | 11 |
| Frontier Airlines | 87 | 78 | 19 | 28 |
| Jet America Airlines | 0 | 2 | 2 | 0 |
| Midway Airlines | 0 | 12 | 12 | 0 |
| Muse Air | 0 | 2 | 2 | 0 |
| New York Air | 0 | 13 | 13 | 0 |
| Northwest Airlines. | 31 | 36 | 5 | 0 |
| Ozark Airlines | 47 | 48 | 11 | 10 |
| Pacific Southwest Airlines | 13 | 15 | 5 | 3 |
| Pan American | 34 | 21 | 2 | 15 |
| People Express Airlines | 0 | 10 | 10 | 0 |
| Piedmont Airlines | 48 | 40 | 9 | 17 |
| Republic Airlines | 114 | 104 | 15 | 25 |
| Republic Airlines West | 46 | 37 | 4 | 13 |
| Southwest Airlines | 9 | 14 | 5 | 0 |
| Texas International Airlines | 34 | 32 | 12 | 14 |
| Trans World Airlines | 37 | 50 | 17 | 4 |
| United Airlines | 83 | 77 | 10 | 16 |
| USAir | 54 | 58 | 16 | 12 |
| Western Airlines | 31 | 27 | 5 | 9 |
| World Airways | 0 | 5 | 5 | 0 |
| Total | 987 | 1,055 | 300 | 232 |

SOURCE: *Official Airline Guide*, "Report on Airline Service, Fares, Traffic, Load Factors, and Market Shares," Report #21, June 1982.

## Table 42.—Comparison of Hubs Served by Selected Carriers, 1978 v. 1982 (second quarter)

| Carrier | Large hubs 1978 | Large hubs 1982 | Large hubs Change | Medium hubs 1978 | Medium hubs 1982 | Medium hubs Change | Small hubs 1978 | Small hubs 1982 | Small hubs Change | Nonhubs 1978 | Nonhubs 1982 | Nonhubs Change | Total 1978 | Total 1982 | Total Change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American Airlines | 13 | 12 | +8 | 20 | 24 | +4 | 8 | 12 | +4 | 0 | 0 | 0 | 41 | 57 | +16 |
| Continental Airlines | 11 | 8 | −3 | 10 | 15 | +5 | 4 | 4 | — | 1 | 0 | −1 | 26 | 27 | +1 |
| Delta Air Lines | 20 | 22 | +2 | 17 | 22 | +5 | 19 | 20 | +1 | 11 | 5 | −6 | 67 | 69 | +2 |
| Eastern Airlines | 19 | 23 | +4 | 20 | 26 | +6 | 21 | 19 | −2 | 4 | 2 | −2 | 64 | 70 | +6 |
| Frontier Airlines | 5 | 12 | +7 | 9 | 9 | — | 5 | 11 | +6 | 47 | 25 | −22 | 66 | 57 | −9 |
| Northwest Airlines | 11 | 17 | +6 | 3 | 3 | — | 5 | 6 | +1 | 1 | 5 | +4 | 20 | 31 | +11 |
| Ozark Airlines | 7 | 13 | +6 | 7 | 7 | — | 5 | 7 | +2 | 23 | 9 | −14 | 42 | 36 | −6 |
| Pan American | 12 | 12 | — | 5 | 2 | −3 | 8 | 2 | −6 | 0 | 0 | — | 25 | 16 | −9 |
| Piedmont Airlines | 4 | 13 | +9 | 9 | 11 | +2 | 10 | 7 | −3 | 20 | 9 | −11 | 43 | 40 | −3 |
| Republic Airlines | 19 | 23 | +4 | 14 | 17 | +3 | 25 | 22 | −3 | 86 | 54 | −32 | 144 | 116 | −28 |
| Trans World Airlines | 15 | 18 | +3 | 12 | 13 | +1 | 4 | 6 | +2 | 0 | 0 | — | 31 | 37 | +6 |
| United Airlines | 18 | 20 | +2 | 19 | 24 | +5 | 21 | 17 | −4 | 19 | 6 | −13 | 77 | 67 | −10 |
| USAir | 9 | 15 | +6 | 13 | 14 | +1 | 8 | 9 | +1 | 17 | 8 | −9 | 47 | 46 | −1 |
| Western Airlines | 8 | 9 | +1 | 5 | 8 | +3 | 2 | 2 | — | 9 | 5 | −4 | 24 | 24 | — |

SOURCE: Civil Aeronautics Board, *Competition and the Airlines: An Evaluation of Deregulation*, app. D, December 1982.

**Table 43.—Aircraft Departures by Hub Size (June 1,** 1978, and June 1, 1982)

| Hub size[a] | Number of communities | Departures per week[b] June 1978 | Departures per week[b] June 1982 | Increase or decrease | Percent change |
|---|---|---|---|---|---|
| ***Departures by hub size:*** | | | | | |
| Large | 1923 | 60,384 | 63,825 | 3,441 | 5.7 |
| Medium | 36 | 23,076 | 25,480 | 2,404 | 10.4 |
| Small | 66 | 13,788 | 14,115 | 327 | |
| Nonhub | 504 | 28,575 | 25,239 | (3,336) | (1::;) |
| Total | 629 | 125,823 | 128,659 | 2,836 | 2.3 |

***Distribution of departure changes by hub size:***

| | Number of hubs | | | | |
|---|---|---|---|---|---|
| Change | Large | Medium | Small | Nonhub | Total |
| Increase | 18 | 23 | 30 | 200 | 271 |
| No change | 0 | 0 | 1 | 12 | 13 |
| Decrease | 5 | 13 | 35 | 292 | 345 |

[a] Hub classification based on data for year ended Sept. 30, 1982.
[b] Includes departures to all destinations by all carriers listed in the *Official Airline Guide*

SOURCE: *Official Airline Guide*, June 1, 1978, and June 1, 1982.

for all commercial service airports, shown in table 44. According to CAB, over 292 nonhub cities lost service from 1978 to 1982.[9] In some instances, localities dropped by larger carriers have received replacement service from commuter airlines. As a result, the average size of aircraft serving these points is smaller, and the number of seats available per departure has declined.

Medium hubs appear to be the main beneficiaries of increased air carrier activity. Two factors appear to account for this trend: the air traffic controllers' strike, which limited access to many large airports, and the growth of regional hubbing. As shown in table 45, departures from medium hubs to other medium hubs increased by 30 percent between 1978 and 1982. Departures from medium hubs to small or large hubs have also increased. By contrast, flights between large hubs have declined.

## Formation of New Hubs

Air traffic has increased at airports in several medium-size cities as a result of moves by trunk airlines and local service carriers to consolidate their operations in hub-and-spoke route systems. (A diagram of a typical hub-and-spoke structure is shown in fig. 19. ) The basic strategy is to establish one airport as the hub into which traffic from other cities is fed along radial routes. Flights by a carrier into and out of the hub are closely scheduled in "complexes" or "connecting blocks" of approximately 30 to 45 minutes so as to facilitate transfers and minimize passengers' waiting time. For the air carrier, the chief advantage is that service can be provided between smaller cities and along thinly traveled routes more economically than if they were connected by direct flights.

Hubbing is not new. Delta established a hub at Atlanta long before deregulation, and hubbing has been the core of Delta's operating and marketing philosophy for years. The same principle of tight control of traffic feed through a single point was applied over 20 years ago by United in Chicago and USAir in Pittsburgh.

Deregulation, however, has added impetus to the practice of hubbing by allowing airlines almost complete freedom to set up new routes and service points. Many local carriers, no longer satisfied to feed traffic to the trunk carriers, have taken the opportunity to establish their own regional hubs—e.g., Piedmont at Charlotte, Dayton and, most recently, Baltimore; Republic at Memphis; and Western at Salt Lake City.

By setting up a hub at an underutilized airport (usually in a medium-size city), a carrier can avoid the congestion encountered at major airports and reduce operating costs, while at the same time creating markets in surrounding cities where it might

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[9] *Report on Airline Service, Fares, Traffic, Load Factors and Market Shares* (Washington, DC: Civil Aeronautics Board, June 1982), table 15.

## Table 44.—Weekly Departures and Seats, by Hub Size, 1978-83

| | Weekly data | | | | | | Percent change | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6/78 | | 6/82 | | 6/83 | | 6/78 to 6/82 | | 6/82 to 6/83 | | 6/78 to 6/83 | |
| | Number | Percent of system | Number | Percent of system | Number | Percent of system | Ratio | Average annual rate | Annual rate | Rate change in 1983 | Ratio | Average annual rate |
| Large hubs: | | | | | | | | | | | | |
| Departures | 58,886 | 47 | 61,545 | [illegible] | 70,371 | [illegible] | 4.5 | 1.1 | 14.3 | 13.1 | 19.5 | 3.6 |
| Seats | 6,672,500 | 59 | [illegible] 170,320 | [illegible] | 8,270,855 | [illegible] | 7.5 | 1.8 | 15.3 | 13.3 | 24.0 | 4.4 |
| Seats/departure | 113.3 | — | 116.5 | — | 117.5 | — | 2.9 | 0.7 | 0.9 | 0.2 | 3.8 | 0.8 |
| Medium hubs: | | | | | | | | | | | | |
| Departures | 23,032 | 18 | 25,394 | 20 | 28,982 | 20 | 10.3 | 2.5 | 14.1 | 11.3 | 25.8 | 4.7 |
| Seats | 2,264,932 | 20 | 2,368,046 | 20 | 2,731,820 | 21 | 4.6 | 1.1 | 15.4 | 14.1 | 20.6 | 3.8 |
| Seats/departure | 98.3 | — | 93.3 | — | 94.3 | — | (5.2) | (1.3) | 1.1 | 2.4 | (4.1) | (0.8) |
| Small hubs: | | | | | | | | | | | | |
| Departures | 12,613 | [illegible] | [illegible] | [illegible] | 14,240 | [illegible] | 1.2 | 0.3 | 11.6 | 11.3 | 12.9 | 2.5 |
| Seats | 1,073,643 | [illegible] | [illegible] | [illegible] | 1,061,216 | [illegible] | (6.3) | (1.6) | 5.4 | 7.1 | (1.2) | (0.2) |
| Seats/departure | 85.1 | — | [illegible] | — | 74.5 | — | (7.3) | (1.9) | (6.4) | (4.6) | (12.5) | (2.6) |
| Nonhubs: | | | | | | | | | | | | |
| Departures | 31,479 | 25 | 28,911 | 22 | 31,253 | 22 | (8.2) | (2.1) | 8.2 | 10.5 | (0.7) | (0.1) |
| Seats | 1,332,488 | 12 | 1,156,734 | 10 | 1,194,757 | 9 | 13.2) | (3.1) | 3.3 | 6.6 | (10.3) | (2.2) |
| Seats/departure | 42.3 | — | 40.0 | — | 38.2 | — | (5.4) | (1.4) | (4.5) | (3.1) | (9.7) | (2.0) |
| Total: | | | | | | | | | | | | |
| Departures | 126,010 | 100 | 128,609 | 100 | 144,846 | 100 | 2.1 | [illegible] | 12.6 | 12.1 | 14.9 | [illegible] |
| Seats | 11,343,563 | 100 | 11,701,435 | 100 | 13,258,648 | 100 | 3.2 | [illegible] | 13.3 | 12.4 | 16.9 | [illegible] |
| Seats/departure | 90.0 | — | 91.0 | — | 91.5 | — | 1.1 | [illegible] | 0.5 | 0.2 | 1.7 | [illegible] |

SOURCE: Civil Aeronautics Board, "Report on Airline Service, Fares, Traffic, Load Factors, and Market Shares," table [illegible] June 1982, and table 18, June 1983.

**Table 45.—Changes in Weekly Departures Between Major Categories of Airports**

| Item | Percent change (June 1978 to June 1982) |
|---|---|
| Between large hubs and: | |
| Large hubs | (11.5) |
| Between medium hubs and: | |
| Large hubs | 6.5 |
| Medium hubs | 30.4 |
| Between small hubs and: | |
| Large hubs | (5.8) |
| Medium hubs | 11.2 |
| Small hubs | (12.0) |
| Between nonhubs and: | |
| Large hubs | (9.4) |
| Medium hubs | (12.1) |
| Small hubs | (25.5) |
| Nonhubs | (28.4) |

SOURCE: *Official Airline Guide*. City categories are based on July 1982 hub classifications. Only nonstop flights between cities are counted. Nonhub departure statistics include 11 communities which lost service between June 1978 and the enactment of the Deregulation Act in October 1978.

not otherwise be practical to offer frequent air service, or any service at all. Further, by choosing an airport that is not extensively served by competing carriers, the hubbing carrier maintains control over traffic; passengers who arrive on the carrier's flights will depart on one of its connecting flights, not on a competitor's.[10] In general, carriers setting up new regional hubs have concentrated on serving the traveler flying less than 1,000 miles, a group which may represent as much as two-thirds of the domestic market.

Hub-and-spoke operations seem to be increasing even at large airports, such as Chicago, Atlanta, Denver, and St. Louis. Since deregulation, most of the trunk carriers have increased the number of markets served nonstop from large hubs. Ninety-nine percent of Continental's departures (before the airline filed for bankruptcy) fed the Houston and Denver hubs. In 1979, Delta operated nonstop flights from Atlanta to 59 cities; today it is serving 72, having added routes to the Caribbean as well as stations in the West and South. United's schedule shows a net gain of 16 points served nonstop from its Denver hub. In 1981, TWA dropped direct service from its St. Louis hub to Atlanta, Toledo, and Knoxville but added direct service to Des Moines, Houston, Little Rock, San Diego, San Antonio, and Chicago. However, some observers believe that this type of route experimentation and readjustment may not signal a long-term trend. They expect that, as air traffic increases generally, the disadvantages of hub-and-spoke operation at the largest airports will outweigh the advantages, and some air carriers will divert their activity to medium hubs.

Air cargo carriers are also turning to hubbing. In 1972, Federal Express adopted the hub-and-spoke strategy for fast delivery of air cargo under 70 pounds. The site selected, Memphis, is centrally located with a modern airport that is relatively uncrowded and practically never shut down by weather. Between 11:00 p.m. and 4:00 a.m. each day, Federal Express flights converge on Memphis from all over the country, unloading as many as 80,000 packages, which are sorted and reloaded on flights to destination cities within a 4-hour period.

Other cargo carriers have likewise adopted the hubbing concept, especially for the overnight delivery and small package segments of their business. For example, Flying Tigers has converted its Chicago storage facility into an overnight sorting center. Emery Air Freight, a large freight forwarder that now operates an aircraft fleet, has built an overnight sorting center in Dayton.

Selection as the site of a new hub can be a boon to the local airport in terms of growth in traffic and revenue. For example, since Piedmont established a hub at Charlotte, the increased traffic volume has made it possible for the airport management to reduce landing fees for all airport users and still enjoy higher revenues. Other aspects of airport operation at Charlotte have benefited as well. Income from parking and concessions is now 20 percent ahead of forecasts, and the airport has recently built a new 10,000-ft runway and a $64 million terminal. Similarly, Piedmont's Midwestern hub in Dayton appears to be revitalizing an airport which had lost service after deregulation.

Western Airlines embarked on development of a major hub in Salt Lake City in direct competition with carriers serving regional and transcontinental markets through Denver and Dallas/Fort Worth. Western currently offers nonstop service

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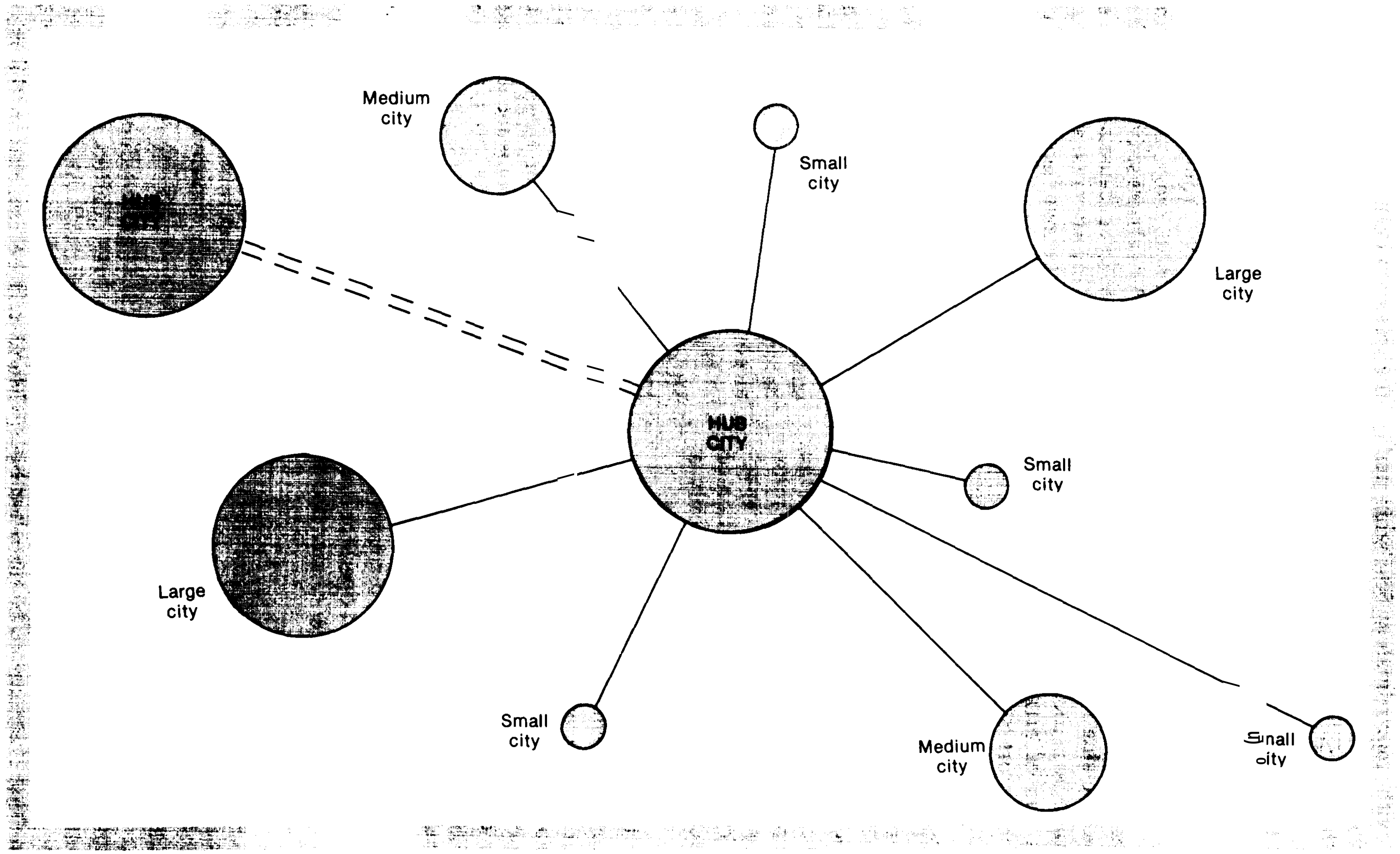
[10] A hub-and-spoke system offer benefits apart from the marketing advantages. Crew expenses, maintenance costs, and other costs of terminal operations can be significantly reduced, and labor stability can also be markedly improved by selection of an effective hub.

Figure 19.—Hub-and-Spoke Route System



SOURCE: Office of Technology Assessment.

to 33 cities, with approximately 86 flights per weekday. Largely as a result of Western's hubbing, traffic through Salt Lake City has increased dramatically. Domestic enplanements are up 13 percent from 1981, and departures have increased by 25 percent. Salt Lake City Airport has responded by raising $30 million in bonds to expand the terminal and to build Western a new eight-gate concourse.

On the other hand, becoming a new hub may prove a mixed blessing for an airport. The pattern of operations associated with hubbing—many closely spaced arrivals and departures—means that the airport is extremely busy for brief periods but practically idle the rest of the time. This peaking effect is illustrated in figure 20, which is a partial listing of Western Airlines' arrivals and departures at Salt Lake City. In fact, peaking is even more severe than the figure shows since there are other airlines that rely on connections with Western or that operate flights at the same time as one of Western's connecting banks. These extreme traffic surges strain airport capacity and may create the need for construction of additional facilities that are needed for only a small part of the day.

Where the hubbing carrier dominates airport use, the airport management may find itself at the mercy of that carrier's operating and expansion plans. For example, while Piedmont's establishment of a hub at Dayton has led to a doubling of air carrier operations there, it also made the airport management dependent on one carrier for half its revenues. Construction of new facilities, needed solely to accommodate the highly peaked pattern of service of a single carrier, increases that dependency and leaves the airport operator open to great financial risk should the carrier decide to move elsewhere.

Other adjustments may lie ahead for airports that serve as national or regional hubs. It is not yet known if there are minimum requirements for a hub to operate successfully or whether the operation of several hubs in the same region will lead to an oversupply of air services in certain markets. The pattern of hubbing will probably endure, but the fluidity of a deregulated market, especially one that continues to be distorted by the recession and the lingering effects of the air traffic controllers' strike, makes the future difficult to predict.

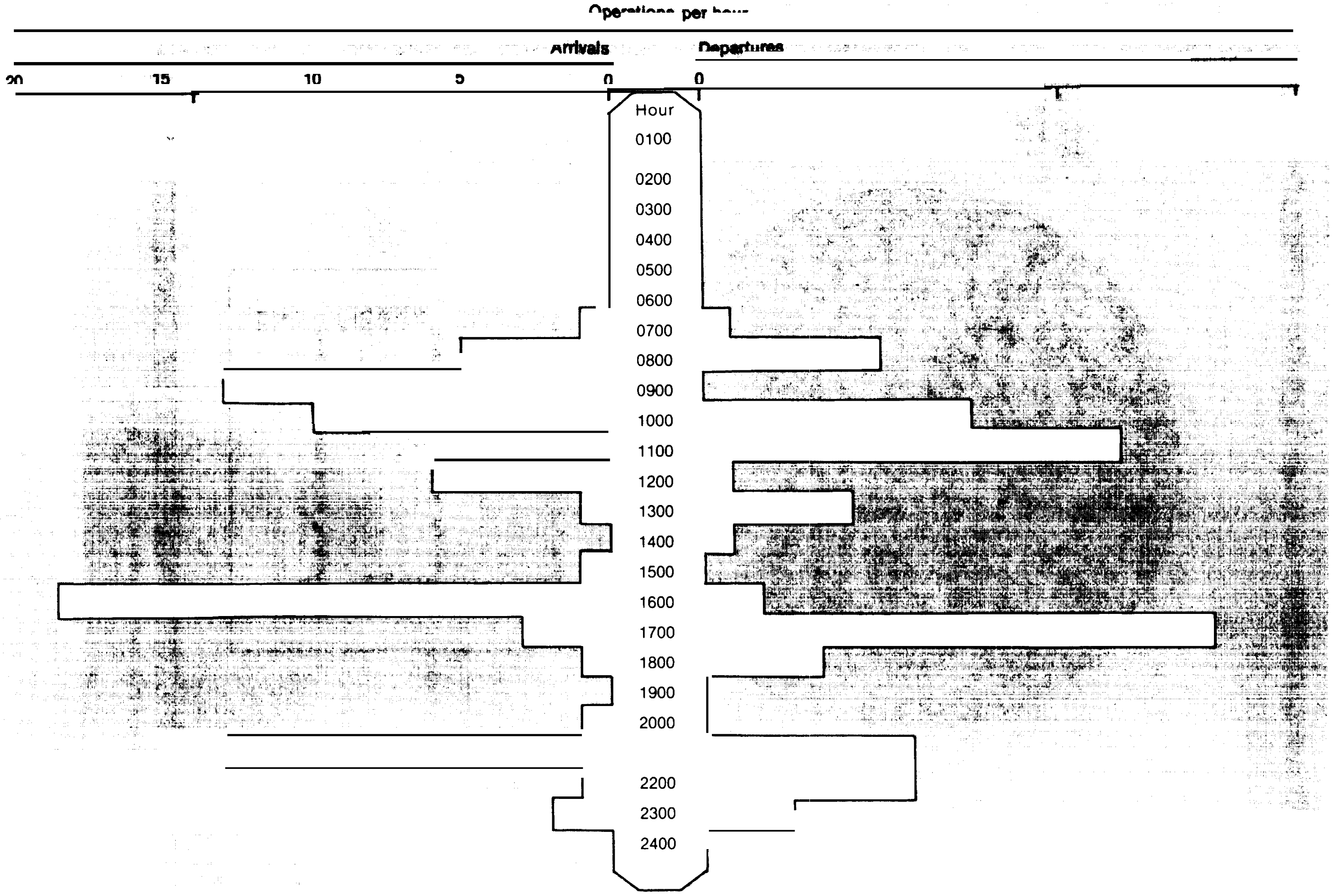
## Aircraft Equipment

The key to economic efficiency for an aircraft is operation on a route to which it is well suited in terms of size, range, and performance characteristics. Air carriers strive to use their equipment in this way; but because aircraft are expensive and long-lived investments, available equipment cannot always be matched to routes and traffic volume as well as one would like. It is especially difficult now, when service patterns and markets are in flux. The efficiencies attainable through the use of larger aircraft may not be available if the economics of hub-and-spoke operation and increased competition among carriers argue for the use of smaller aircraft. As carriers begin to replace their present fleets with aircraft that are better suited to current market conditions, aircraft size becomes an important factor in assessing future airport capacity needs.

The aircraft that now make up the U.S. jet fleet are of three major types. Narrowbody short- and medium-range aircraft, like the DC-9, B-727, and B-737, constitute about 75 percent of the fleet. These aircraft, which seat 100 to 150 passengers, are used primarily for flights with stage lengths under 1,000 miles or those with several intermediate stops. Medium- and long-range widebody aircraft such as the DC-10, L-1011, or B-747 make up about 18 percent of the jet fleet. These aircraft, seating 250 to 400 passengers, are most efficiently operated on heavily traveled long routes of more than 1,500 miles, but they can be (and have been) used effectively on shorter routes of sufficiently high density. Long-range narrowbody aircraft like the DC-8 and B-707, with 140 to 180 seats, make up only about 7 percent of the fleet and are usually operated on routes over 1,500 miles which are not densely traveled enough to warrant use of a widebody (see fig. 21 and table 46).

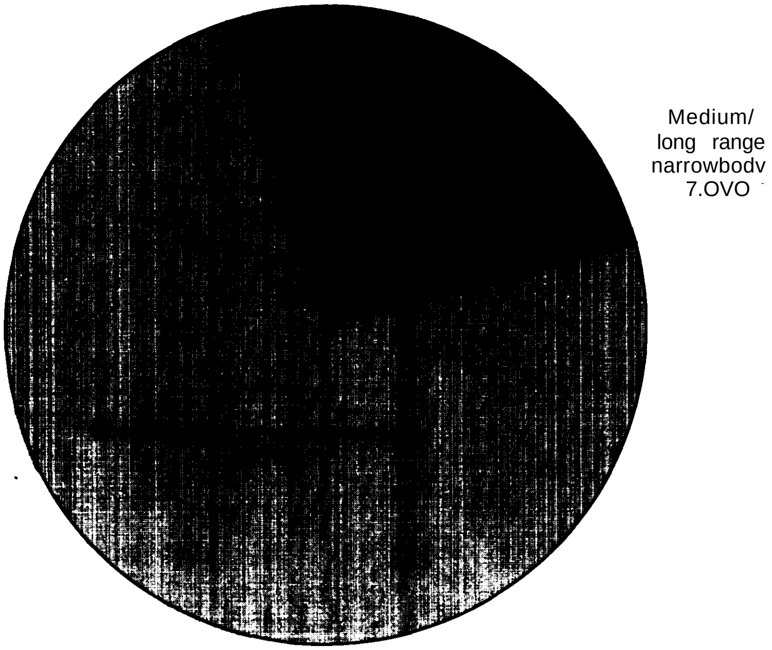
The short- and medium-range aircraft which make up three-quarters of the fleet vary widely in age (see fig. 22). About 60 percent are over 10 years old, and 40 percent are over 15 years old. Many will be replaced in the next few years,

Figure 20.—Western Airlines Activity at Salt Lake City



SOURCE: Western Airlines

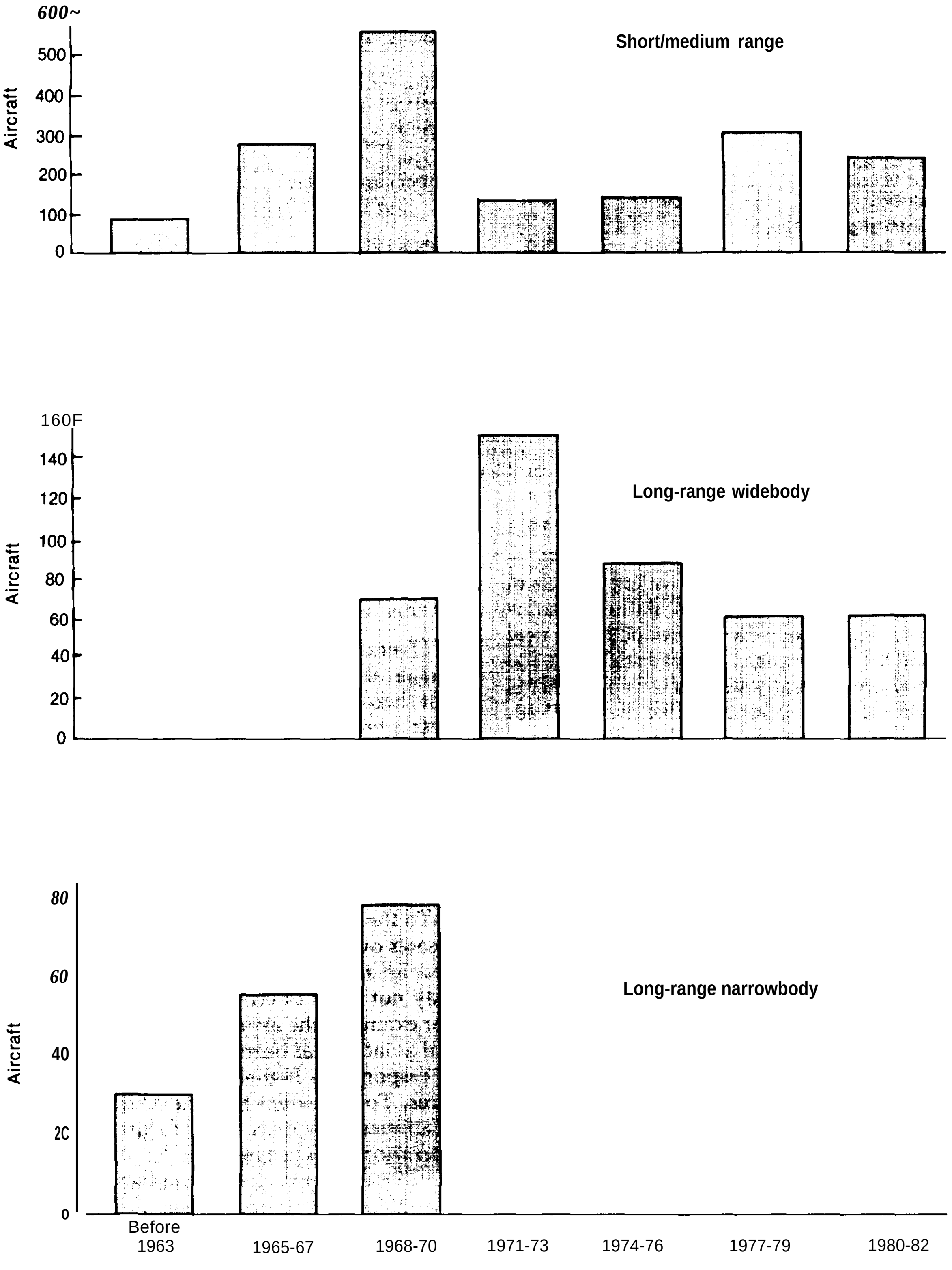
## Figure 21.–Composition of U.S. Commercial Jet Fleet, 1982



| | |
|---|---|
| **Short/medium range narrowbody aircraft:** | |
| B-727 | 1,012 |
| B-737 | 238 |
| BAC-111 | 26 |
| DC-9 | 473 |
| | 1,749 |
| **Medium/long range widebody aircraft:** | |
| A-300 | 25 |
| B-747 | 128 |
| DC-10 | 159 |
| L1011 | ~ |
| | 429 |
| **Medium/long range narrowbody aircraft:** | |
| 6-707 | 71 |
| DC-8 | 90 |
| | 161 |

SOURCE: Commercial Aircraft Fleet Databank, Lockheed-Georgia Co., July 1982.

**Figure 22.—Age of Aircraft in Service in U.S. Commercial Jet Fleet** (different scales)



SOURCE: Commercial Aircraft Fleet Databank, Lockheed-Georgia Co., July 1982.

**Table 46.—Present and Future Commercial Jet Aircraft**

| Current generation | | | Next Generation | | |
|---|---|---|---|---|---|
| Manufacturer | Designation | Seats[a] | Manufacturer | Designation | Seats[a] |
| ***Short/medium-range narrowbody*** | | | | | |
| Boeing | B-727-1OO | 70-131 | Airbus Industrie | A-320 | 150 |
| Boeing | B-727-200 | 120-175 | Boeing | B-737-300 | 132-148 |
| Boeing | B-737-200 | 115-130 | Boeing | B-757 | 186-220 |
| Fokker | F-28 | 65-85 | British Aerospace | BAE-146-200 | 82-109 |
| McDonnell Douglas | DC-9-1O | 90 | Fokker | P-332 | 110 |
| McDonnell Douglas | DC-9-30 | 115 | McDonnell Douglas | MD-80 | 167 |
| McDonnell Douglas | DC-9-50 | 139 | | | |
| ***Medium/long-range widebody*** | | | | | |
| Aribus industrie | A-300 | 220-300 | Airbus Industrie | A-31O | 205-265 |
| Boeing | B-747-1OO | 374-452 | Boeing | B-747-300 | 530 |
| Boeing | B-747-200 | 374-500 | Boeing | B-767-200 | 210-255 |
| Lockheed | L-101 1 | 256-400 | Boeing | B-767-300 | 270 |
| McDonnell Douglas | DC-10-IO | 250-380 | | | |
| McDonnell Douglas | DC-10-4O | 250-380 | | | |
| ***Medium/longwange narrowbody*** | | | | | |
| Boeing | B-707-120 | 125 | | | |
| Boeing | B-707-320 | 120-189 | | | |
| McDonnell Doualas | DC-8-62 | 189 | | | |

[a] The number of seats on any given model of aircraft may vary according to cabin configuration, mix of first class and coach accommodations, and seat pitch.

SOURCE: Simat, Helliesen & Eichner, and *The Airline Handbook, 1983-1984* (Cranston, RI: Aerotravel Research, December 1983).

largely with aircraft like the B-757 (195 seats), DC-9-80 (155 seats), and the B-737-300 (140 seats)—all of which are bigger than equivalent models in common use today (see table 46). Although some manufacturers are considering production of new short- and medium-range aircraft with about 100 seats, they are generally viewed as replacements for aircraft of yet smaller size, like the DC-9-1O.

A somewhat opposite trend is expected in the long-haul segment of the fleet. The long-range narrowbody jets are 13 to 20 years old. They are technologically obsolete, fuel-inefficient, and noisy by present FAA standards. Most will be retired from service within the next 5 years, although it is possible that some could be refitted with new engines to extend their economic lifetime a bit longer. There is no new narrowbody aircraft in design or production which is an exact equivalent. Instead they will be replaced either with current generation widebodies or new models like the B-767 or the A-31O.

Most long-range widebody aircraft now in the fleet are expected to remain in service for several more years, but they too will eventually be replaced. Except for a stretched version of the B-747, which Boeing expects to produce for use on heavily traveled long-haul routes, most new widebodies for domestic use will be smaller than existing models. Aircraft such as the B-767 and A-310, which seat between 230 and 270, are typical of this new generation of long-range aircraft.

Overall, the average size of the jet fleet may remain about the same, or perhaps decrease slightly, but there will be a greater range of sizes. Today's fleet averages 150 seats within a range of 85 to 400; the future fleet might be as much as 10 percent smaller and made up mostly of aircraft in the 100- to 250-seat range, but with some much larger aircraft with 500 seats (or even 700 to 800 seats for a full upper deck 747) operating on dense routes.

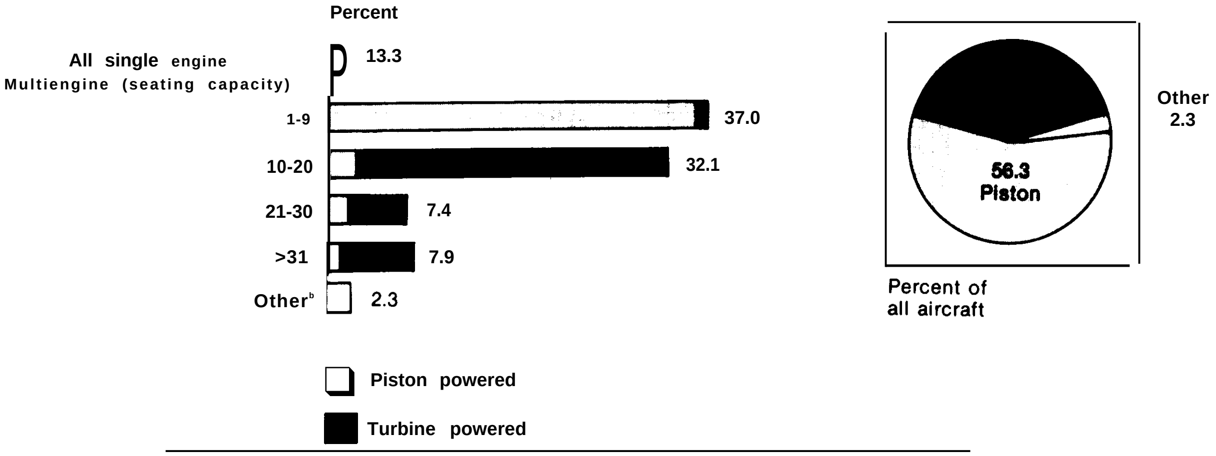
To the extent that the demand for air travel increases over the coming years, airports will clearly bear an additional burden. However, this burden may not be as onerous as it would first appear. For example, the average load factor in commercial aviation has been rising over the past 5 years in response to higher operating cost and lower fares. To the extent that the average load factor continues to increase in the future, fewer aircraft operations will be needed to handle a given number of passengers. Or, viewed another way, the growth of aircraft operations will not be as rapid as the growth in passenger enplanements. If, however, the number of competitors increases in certain high-density markets, the average number of passengers attracted by each competitor will thereby be reduced. In this case, the total number of flight operations would be likely to increase as carriers favored smaller aircraft and placed emphasis on frequency of service and price competition.

The next generation of short- and medium-range aircraft—workhorses of the current jet fleet—are likely to have an additional 20 to 30 seats per aircraft. This should translate into a reduction of 20 percent or so in the number of operations needed to carry a given volume of passengers. On the other hand, the average size of aircraft on long-haul routes will probably decrease over the next decade as more carriers compete for the market. While this might lead to an increase in the number of operations, there is reason to believe that reduction in aircraft size could also augur a change in the structure of airline networks.

The present generation of widebodies proved economical only in service between major hubs. Many passengers had to be routed through these hubs in order to take advantage of the attractive economics afforded by widebodies. Bringing these people into and out of large hubs often created additional and unnecessary aircraft operations that contributed to the delay and congestion at these airports. If airlines choose to utilize the new generation of smaller (but economical) long-range aircraft to provide direct service in lower volume markets or in connecting flights to smaller hubs, the burden of increased passenger enplanements will be shifted away from presently congested major hubs.

The aircraft used by commuter carriers are almost entirely propellor-driven, with either piston or turbine engines. Although they range in size from 6 to 60 seats, over 80 percent seat 19 or fewer passengers (fig. 23). Federal regulations—which limited the size of commuter aircraft to a maximum of 19 seats before 1972, 30 seats in 1972, and 60 seats since 1978—dampened the interest of U.S. manufacturers in building small transport aircraft.[11] Consequently, few U.S. firms now pro-

Figure 23.—Composition of Commuter Aircraft Fleet, 1981[a]



[a]Passenger aircraft only
[b]Helicopter and jet.

SOURCE: Regional Airlines Association Annual Survey, 1981.

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[11] See *Impact of Advanced Air Transport Technology, Part III—Air Service to Small Communities* (Washington, DC: U.S. Congress, Office of Technology Assessment, OTA-T-120, February 1982).

duce small transport aircraft, most of which are imported from Canada, Brazil, and the Netherlands. With the progressive lifting of restrictions on the size of aircraft that commuters may operate, the average size of aircraft in the commuter fleet has increased from about 10 seats in 1970 to about 15 in 1980. This growth trend is likely to continue, and many of the new commuter aircraft entering the fleet over the next decade will be in the 30- to 60-seat range.

The growth of commuter airlines will have important implications for future airport needs. The commuter airline fleet tripled between 1970 and 1981, with much of the growth occurring since deregulation (table 47). FAA forecasts that by 2000 the commuter fleet will triple again, reaching about 4,500 aircraft .12 While many of these will be used in air service to small communities, where major air carriers do not find it profitable to operate, a large number will also converge at hub airports to feed passengers to larger carriers. Many of these operations will be at busy airports where it will be hardest to accommodate them at gates and in terminal facilities. Further, the mixing of large jet and small propellor-driven aircraft in the same traffic stream will add a burden to air traffic control and could aggravate congestion and delay both in the airspace and on the airport surface. A partially offsetting factor is that the average size of commuter aircraft will probably increase. Thus, while commuter operations will grow, they will not be as great as they would be if aircraft size were still restricted by a regulatory ceiling of 19 or 30 seats.

**Table 47.—Aircraft Operated by Commuter and Regional Airlines, 1970-81**

| Year[a] | Aircraft in service | Percent annual change |
|---|---|---|
| 1970 . . . . . . . . . . . . . . | 687 | |
| 1971 . . . . . . . . . . . . . . | 782 | 14 |
| 1972 . . . . . . . . . . . . . . | 791 | 1 |
| 1973 . . . . . . . . . . . . . . | 885 | 12 |
| 1974 . . . . . . . . . . . . . . | 997 | 13 |
| 1975 . . . . . . . . . . . . . . | 1,073 | 8 |
| 1976 . . . . . . . . . . . . . . | 1,009 | – 6 |
| 1977 . . . . . . . . . . . . . . | 1,119 | 11 |
| 1978 . . . . . . . . . . . . . . | 1,200 | 7 |
| 1979 (est) . . . . . . . . . . | 1,350 | 12 |
| 1980[b] . . . . . . . . . . . . . . | 1,606 | 19 |
| 1981[b] . . . . . . . . . . . . . . | 1,743 | 8 |

SOURCES: [a]Civil Aeronautics Board, *Commuter Air Carriers Traffic Statistics*, fiscal years 1970-79.
[b]Regional Airlines Association, *Annual Survey of U.S. Commuter and Regional Airlines*.

# IMPLICATIONS FOR AIRPORT DEVELOPMENT

There is almost universal agreement that air traffic will continue to increase throughout the rest of this century and that some forms of growth could lead to serious congestion and delay in the national airport system. There is considerably less agreement about how much traffic will grow and how it will be distributed across airports and among sectors of civil aviation. Of the two questions, distribution is probably the more important, since it will determine which airports are affected and what measures can be taken to deal with the congestion and delay that could result. If, for example, traffic continues to concentrate at airports that are already severely congested or at those now approaching capacity limits, there is a legitimate fear that major hubs will be caught in a form of “gridlock” that will spread throughout the national airport system. On the other hand, if traffic patterns change and new growth occurs not at the airports now saturated but at other airports with adequate reserve capacity, the system can absorb a large amount of new traffic without an appreciable increase in local or general congestion and delay. Between these extremes are other possibilities, each with differing consequences for various types of airports and classes of airport users.

If aviation demand grows at the rate foreseen by FAA, delay will increase at high-density airports—perhaps intolerably—and could even spread to other airports that are now relatively free of congestion. Congestion would be especially severe if traffic were to concentrate at a few large hubs, so severe that air carriers would probably seek to avoid escalating delay costs by shifting their centers of operation to other airports. Some carriers might shift to other suitable large hubs, but

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12 National Airspace System Plan (Washington, DC: Federal Aviation Administration, April 1983, revised edition), p. II-2.

more likely the move would be to medium airports with adequate facilities and ample surplus capacity—in effect breaking the pattern that now exists at airports such as Atlanta or Chicago and selecting a site where the rehubbing carrier would be the principal, if not the only, major airline at the site. The current trend toward hub-and-spoke route structure and the present inclination of airlines to purchase short- and medium-range narrowbody aircraft seem to indicate the likelihood of rehubbing. If so, the area of greatest interest over the next decade or so could be medium hubs, where the influx of traffic may necessitate rapid, but selective, expansion of airport facilities.

The prospect of extensive rehubbing at medium airports does not necessarily imply that these airports will face a capacity crisis like that of some major hubs today. If the medium airports that are to serve as new hubs are chosen wisely and if the practice does not lead to abuse,1[3] they offer a large capacity reserve. The key is how the airlines respond in a deregulated environment where they may compete in a variety of ways, some of which might offer a short-term advantage but at the cost of an unbalanced use of the airport system as a whole. The full implications of rehubbing are by no means clear. On one hand, rehubbing seems to be an attractive way to absorb growth in demand and provide air transportation service while avoiding the delay costs of a large multi-airline hub. On the other hand, we have too little experience with the dynamics of an unregulated air travel market to know how many new, smaller, single-airline hubs are economically practical.

h this setting, the reliever concept is of great potential value. By shifting GA traffic away from centers of air carrier operation while still allowing GA adequate access to major metropolitan areas, relievers offer important advantages. There is the advantage of allowing each sector of civil aviation to grow without impediment to the other. This would not only reduce delay and its associated costs for all users of metropolitan airports, it would also have important collateral effects on airport efficiency (through segregation of dissimilar types of traffic) and on airport expansion costs. It may be less costly to upgrade one or two reliever airports to handle more traffic than to expand the major air carrier airport to absorb the same amount. If general aviation—especially business aviation—grows as much as FAA projects, it is clear that some way will have to be found to serve this segment of civil aviation.

For the reliever concept to work, however, it will not be sufficient simply to push GA traffic off to some other airport in the metropolitan area. For GA to accept this diversion and to embrace the reliever concept, the alternate airports must provide facilities and services appropriate to GA needs and of quality comparable to that of the major airport. This implies not only adequate runways, aprons, navigation aids, and ATC services, but also facilities for aircraft storage and maintenance and landside connections to activity centers in the metropolitan area. The reliever thus needs to be a mirror of the air carrier airport, not just another place to land.

Both these observations suggest the need to think of airports as a system, not as separate parts. The recently enacted Airport Improvement Program makes it clear that such a broad view is needed in order to determine how to make good use of the infrastructure already in place and how to fit new demand into an existing system that has large unused capacity overall, even though it is congested at a few points. This implies that a strategy of restructuring airport use through adjustment of operational patterns and judicious improvement of existing airports may be a less expensive and more manageable alternative than continuing to build new facilities in response to demand wherever and whenever it occurs.

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[13] One form of abuse might be too heavy concentration of traffic at the new site by the rehubbing carrier. Another might be transfer of operations by other airlines to the same airport in an effort to compete for transfer passengers or to cash in on the traffic boom.