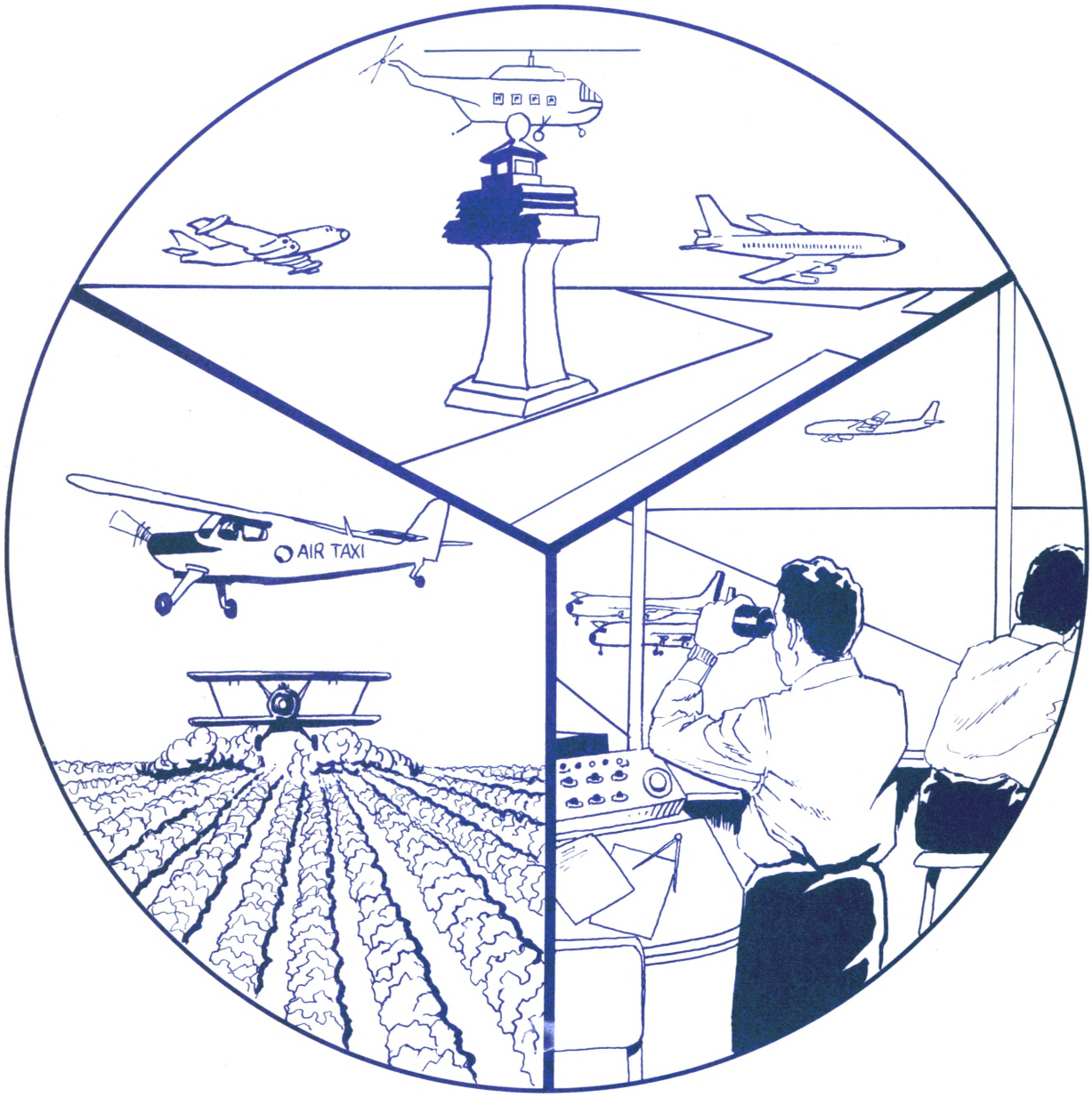
Employment Requirements and Changing Occupational Structure in Civil Aviation



UNITED STATES DEPARTMENT OF LABOR
W. Willard Wirtz, Secretary

BUREAU OF LABOR STATISTICS
Ewan Clague, Commissioner

Bulletin No. 1367

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June 1964

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Preface

Civil aviation has developed rapidly, particularly since the end of World War II. By 1960, civil aviation employed about 280,500 people. In that year, the Nation's scheduled airlines, the largest employer of civil aviation workers, accounted for almost as many intercity passenger-miles as buses and railroads combined, and currently these airlines make an even greater contribution to the mobility of our society. The future development of civil aviation promises to be as dynamic as its past. Continuing rapid increases in passenger traffic and much greater use of small aircraft in business, and recreational activities are expected to result in further rapid employment growth.

The Bureau is grateful for the cooperation of officials of airlines, general aviation companies, trade associations, trade unions, and Government agencies, and others who cooperated generously in providing information, and reviewing and commenting on the draft of this study.

The bulletin was prepared by Sheldon H. Luskin under the supervision of Allan F. Salt. The project was directed by Bernard Yabroff in the Bureau's Division of Manpower and Occupational Outlook, under the general direction of Harold Goldstein, Assistant Commissioner for Manpower and Employment Statistics.

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EMPLOYMENT REQUIREMENTS AND CHANGING OCCUPATIONAL STRUCTURE IN CIVIL AVIATION

Introduction

This bulletin presents the results of a Bureau of Labor Statistics study of employment in civil aviation, particularly occupational patterns and trends. Aggregate employment totals shown cover full-time and part-time workers in virtually all nonmilitary flying activities, including the airlines (U.S. certificated route, supplemental, and foreign-flag),[1] general aviation (business, commercial, instructional; pleasure, and test, ferry, and other flying, and certificated repair stations), and the regulatory and flying activities of the Federal Aviation Agency (FAA) and the Civil Aeronautics Board (CAB). Other Federal Government flying activities, and those of State and local governments, are excluded from this study because of the relatively small number of workers employed. Workers who perform services ancillary to civil aviation, such as those employed by civil airports, air freight forwarders, or airport limousine operators, are considered to be outside civil aviation as the term is used in this bulletin.

Civil aviation was selected for study because substantial employment growth in this field is anticipated during the remainder of the 1960's and because careers in civil aviation are attractive to many young people.[2] The future opportunities to enter civil aviation, that are described in this bulletin, are limited to those resulting from employment growth. Because pertinent data were not available, no attempt was made to estimate job opportunities resulting from the need to replace the many thousands of workers who leave civil aviation for jobs in other industries, or who retire or die. Job openings from these sources may be more numerous than those created by employment growth, even in some of the faster growing occupational categories, such as flight attendant.

This bulletin does not examine developments affecting the availability of trained workers to meet employment requirements. The availability of an adequate supply of trained workers is particularly important for occupations, such as pilots, mechanics and others, requiring extended training. In this connection, a comprehensive investigation of current and future manpower requirements and supply in such occupations, was started in early 1964 by the Aviation Human Resources Study Board, an independent group supported by the Federal Aviation Agency. This project will include the aviation sectors covered in this bulletin, as well as the military, State Governments, and aircraft manufacturing. The Board is also investigating the capacity of existing private and public schools that train civil aviation workers in long lead-time occupations, and changes in training programs that might result from technological advances.

In addition to presenting the available employment data for the scheduled and supplemental airlines for 1960, this bulletin provides estimates of the number of general aviation workers, and of U.S. citizens working for foreign-flag airlines. Employment was projected to 1970 for civil aviation as a whole, and for its three major divisions--airlines, general aviation, and the FAA and CAB, separately.

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[1] For definitions, see glossary.

[2] A discussion of civil aviation occupations, including the nature of the work, education and training requirements, earnings and working conditions, and employment outlook, appears in the *Occupational Outlook Handbook*, 1963-64, 6th ed. (BLS Bulletin 1375), pp. 553-573.

In the course of the research for this bulletin, gaps and weaknesses in existing civil aviation employment and occupational data, particularly for general aviation, were encountered. Deficiencies in existing data limit the use of some of the 1960 employment estimates to indications of general magnitude, subject to revision as new information becomes available. The long-range projections of employment also require cautious interpretation.

Some of the information collected for the study was obtained from basic statistical sources, such as the FAA and CAB. Other information was obtained from sources such as periodicals, books, special studies, and newspaper articles. Interviews with industry, trade associations, unions, and Government officials also provided much helpful information. Source references are given in the text, table footnotes, and in the selected bibliography.

The study of employment outlook in civil aviation used 1960 as the base year for projections in this bulletin, which were made to 1970. The year 1960 was the latest year for which most of the basic statistics for civil aviation were available at the time the study was undertaken in 1962.

At the time this bulletin was going to press, the employment projections were assessed in the light of actual experience between 1960 and 1963. For the airlines, current employment levels approximate that implied by the projections. For general aviation, the number of planes in use in 1963 is consistent with the projected number; employment projections in general aviation were based largely on the projected number of general aviation aircraft. Employment in 1963 in independent certificated repair stations, the largest segment of general aviation, is estimated to be somewhat higher than the level implied by projections in this bulletin.

Summary

Civil aviation employment is expected to rise by more than a quarter between 1960 and 1970. By 1970, the number of civil aviation workers may reach nearly 360,000, 80,000 more than in 1960. Airlines' employment, which makes up almost three-fifths of civil aviation employment, may rise by about 20 percent as passenger and cargo traffic increase. In general aviation employment growth is expected to be more than twice as rapid as for the airlines. In contrast, employment in the Federal Government (Federal Aviation Agency and Civil Aeronautics Board), is expected to grow slowly. These projectionasare based on a number of assumptions concerning the economy, and technological developments, in the 1960's. Should these assumptions not be realized, the projected employment levels would not be met.

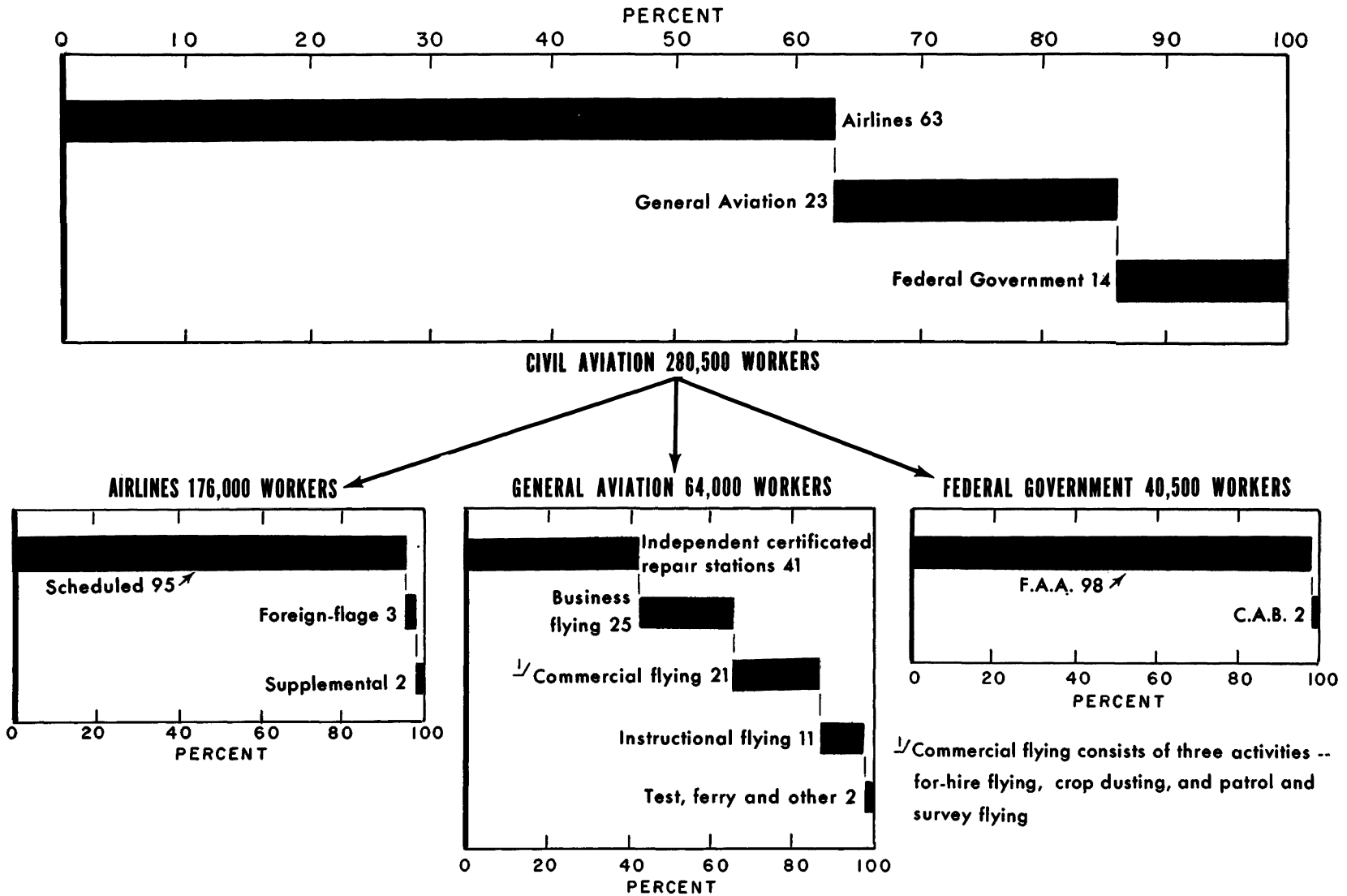
In the scheduled airlines, which employ practically all of the airlines' personnel, the number of workers nearly doubled between 1947 and 1960, mainly because of huge increases in passenger traffic and the size of the airline fleet. By 1960, employment had reached 167,300. The number of nonflight workers, who account for 4 out of 5 scheduled airline employees, nearly doubled largely because of additional reservation, ticket, baggage, and other services required by the growth in passenger traffic. Even more rapid increases occurred in flight employment, mainly because of the rise in the size of the airline fleet.

Scheduled airline passenger and cargo traffic will continue to grow in the years ahead. By 1970, the number of revenue passenger-miles flown by the scheduled airlines is expected to increase by about 85 percent over the 1960 level because of increases in population and family income. Cargo ton-miles may increase more than fourfold because of rate reductions that are likely to occur due to more efficient aircraft and cargo loading procedures. Employment in the scheduled airlines is projected to increase by about a fifth, with most of this growth occurring among nonflight occupations. Within this group, aircraft and traffic servicing employment probably will grow most rapidly and, by 1970, may account for nearly 1 out of 3 scheduled airline workers. Increases in flight employment are expected to be limited to stewardesses and other flight attendants.

Employment in the certificated supplemental airlines in 1970 is expected to decline to about half of the 2,300 employed in 1960. The number of certificated supplemental airlines is expected to decrease as a result of recent Federal legislation limiting their activity and establishing additional aircraft maintenance requirements and stricter financial regulation. Employment of U.S. citizens in this country by foreign-flag airlines was estimated at more than 6,400 in 1960, mainly in aircraft and traffic servicing, and office occupations. By 1970, employment in these airlines is expected to grow by more than 70 percent as a result of increases in international air traffic.

General aviation employment, including part-time workers, may reach 100,000 by 1970, compared with an estimated 64,000 workers in 1960. Certificated repair stations employed the largest group of general aviation workers in 1960--about 26,000, virtually all as airplane mechanics. By 1970, such stations will still be the largest employer, with about 37,000 workers. Growth will stem from the anticipated large increase in the number of general aviation aircraft. Business and commercial flying activities, which employed 16,000 and 14,000 workers, respectively, in 1960, mainly as pilots and copilots, are expected to employ about 25,000 workers each by 1970. In business flying, employment will increase because of the greater use of aircraft to reduce nonproductive travel time. In commercial flying, higher employment will result from increased demand for more of the services typically associated with commercial flying, such as crop dusting and for-hire (charter) flying.

DISTRIBUTION OF CIVIL AVIATION EMPLOYMENT, 1960



Employment in the Federal Aviation Agency (FAA) and Civil Aeronautics Board (CAB) is projected to increase by about 6,000 to 47,000. Nearly all of these workers will be employed by the FAA. In this agency, the number of air traffic controllers, flight service station specialists, and other air traffic servicing workers will probably increase rapidly. Employment of these workers is expected to rise as a result of increased traffic and services.

Research now underway by the Aviation Human Resources Study Board, an independent group supported by the FAA, is expected to develop information on the relationship between supply of and demand for civil aviation workers in future years. This group is also investigating the capacity of existing public and private schools that train civil aviation workers, and changes in training programs that might result from technological advances.[3]

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[3]For more detail on the work of this Board, see p. 1.

Early Development

In 1918, the achievements of Eddie Rickenbacker and other World War I flying aces were providing the public with colorful news stories. Still more significantly for the future of commercial air transportation, in that same year, the U.S. Post Office Department inaugurated regular airmail service between New York City and Washington, D.C. During the next 8 years, the Post Office Department laid the groundwork for the air transportation system by establishing transcontinental air routes, developing navigational equipment and flying procedures, and building airports. The airmail service demonstrated the advantages of air transportation, and provided training for Charles A. Lindbergh and others who helped develop commercial air transportation during the late 1920's, and 1930's. In 1926, private operators replaced the Post Office Department as airmail carriers, and additional airlines were established mainly with the intention of obtaining airmail contracts.[4] With this stimulus, employment in the infant industry increased from several hundred persons in 1926 to about 6,300 workers in 1933.[5]

During the late twenties and early thirties, the airlines were heavily dependent on airmail revenues for income because passenger transportation was negligible. Between 1929 and 1932, according to the Office of the Federal Coordinator of Transportation, mail accounted for nearly three-fourths, passenger nearly one-fourth, and cargo the remainder of total airline revenue. High cost, uncomfortable equipment, and a relatively poor safety record discouraged passenger travel. In 1934, when the Federal Government temporarily canceled all commercial airmail contracts,[6] the airlines tried to attract a passenger market by introducing larger, faster, and more comfortable airplanes. Between 1934 and 1938, representative airplane speeds increased from 110 miles per hour to 158 miles per hour and average seating capacity increased from 8 to 13 seats per plane.[7] The public, which was becoming increasingly airminded because of the widely publicized achievements of noted aviators, accepted air travel to a greater degree. In 1935, the airlines carried nearly 40 percent more passengers than in the previous year and, by 1939, passenger traffic was more than three times the 1934 level.

Increases in airline passenger traffic contributed to increases in employment, and changes in occupational structure. Airline employment increased from 6,500 in 1934 to nearly 16,000 in 1939.[8] Whereas 46 percent of airline employees in 1934 were pilots, copilots, or mechanics, only 36 percent were in these occupations in 1939. This relative decline reflected increasing employment of stewardesses, ticket and reservations agents, and office personnel who were needed to serve the growing number of passengers.

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[4] John H. Frederick, *Commercial Air Transportation*, 5th ed. (Homewood, Ill., Richard D. Irwin, Inc., 1961), p. 70.

[5] Estimate based on data in *Hours, Wages, and Working Conditions in Scheduled Air Transportation* (U.S. Office of the Federal Coordinator of Transportation-OFCT, March 1936), table 27, p. 86.

[6] Paul M. Godehn and Frank E. Quindry, "Air Mail Contract Cancellations of 1934 and Resulting Litigation," *The Journal of Air Law and Commerce* (Dallas, Texas), vol. 21, No. 3 (Summer 1954), p. 253.

[7] John H. Frederick, op. cit., p. 75.

[8] *CAA Statistical Handbook of Aviation* (Civil Aeronautics Administration), 1958 ed., pp. 66 and 83; *FAA Statistical Handbook of Aviation* (Federal Aviation Agency), 1961 ed., pp. 80 and 98.

Despite the expansion in passenger traffic and improvements in equipment, the airlines faced many problems during the late 1930's. Because of the general business depression and a series of costly accidents, many airlines were unprofitable and some were on the verge of bankruptcy. Others lacked capital to purchase needed equipment. To assist the airlines, and to provide for unified Government regulation, Congress passed the Civil Aeronautics Act in 1938. This act broadened the scope of air safety regulations, placed the air carriers under the same type of economic regulation covering public utilities, and authorized subsidy assistance to the carriers in the form of mail pay.[9]

Between 1939 and the entrance of the United States into World War II, employment in the scheduled airlines increased by almost 70 percent, to 26,500. Increases in passenger traffic, partly reflecting the establishment of new routes,[10] caused most of this employment expansion.

During and immediately following the war years, increasing demand for air transportation resulted in exceptionally high utilization of scheduled airline capacity,[11] and large increases in employment. Between 1941 and 1946, employment increased nearly fourfold--reaching 96,600 in 1946 (table 1). More than half of this increase occurred between 1944 and 1946, when many additional aircraft were placed into service.

Developments that occurred during World War II provided the impetus for the subsequent expansion in airline passenger traffic and employment. The airplane's wartime achievements made it more acceptable to the public as a mode of travel. Many people flew for the first time during the war. New flying equipment and techniques developed by the military during the war were adopted by the airlines. In addition, the airlines, in anticipation of large traffic increases, hired many thousands of workers including pilots, copilots, mechanics, and other workers trained by the military.

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[9]More specifically, the act provided for a five-member Civil Aeronautics Authority to regulate economic activity in the industry; an administrator, to develop navigational and control systems, promote civil aviation, and carry on experimental work; and a three-man Air Safety Board, to investigate accidents. After 2 years, the tripartite organization was replaced by a bipartite organization similar to the one in effect today. The Civil Aeronautics Board replaced the Civil Aeronautics Authority and the Air Safety Board, and the Civil Aeronautics Administration was established in the U.S. Department of Commerce to assume the responsibilities of the administrator.

[10]The route mileage operated by domestic scheduled airlines increased by nearly 25 percent between 1939 and 1941.

[11]From 1942 to 1945, the domestic airlines operated at between 72 and 89 percent of passenger capacity and in 1946, at 79 percent of capacity. In the 5 preceding years, 1937-41, the domestic airlines had operated at less than 60 percent of capacity. *Civil Aeronautics Board Handbook of Airline Statistics,* 1961 ed., p. II-17.

Table 1. Scheduled airline activity, selected measures, 1939-46

Years	Total Employment	Number of planes	Revenue plane-miles (in millions)	Revenue passenger-miles, scheduled service (in billions)
1939	16,000	360	90.8	0.8
1940	22,100	437	120.2	1.2
1941	26,500	453	149.3	1.5
1942	39,700	254	130.5	1.7
1943	39,300	274	123.9	1.9
1944	42,600	358	161.1	2.5
1945	68,300	518	242.0	3.8
1946	96,600	821	369.3	7.0

Sources: Employment and number of planes--*FAA Statistical Handbook of Aviation,* 1961 ed. (Federal Aviation Agency). Revenue plane-miles and revenue passenger-miles--*Civil Aeronautics Board Handbook of Airline Statistics,* 1961 ed.

From 1946 to 1949, employment in the scheduled airlines declined by 14 percent, because anticipated increases in traffic failed to materialize. Also, a series of accidents involving new types of airplanes led to the temporary grounding of these planes.[12] Employment rose in 1950, as passenger traffic increased, as shown in the following tabulation:

	Employment	Revenue passenger-miles (billions)
1947	85,200	7.9
1948	84,600	7.9
1949[1]	83,000	8.8
1950[1]	85,900	10.2

[1]Data include all-cargo, intra-Alaska and intra-Hawaii air carriers.

Sources: Revenue passenger-miles--*Civil Aeronautics Board Handbook of Airline Statistics.* Employment--BLS estimates based on data appearing in FAA *Statistical Handbook of Aviation,* op. cit., and *Civil Aeronautics Board Handbook of Airline Statistics,* op. cit.

During the 1946-50 period, the establishment of local service lines provided employment for a few thousand scheduled airline workers. These lines fly short routes, between small cities where trunk line service is not available, and between these cities and the main terminals.

[12] 1947 *Annual Report to Stockholders* (American Airlines, New York, N.Y.), pp. 4 and 50; and 1947 *Annual Report to Stockholders* (United Airlines, Chicago, Ill.), pp. 1, 5, and 10.

Although employment data for general aviation are not available for the years from 1946-50, there is substantial evidence of employment growth. Several all-cargo airlines (since 1949, part of the scheduled airlines), were established, mainly as a result of the wartime success of the airplane as a mover of cargo. Between 1946 and 1950, the estimated number of miles flown in business and commercial flying activities increased by 180 percent and 67 percent, respectively.[13] Also, indications are that employment in "irregular" airlines (those that carry passengers and cargo on a nonscheduled basis) increased rapidly in the immediate postwar period. Most nonscheduled operators had just a few small airplanes but there were some who had fleets of large war-surplus planes. These major operators were responsible for most of the employment increase among irregular carriers. Although the total number of irregular carriers dropped from about 3,600 in late 1945, to about 1,500 in 1947,[14] available information suggests that employment did not decline and may even have increased.

The 1950's were a decade of further expansion and technological development for the scheduled airlines. Employment almost doubled, as the airlines became the Nation's number one intercity common carrier of passengers. Major reasons for the increase in airline passenger traffic include the introduction of new routes, and the introduction and rapid growth of coach and economy service.[15] Passenger helicopter service was established around New York City, Chicago, and Los Angeles. In 1958, the introduction of large turbojet planes on the longer domestic and international routes inaugurated the jet age which revolutionized air transportation. Air cargo ton-miles flown by the domestic airlines more than doubled, from about 152 million cargo ton-miles in 1950 to 385 million in 1960.

Available evidence indicates that employment in certificated supplemental airlines and in general aviation also increased during the 1950's. The number of revenue passenger-miles flown by the certificated supplemental airlines increased by about 50 percent.[16] In general aviation, the estimated number of miles flown increased by about 55 percent; the greatest growth was in business flying, which more than doubled over the decade and, by 1960, accounted for almost half of all general aviation flying (table 2).

Employment in the Federal Government's regulatory activities, mainly in the FAA, also increased between 1950 and 1960 (table 3). All of this growth occurred during the second half of the decade, largely because of increased civil air traffic and the use of complex new equipment to control such traffic.

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[13] The number of business miles flown increased from 121.5 million miles in 1946 to 339.7 million in 1950. The number of commercial flying miles increased from 107.9 million to 180.5 million in 3 years. *FAA Statistical Handbook of Aviation*, op. cit., p. 56.

[14] *CAA Statistical Handbook of Civil Aviation* (Civil Aeronautics Administration), 1948 ed., pp. 37 and 38.

[15] Route mileage flown by the airlines increased by about 26 percent between 1950 and 1960. Domestic coach and economy class traffic, introduced in 1948, grew from 1.7 billion revenue passenger miles in 1950 to 14.4 billion in 1960, while first class revenue passenger miles increased from about 9 billion to 18 billion.

[16] The certificated supplemental airlines, which evolved from the irregular, nonscheduled airlines established immediately after World War II, were authorized by the Civil Aeronautics Board to provide not more than 10 round trip flights per month between any two points and to engage in unlimited charter service. See New York Times, "Non-skeds' Have Grown Up," Feb. 15, 1959, p. 23; Walter Adams, *The Structure of American Industry*, 3d ed. (New York, Macmillian Co., 1961), chap. XIII, pp. 468-508; and "Probes to Shape Status of Supplementals," *Aviation Week and Space Technology*, Nov. 20, 1961, pp. 37-38.

Table 2. Estimated miles flown in general aviation, by segment, 1950-60

Year	Miles flown (in thousands)						
	Total	Business[1]		Commercial[1]		Instructional, personal, and other[1]	
		Number	Percent	Number	Percent	Number	Percent
1950 . . .	1,061,500	339,700	32	180,500	17	541,300	51
1951 . . .	975,480	379,845	39	190,480	20	405,155	42
1952 . . .	972,055	419,705	43	217,865	22	334,485	34
1953 . . .	1,045,346	499,166	48	209,937	20	336,243	32
1954 . . .	1,119,295	552,610	49	226,240	20	340,445	30
1955 . . .	1,216,000	627,800	52	245,700	20	342,500	28
1956 . . .	1,315,000	672,000	51	247,000	19	396,000	30
1957 . . .	1,426,285	720,800	51	249,400	17	546,085	32
1958 . . .	1,544,000	787,000	51	278,000	18	479,000	31
1959 . . .	1,596,000	798,000	50	279,000	17	519,000	33
1960 . . .	1,645,000	811,000	49	281,000	17	553,000	34

[1]For definitions, see glossary.

Note: Because of rounding, sums of individual items may not equal totals.

Source: *FAA Statistical Handbook of Aviation*, op. cit., p. 56.

Table 3. CAA/FAA[1] and CAB employment, 1950-60
(As of December 31)

Year	Total	CAA/FAA	CAB
1950	18,200	17,600	600
1951	18,400	17,800	600
1952	17,300	16,800	600
1953	16,100	15,600	500
1954	15,500	15,000	500
1955	16,400	15,900	600
1956	18,900	18,300	600
1957	23,900	23,200	700
1958	30,200	29,500	700
1959	34,800	34,100	700
1960	40,500	39,700	800

[1]In 1959, the CAA was succeeded by the FAA.

Note: Because of rounding, sums of individual items may not equal totals.

Source: Unpublished U.S. Civil Service Commission data.

Current Structure

By 1960, civil aviation had evolved into a major component of the U.S. transportation system, employing an estimated 280,500 workers. The U.S. certificated and foreign flag airlines employed 63 percent (176,000)[17] of these workers and accounted for about a third of all takeoffs and landings from airports with FAA-operated control towers, although they operated only about 3 percent of all aircraft (table 4). General aviation, which accounted for the operation of the great majority of all aircraft and for most takeoffs and landings and hours flown, employed an estimated 64,000 (23 percent) civil aviation workers. The Federal Government employed 40,500 civil aviation workers (14 percent).

Table 4. Civil aviation activity, selected measures, 1960

Division	Total employment	Aircraft	Arrivals at and departures from airports with FAA-operated control towers (in thousands)	Hours flown (in thousands)
All divisions	280,500	[1] 78,537	21,990	[1,2] 16,403
U.S. certificated and foreign-flag airlines	176,000	[1] 2,030	7,164	[1,2] 4,088
General aviation	64,000	76,400	14,826	12,200
FAA and CAB	40,500	107	(3)	115

[1] Does not include foreign-flag airlines.

[2] Does not include supplemental or foreign-flag airlines.

[3] Not available.

Sources: Aircraft, operations, and hours flown for U.S. certificated airlines, and general aviation--*FAA Statistical Handbook of Aviation,* op. cit; for FAA and CAB--unpublished FAA and CAB data. Employment in U.S. certificated and foreign-flag airlines, and general aviation--BLS estimates; in FAA and CAB--see source for table 3.

[17] Certificated airline employment data in this report are those published by the FAA for the certificated route and supplemental air carriers. They are not significantly different from employment data published monthly by BLS for Air Transportation, Certificated and Noncertificated Carriers (Standard Industrial Classification 451 and 452) in *Employment and Earnings*. For example, in 1960, BLS data for the industries included in these codes, averaged nearly 172,000 compared with an FAA employment figure of nearly 168,000.

Differences between FAA employment data used in this study and BLS employment data covering SIC 451 and 452 are attributable to the latter's exclusion of U.S. citizens employed overseas by U.S. international airlines and inclusion of for-hire operators. (See glossary.) FAA airline employment data exclude U.S. citizens employed in the U.S. by foreign-flag airlines (estimated in this report at about 6,400). FAA data were used because they provided information on occupational employment.

Three groups of *airlines* in 1960 were engaged in the transportation of passengers and cargo. The largest group, by far, was the U.S. certificated route air carriers (scheduled airlines) which flew 95 percent of the revenue passenger-miles and 85 percent of the freight and express (cargo) revenue ton-miles flown by the airlines. These carriers employed 95 percent of total airline employment (table 5).

Table 5. Certificated and foreign-flag airline activity, selected measures, 1960

Type of airline	Total employment	Operators	Aircraft	Scheduled revenue passenger-miles (in billions)	Scheduled freight and express ton-miles (in billions)
All airlines	176,000	166	[1]2,030	[1]41,071	[1] 823
Scheduled airlines	167,300	53	1,867	38,863	703
Domestic[2]	134,600	37	1,626	30,557	385
International	30,100	10	182	8,306	194
All-cargo	2,600	6	59	-	124
Supplemental airlines . .	2,300	33	163	2,208	120
Foreign-flag air carriers	6,400	80	(3/)	(3/)	(3/)

[1]Does not include foreign-flag air carriers.
[2]Includes intra-Alaska and intra-Hawaii airlines.
[3]Not available.

Sources: Employment in scheduled airlines and supplemental airlines--*FAA Statistical Handbook of Aviation*, op. cit., and *Civil Aeronautics Board Handbook of Airline Statistics*, op. cit.; foreign-flag air carriers--BLS estimates. Operators, scheduled revenue passenger-miles, and scheduled freight and express ton-miles--*CAB Handbook of Airline Statistics*, op. cit., Aircraft--*FAA Statistical Handbook of Aviation*, op. cit.

The 53 scheduled airline companies accounted for the movement of nearly 58 million passengers in 1960. The transportation of these passengers accounted for about 83 percent of the revenues collected.[18] Most of the people working for the scheduled airlines were employed in jobs related to the transportation of passengers.

The 37 domestic airlines employed about 80 percent of total scheduled airline employment and accounted for about the same proportion of their revenue passenger-miles.[19] The U.S.-flag international airlines accounted for about 21 percent of scheduled airline passenger traffic, about 28 percent of cargo traffic, and 18 percent of scheduled airline employment. The all-cargo lines, which flew 18 percent of cargo-ton miles, had less than 2 percent of the scheduled airline employment.

The four largest domestic trunklines (United Air Lines, American Airlines, Trans World Airlines, and Eastern Air Lines) employed about one-half of all scheduled airline workers in 1960.

[18]*Civil Aeronautics Board Handbook of Airline Statistics*, op. cit., p. IV-1.

[19]Domestic airline data reflect all operations of trunk, local service, helicopter, and intra-Alaska and Hawaii carriers, including the small amount of international operations handled by some of these carriers.

About 80 percent of U.S.-flag international airline employees worked for the largest international carrier (Pan American World Airways).

Almost all airline employees were in establishments with 100 workers or more and over 60 percent worked in establishments with 1,000 workers or more.[20] Although comparable data for general aviation are not available, indications are that employment in general aviation is much less concentrated than in the airlines.

Detailed geographical employment data for civil aviation are not available, but those States with relatively large numbers of civil aviation workers can be identified on the basis of indirect evidence. The geographical distribution of employment in Air transportation, Certificated and Noncertificated Carriers (SIC Groups 451 and 452), indicate that more than half of all airline workers were employed in five States-- New York, California, Florida, Illinois, and Texas (table 6). Data on aircraft registrations and airports imply that these States were also leading employers of other civil aviation workers.

These States have relatively large numbers of civil aviation workers for various reasons. They may be the site of a scheduled airline major overhaul base, training center, or headquarters, or originate a large amount of airline traffic. For instance, Texas, in addition to having a large population and geographical area, is the location of three airlines' main aircraft overhaul bases and the location where one major airline conducts its training for stewardesses. New York and California originate large amounts of international and domestic passenger traffic.

Table 6. Employment in air transportation, certificated and noncertificated carriers, mid-March 1959, and number of civil and military airports and airfields and active civil aircraft, 11 States and the United States, 1960.

State	1959 (mid-March)		1960			
	Total employment	Percent	Civil and military airports and airfields	Percent	Active civil aircraft	Percent
United States, total.	155,800	100.0	6,880	100.0	78,600	100.0
New York	28,200	18.1	245	3.6	3,700	4.7
California	24,400	15.7	400	5.8	10,000	12.7
Florida	16,900	10.8	150	2.2	2,700	3.4
Illinois	11,800	7.6	270	3.9	4,100	5.2
Texas	8,000	5.1	545	7.9	6,900	8.8
Missouri	7,500	4.8	160	2.3	1,900	2.4
Virginia	6,700	4.3	90	1.3	900	1.1
Oklahoma	4,700	3.0	130	1.9	1,700	2.2
Georgia	4,600	3.0	110	1.6	1,200	1.5
Minnesota	3,500	2.2	215	3.1	2,200	2.8
Massachusetts	3,300	2.1	75	1.1	1,000	1.3

Source: Employment--U.S. Bureau of the Census and U.S. Bureau of Old-Age and Survivors Insurance, cooperative report, *County Business Patterns, First Quarter, 1959,* table 2, pts. 1-10. Airports, airfields, and aircraft--*FAA Statistical Handbook of Aviation,* op. cit.

[20] *Employment and Wages* (U.S. Department of Labor, Bureau of Employment Security), First Quarter, 1961, table B-1, p. 105. (An establishment is defined as a single physical location at which one, or predominately one, type of economic activity is carried on.)

General aviation accounted for the largest share of many significant measures of civil aviation activity such as hours flown, and the number of aircraft (table 7). In spite of the importance of general aviation, employment statistics for this civil aviation division are fragmentary. Consequently, the employment estimates for general aviation are based on limited information and resulted in the inclusion of an unknown number of part-time workers.

General aviation includes a variety of flying activities, divided into five segments--business flying; commercial flying; instructional flying; pleasure flying; and test, ferry, and other flying. In addition, general aviation includes independent certificated repair stations. Although some operators engage in more than one of these activities, such operators were classified, for purposes of this study, according to their primary activity. Business flying was the most important segment of general aviation in 1960; it accounted for about two-fifths of general aviation aircraft, and hours flown.

Independent certificated repair stations, which are certificated by the FAA to maintain and repair specified aircraft components and equipment, were the largest employer of general aviation workers.[21] As of July 1, 1961, approximately 26,000 workers were employed in 773 stations.

Business flying activities--the operation and maintenance of company-owned aircraft--accounted for an estimated 16,000 workers. Nearly 40 percent of general aviation aircraft were flown by business firms, making this the second largest use of general aviation aircraft. Only pleasure flying by private owners accounted for the use of more aircraft.

About 1 of every 5 general aviation workers (14,000) was employed in commercial flying activities in 1960, the third largest field of general aviation employment. A little more than half of these workers were employed by for-hire operators (air taxi operators and others who provide charter services). Although these operations accounted for most commercial flying employment, only about one-third of commercial flying aircraft were used in for-hire operations. Nearly half of commercial flying aircraft were used for crop-dusting and other agricultural services, even through these services account for only about 30 percent of commercial flying employment. The following tabulation presents selected measures of commercial flying, by type of activity, in 1960:

Activity	Employment	Percent	Aircraft	Percent
All commercial flying	14,000	100.0	10,300	100.0
For-hire operations	7,600	54.3	3,200	31.1
Crop-dusting	4,100	29.3	5,100	49.5
Patrol and survey flying	2,300	16.4	2,000	19.4

[21] In addition to the independent certificated repair stations, there are certificated repair stations operated by the airlines and the FAA. Twenty scheduled airlines operate certificated repair stations which do maintenance and repair work on general aviation aircraft and some transport aircraft used by the military. However, because it is impossible to separate employment of those who work on airline aircraft from those who work on other aircraft, all scheduled airline certificated repair station employment is included with scheduled airline employment.

The FAA operated three certificated repair stations to maintain and repair its own aircraft. Employment in these establishments is included with FAA employment. For a complete list of certificated repair stations, see *Consolidated Listing of FAA Certificated Repair Stations,* (FAA), July 1, 1961.

There are repair stations that are not certificated by the FAA. Although data on noncertificated stations are not available, available evidence indicates that they are not as important as the certificated ones in terms of numbers and employment.

Table 7. General aviation activity, selected measures, 1960

Segment	Employment	Percent	Hours flown (in millions)	Percent	Miles flown (in billions)	Percent	Number of aircraft	Percent
Total general aviation	64,000	100.0	12.2	100.0	1,645.0	100.0	76,350	100.0
Business flying	16,000	25.0	5.3	43.4	811.0	49.3	29,000	38.0
Commercial flying	14,000	21.9	2.2	18.0	281.0	17.1	10,300	13.5
Instructional flying	7,000	10.9	1.7	13.9	184.0	11.2	6,000	7.9
Pleasure flying	--	--	3.0	24.6	362.0	22.0	30,350	39.8
Test, ferry, and other flying	1,000	1.6	(1)	(1)	7.0	.4	700	.9
Independent certificated repair stations [2]	26,000	40.6	-			-	--	

[1] Less than 0.1 percent.
[2] As of July 1, 1961.

Note: Because of rounding, sums of individual items may not equal totals.

Source: Employment--BLS estimates. Hours flown and miles flown--*FAA Statistical Handbook of Aviation,* op. cit. Number of aircraft--see appendix table A-1.

The FAA and the CAB employed about 40,500 workers in 1960 to regulate and assist civil aviation. Nearly all (39,700) were employed by the FAA (table 3). About three-fourths of FAA workers were employed in two divisions--Air Traffic Service and Aviation Facilities Service. About 17,500 workers were employed by the Air Traffic Service division to direct air traffic, and to provide weather information and in-flight following service. More than 14,000 workers were employed by the Aviation Facilities Service to install and maintain radar, ultrahigh frequency radio, and the thousands of electronic and visual devices that comprise the Nation's system of air traffic control and aerial navigation. In addition FAA employees do a variety of other types of work such as administering license examinations for pilots and other airmen, and promoting flight safety by inspecting maintenance procedures and equipment.

Nearly three-fourths of CAB employees work in administrative or clerical occupations involving the economic regulation of the airlines, supervision of international air transportation, promotion of aviation safety, and investigation of accidents.

Chapter II. Occupational Structure and Trends

The occupational structure of each of the three major divisions of civil aviation differs significantly, reflecting their different activities. For example, pilots and copilots comprise about half of the workers in general aviation, but only 8 percent of scheduled airline employment and less than 1 percent of FAA and CAB employment. The discussion of occupational patterns that follow are presented separately for each division mainly because of differences in occupational composition, but also because of the lack of comprehensive, comparable occupational data for the three civil aviation divisions. Because historical occupational employment data are not available for general aviation and other segments of civil aviation, the discussion of occupational trends is limited to the scheduled airlines and the FAA and CAB.

Airlines

The discussion of airline occupational patterns relates mainly to the scheduled airlines because detailed occupational employment information is available only for these airlines (table 8). Sparse occupational data are available for the supplemental airlines, and almost no occupational data are available for foreign-flag airlines operating in the United States.

Scheduled Airlines.

Comparable employment information for the entire 1947-60 period is available only for 4 of 8 occupational categories: maintenance workers, pilots and copilots, flight attendants, and other flight personnel.[22] For the other 4 categories (aircraft and traffic servicing workers, office workers, communications workers, and "other workers"), occupational data for the 1957-60 period are not comparable with occupational employment information available for 1947-56, inclusive.

In addition to the absence of consistent data for some occupational categories for the 1947-60 period, there are two other factors that restrict the analysis of occupational trends. Comparability of employment statistics for individual occupations within particular occupational categories[23] is limited because of the reclassification of workers by some airlines in 1960. For example, one major airline reclassified some of their workers from one occupation to another occupation within the aircraft and traffic servicing worker category. Consequently, employment data for individual occupations within this group for 1960 are not comparable with earlier years. However, 1960 employment data for the category as a whole are comparable with 1957, 1958, and 1959 data. The other factor restricting analysis is the large number of occupations within some categories. This factor makes it difficult to determine the effect and relative importance of the variables influencing employment for these categories. For example, within the "other worker" occupational category, a variable may, in different degrees, adversely affect certain occupations but favorably affect other occupations. For this reason, a comprehensive analysis of the factors influencing employment in this category is not attempted. In spite of these limitations, approximate employment levels can be determined and trends can be traced for broad occupational categories.

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[22] Employment information for the scheduled airlines is collected by the CAB on Schedule P-10, Form 41, "Payroll Analysis," for 31 functions, such as maintenance labor, and passenger service, and summarized into 8 occupational categories by the FAA. These data are published annually by the FAA in the *FAA Statistical Handbook of Aviation.* The 8 occupational categories form the basis for the analysis of occupational patterns for the scheduled airlines.

[23] A list of the occupations included in each of the 31 functions for which the CAB collects data is available in *Item List Guide to Uniform System of Accounts and Reports,* (CAB, Effective January 1, 1957), pp. 26.1-26.9.

Table 8. Scheduled airline employment, by occupational group, 1947-60

Year	Total employment	Aircraft and traffic servicing workers	Office workers	Maintenance workers[1]	Flight attendants	Pilots and copilots	Other flight personnel	Communications workers	Other workers
1947	85,200	(2)	(2)	21,100	4,100	6,600	1,300	(2)	52,000
1948	84,600	(2)	(2)	21,800	4,100	6,900	1,500	(2)	50,200
1949	83,000	(2)	(2)	20,100	4,400	7,200	1,700	(2)	49,700
1950	85,900	(2)	(2)	20,500	4,500	7,800	1,700	(2)	51,500
1951	100,500	(2)	(2)	24,700	5,400	9,100	2,000	(2)	59,200
1952	108,800	(2)	(2)	27,400	6,000	9,500	2,100	(2)	63,800
1953	114,500	(2)	(2)	27,400	6,200	10,200	2,500	(2)	68,100
1954	113,100	(2)	(2)	26,100	6,500	10,000	2,700	(2)	67,700
1955	126,900	(2)	(2)	30,400	7,600	11,600	3,000	(2)	74,300
1956	138,100	(2)	(2)	32,700	8,200	12,400	3,800	(2)	81,000
1957	153,700	37,600	32,800	32,900	9,600	14,300	4,200	4,100	[2]18,200
1958	152,100	38,400	32,800	30,800	10,000	13,600	4,000	4,100	18,500
1959	165,500	44,100	34,700	32,800	10,800	14,600	4,200	4,400	19,900
1960	167,300	43,500	35,600	34,500	10,700	13,600	3,900	4,200	21,300

[1]Maintenance worker employment data prior to 1957 are not strictly comparable with later data because of a modification of the CAB schedule used to collect these data. Prior to 1957, the CAB required the airlines to report employment for "mechanics." In the schedules used in 1957 and later years, these workers were included with other maintenance workers--carpenters, electricians, and maintenance engineers--in a "maintenance labor" category. A comparison of 1956 "mechanic" employment with 1957 "maintenance worker" employment, indicates that airplane mechanics make up the great bulk of maintenance worker employment and that, therefore, data for the two periods are very nearly comparable. As a result, the entire 1947-60 employment series for maintenance workers is used in the text as an approximation of airplane mechanic employment.

[2]Prior to 1957, data for these occupational categories are not comparable with subsequent data because of changes in the reporting schedule.

Note: Because of rounding, sums of individual items may not equal totals.

Source: Based on *FAA Statistical Handbook of Aviation,* op. cit., and *Civil Aeronautics Board Handbook of Airline Statistics,* op. cit.,

The remainder of this section dealing with the scheduled airlines will describe occupational composition and employment trends for the eight occupational categories established by the FAA,[24] and the factors determining these trends.

In 1960, aircraft and traffic servicing workers was the largest (43,500) of the eight occupational categories. About 21,000 of these workers did traffic servicing work, such as handling cargo or baggage. About 17,000 workers did aircraft servicing work such as parking, fueling, and routine inspecting of aircraft, or scheduling aircraft operating crews for assignments. Nearly 4,000 employees did both aircraft and traffic servicing work. About 1,000 other workers, whose main job was aircraft and traffic servicing, did other work, such as office work. Employment in aircraft and traffic servicing has varied with the number of passengers and amount of cargo carried by the airlines.[25] As a result of increases in these variables, employment of aircraft and traffic servicing workers rose by 16 percent between 1957 and 1960.

More traffic servicing workers were needed to meet increases in the number of passengers and amount of baggage[26] and cargo handled. More aircraft servicing workers were needed because of the increase in miles flown by the airlines, and additions to the scheduled airline fleet. Larger aircraft servicing crews were necessary to minimize the amount of nonproductive time that expensive jet airplanes would spend on the ground.

Office workers were the second largest occupational category. About 19,000 of the 35,600 office workers wrote tickets, made space reservations, or did promotion sales work. Nearly 13,500 others kept records or did routine statistical work in connection with ticket sales. About 1,000 were general management personnel. The remaining 2,100 workers were lawyers, law clerks, traffic solicitors, or purchasing personnel.

Since most office workers are employed in occupations closely associated with ticketing passengers, the number of passengers transported is an important determinant of employment in this category. However, because of more efficient ticketing procedures and the use of automatic reservations equipment, office worker employment did not increase as rapidly as passenger traffic.[27] Between 1957 and 1960, office worker employment increased 8 percent, mainly because of the sizable (24 percent) increase in the number of revenue passengers carried by the scheduled airlines. To accomodate these additional passengers, the airlines built many new ticket offices in cities they serve and consequently hired many new office workers.

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[24]See footnote 22, p. 17.

[25]Between 1957 and 1960, the number of revenue passenger originations increased by 17 percent, *Civil Aeronautics Board Handbook of Airline Statistics,* op. cit., p. II-43; cargo ton-miles (the sum of freight and express ton-miles) increased by 22 percent, Ibid., p. II-24; *FAA Statistical Handbook of Aviation,* op. cit., pp. 91 and 105.

[26]The 5-percent increase in excess baggage revenue ton-miles flown by the scheduled airlines between 1957 and 1960 indicates an overall increase in passenger baggage.

[27]The introduction of these systems was generally accomplished without any major layoffs. A 1958 Bureau of Labor Statistics study *(A Case Study of an Automatic Airline Reservations System, Studies of Automatic Technology)* (BLS Report 137, 1959) found that the installation of an automatic reservations system by one of the Nation's largest domestic scheduled airlines had little effect on the employment of ticket and reservations personnel. The report stated that "....no specific individual job was eliminated. Actually, additional employees were hired as the functions of the office not affected by the automatic reservisor [reservation system] expanded rapidly with greater passenger traffic. Total employment in the airline's reservations office increased by 79 percent from June 1952 to June 1956--from 295 to 529." (Page 11.) Four airlines employing more than half of the domestic scheduled airlines' reservations personnel were already using some type of automatic reservations system in 1957. By 1960, the use of these automatic systems had become more widespread.

Nearly all of the 34,500 workers in the maintenance worker category were airplane mechanics; the others included carpenters and electricians. Between 1947 and 1960, employment in the maintenance worker category grew by nearly two-thirds, with practically all of the expansion occuring between 1947 and 1956. The main reason for this substantial rise was the large (79 percent) increase in the number of planes operated by the scheduled airlines. Between 1957 and 1960, the size of the airline fleet grew slowly relative to traffic increases because of the addition of significant numbers of large jet aircraft that could do many times more work than a similar number of piston planes. Although the jet airplanes introduced in the late 1950's had complex electrical, hydraulic, and cooling systems which required fairly frequent maintenance and repair, the relative ease with which jet engines could be maintained and repaired offset the increased maintenance requirements of the other parts of the plane.

The ratio of mechanics (maintenance workers) to scheduled airline aircraft remained fairly constant between 1947 and 1960. It varied by an average of 1.3 from the average (mean) of 18.9 mechanics per airplane (table 9). The ratio rose to peak levels in 1947 and 1948 when airlines employed additional mechanics to perform maintenance on newly introduced aircraft with which they were having mechanical problems. The ratio was also high in 1951 and 1952 when the airlines operated additional older airplanes because of additional demand for air transportation during the Korean hostilities. In those years, the domestic scheduled airlines operated at a higher passenger load factor (percent of capacity) than at any time since World War II. In 1951, the airlines had to use more DC-3's, whereas they had been replacing these older aircraft in the 4 previous years.

Between 1947 and 1960, employment of pilots and copilots, the largest of the flight occupational categories, more than doubled. Throughout this period, the ratio of the number of pilots and copilots to aircraft fluctuated within a fairly narrow range. Employment in this category was largely determined by the number of scheduled airline aircraft which, in turn, was responsive to passenger demand for air transportation. For example, between 1947 and 1956, the number of pilots and copilots, and the airline fleet, both increased by over 75 percent while passenger traffic increased even faster. Throughout the 1947-60 period, nearly all scheduled airline aircraft were each flown by one pilot and one copilot; the only exceptions were 25 helicopters, which require one pilot, and a small number of jet planes operated with a second copilot. The fairly steady ratio of pilots and copilots to aircraft since 1947 indicates that the additional demand for air transportation was accompanied by increasing size and speed of new airplanes, rather than employment of additional pilots and copilots to fly additional flights in existing types of airlines.

Flight attendant employment rose by about 160 percent between 1947 and 1960--almost double the growth rate for total scheduled airline employment. About 90 percent of the 10,700 flight attendants employed by the scheduled airlines in 1960 were stewardesses, and the others were either stewards or pursers.

The rapid growth of flight attendants, whose work largely involves in-flight passenger services, resulted mainly from the 390-percent increase between 1947 and 1960 in the number of revenue passenger-miles flown by the scheduled airlines. The huge rise in the number of miles flown reflects a significant increase in the average passenger trip length (21 percent), and in the number of revenue passengers (300 percent) during this period. Flight attendant employment did not expand as rapidly as the number of revenue passenger-miles because increased aircraft speed and

Table 9. Pilots and copilots and maintenance workers, per scheduled airline aircraft, and "other flight personnel" per scheduled airline aircraft over 80,000 pounds, 1947-60

Year	Number of:			Number per aircraft:		Number of:		
	Scheduled airline aircraft[1]	Pilots and copilots	Maintenance workers[2]	Pilots and copilots	Maintenance workers	Aircraft weighing over 80,000 lbs.[1]	Other flight personnel	Other flight personnel per aircraft over 80,000 lbs.
1947.....	964	6,600	21,100	6.8	21.9	155	1,300	8.4
1948.....	1,053	6,900	21,800	6.6	20.7	187	1,500	8.0
1949.....	1,129	7,200	20,100	6.4	17.8	275	1,700	6.2
1950.....	1,203	7,800	20,500	6.5	17.0	324	1,700	5.2
1951.....	1,232	9,100	24,700	7.4	20.0	365	2,000	5.5
1952.....	1,342	9,500	24,400	7.1	20.4	430	2,100	4.9
1953.....	1,421	10,200	27,400	7.2	19.3	484	2,500	5.2
1954.....	1,446	10,000	26,100	6.9	18.0	568	2,700	4.8
1955.....	1,480	11,600	30,400	7.8	20.5	612	3,000	4.9
1956.....	1,723	12,400	32,700	7.2	19.0	741	3,800	5.1
1957.....	1,835	14,300	32,900	7.8	17.9	912	4,200	4.6
1958.....	1,895	13,600	30,800	7.2	16.3	969	4,000	4.1
1959.....	1,850	14,600	32,800	7.9	17.7	1,048	4,200	4.0
1960.....	1,867	13,600	34,500	7.3	18.5	1,107	3,900	3.5

[1]Beginning in 1950, the number of aircraft includes those used by intra-Alaska carriers.

[2]Employment data for 1957-60 include a small number of nonmechanics. (See footnote 1, table 8.)

Sources: Employment--See table 8. Aircraft--*FAA Statistical Handbook of Aviation,* op. cit., and *Civil Aeronautics Administration Handbook of Civil Aviation,* 1948 and 1958 editions.

seating capacity, and the rapid growth of coach and economy air transportation after 1951,[28] which offered fewer in-flight services and higher seating density than first-class air transportation,[29] permitted flight attendants to service nearly twice as many revenue passenger-miles in 1960 as in 1947 (table 10).

Table 10. Scheduled airline revenue passenger-miles per flight attendant, 1947-60

Year	Number of flight attendants	Revenue passenger-miles (billions)	Revenue passenger-miles per flight attendant (millions)
1947.....	4,100	7,920	1.9
1948.....	4,100	7,890	1.0
1949.....	4,400	8,827	2.0
1950.....	4,500	10,243	2.3
1951.....	5,400	13,204	2.4
1952.....	6,000	15,624	2.6
1953.....	6,200	18,245	2.9
1954.....	6,500	20,613	3.2
1955.....	7,600	24,351	3.2
1956.....	8,200	27,625	3.4
1957.....	9,600	31,261	3.3
1958.....	10,000	31,499	3.1
1959.....	10,800	36,372	3.4
1960.....	10,700	38,863	3.6

Source: Employment--see table 8. Revenue passenger-miles--*CAB Handbook of Airline Statistics*, op. cit.

In 1960, about 3,500 of the 3,900 other flight personnel were flight engineers and the remainder were navigators. Between 1947 and 1960, total employment in the category tripled, mainly because of a 1948 CAB regulation requiring flight engineers to be aboard all aircraft with a gross takeoff weight of more than 80,000 pounds (table 9). The number of flight engineers increased as heavier aircraft, such as the DC-6 and DC-7, replaced planes weighing less than 80,000 pounds, such as the DC-3 and DC-4. Between 1957 and 1960, flight engineer employment declined slightly. The decline was due to the reduction of the U.S. international airline fleet resulting from the substitution of many large, fast jet aircraft. On the domestic airlines, the number of flight engineers remained the same because the fleet size changed only slightly.

[28]Average airplane speed increased by more than 30 percent between 1949 and 1960, while seating capacity increased from 35 to 69. Coach and economy class air transportation increased from 13 percent of all revenue passenger-miles in 1951 to more than 50 percent in 1960.

[29]One domestic trunk airline operates Boeing 707 airplanes with seats for 96 first-class passengers. This airline also operates 707's with seating capacity for 146 coach passengers.

The effect of the transition to jets on the airline fleet was very apparent in the size of the U.S.-flag international airline fleet. The international fleet declined from 170 airplanes in 1957 (the last year before jet planes were introduced in international routes) to 156 in 1960, despite a 41-percent increase in revenue passenger-miles. Jet aircraft are able to fly about twice as many passengers as the largest piston aircraft, 60-percent faster, according to the CAB. It is estimated that a single, large jet aircraft, such as a DC-8 or 707, can do the work of 3-1/2 DC-7's.[30]

The characteristics of the jet planes put into service between 1958 and 1960 make them particularly well suited to the long, nonstop routes typically operated by U.S.-flag international airlines. By 1960, almost one-third of the U.S.-flag international airline fleet was composed of jets and these planes flew two-thirds of the international revenue passenger-miles.[31] In contrast, only 10 percent of the domestic fleet in 1960 were jets and these planes flew about 40 percent of the revenue passenger-miles.

The ratio of "other flight personnel" to each aircraft over 80,000 pounds fluctuated between 5.2 and 4.6 from 1950 to 1957. In 1948 and 1949, the ratio was high (8.0 and 6.2, respectively), mainly because the scheduled airlines employed large numbers of flight engineers for the first time and had to familiarize many of these people with new equipment. In 1958, 1959, and 1960, the ratio of other flight personnel to aircraft was extremely low because the scheduled airlines were operating at exceptionally low weight load factors, due to the 1958 recession and the introduction of new, large jet planes.

Communications workers make up the smallest occupational category in the scheduled airline. Of the 4,200 communications workers in 1960, about 3,000 were ground radio operators and teletypists. The category also includes workers in a variety of other occupations, such as telegraphers and typists. Communications employment increased only slightly between 1957 and 1960, in spite of a tremendous rise in air traffic. Significant improvements in communications equipment and procedures greatly reduced the need for additional personnel. Improved equipment allowed communications for longer distances with only small increases in the employment of ground radio and teletype operators.

The miscellaneous occupational category designated as "other workers" covers personnel in a wide range of occupations, including hotel, restaurant, and food service workers, trainee and instructor, watchman, porter, and guard. The variety of occupations in this group and the lack of any detailed occupational employment data make it difficult to identify all the factors that caused employment in this group to rise by 17 percent--to 21,300--between 1957 and 1960. Many different factors apparently were responsible. For example, increasing numbers of passengers required additional hotel, restaurant, and food service personnel. Also, the transition from piston engine planes to jet aircraft led to the employment of instructors to teach new flying and maintenance procedures to aircraft operating and servicing personnel.

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[30] *General Characteristics of Turbine-Powered Aircraft, Air Transport Economics in the Jet Age,* (CAB Staff Research Report No. 2, February 1960), pp. 11 and 12.

[31] Statistics relating to revenue passenger-miles were obtained from *CAB Handbook of Airline Statistics,* op. cit. Information on passenger and weight load factors, passenger and cargo traffic increases, passenger trip length, and average aircraft speed, used in the following paragraphs, were also obtained from this source.

Certificated Supplemental Airlines.

Employment in the supplemental airlines changed only slightly between 1957 and 1960[32] (table 11). The number of revenue passenger-miles flown by the supplemental airlines nearly tripled and cargo-ton miles increased by 38 percent, but the number of planes increased by only 3 percent.

Of the 2,300 workers employed by the 33 supplemental airlines in 1960, 1,500 were reported in flight occupations with the remainder in nonflight occupations.[33] An estimated two-thirds of those employed in flight occupations were pilots or copilots; the remainder were nearly evenly distributed between two occupational categories--flight attendant and other flight personnel (flight engineers and navigators). Most of the workers in the latter category were flight engineers. Of the 800 employees working in nonflight occupations, most were airplane mechanics, and the remainder worked in a variety of jobs ranging from manager of an airline to loader of baggage and cargo aboard airplanes.

Employment estimates for pilots, copilots, and flight attendants were developed as follows: A ratio of pilots and copilots to aircraft was constructed, based largely on the ratio as it existed in the scheduled airlines, which operate many of the same type of airplanes. Flight engineer and navigator employment was estimated by using the scheduled airline ratio of such personnel to airplanes over 80,000 pounds. Navigators, required only on over-water flights, make up a small proportion of other flight personnel. The remaining flight employees were assumed to be flight attendants. This assumption implies that a flight attendant on the supplemental airlines flies approximately twice as many revenue passenger-miles as does one on the scheduled airlines. This appears reasonable because the supplemental airlines provide fewer in-flight services than the scheduled airlines and on some supplemental airline flights, no flight attendant is aboard.

Table 11. Supplemental airline activity, selected measures, 1957-60

Year	Employment	Aircraft	Revenue passenger-miles (billions)	Cargo-ton miles (millions)
1957.....	2,400	158	767	87
1958.....	2,500	186	1,153	89
1959.....	2,600	152	1,630	85
1960.....	2,300	163	2,208	120

Source: Employment and cargo-ton miles--*Civil Aeronautics Board Handbook of Airline Statistics,* op. cit. Aircraft, revenue passenger-miles--unpublished FAA data.

[32]The supplemental airlines filed employment data with the CAB prior to 1957, but the Board has not compiled these data.

[33]Supplemental airline employment is reported only for two occupational classifications--flight and nonflight. Employment data for these classifications were obtained from schedules filed with the CAB by the supplemental air carriers and served as a basis on which to make more detailed occupational estimates.

The estimate of airplane mechanics was based on the type of airplanes operated by the supplemental airlines. About half of the airplanes operated by these airlines are large DC-6's, DC-7's and "Constellations," similar to those operated by the scheduled airlines. The other half are DC-3's, DC-4's, and C-46's--planes similar to those formerly operated by the scheduled airlines. Based on the number of mechanics employed to service these types of planes on the scheduled airlines, most supplemental airline ground personnel apparently are mechanics.

Foreign-Flag Airlines.

An estimated 6,400 U.S. citizens were employed by foreign-flag carriers in 1960, mainly in managerial, sales, clerical, and maintenance positions. The employment estimate is based principally on information obtained from three major foreign airlines and their number of flights between the United States and Europe. The employment estimate assumes that these foreign-flag carriers have the same proportion of the employment of U.S. citizens as they have of flights between the United States and Europe. Although no information is available on the number of flights between the United States and non-European locations, they comprise a small proportion of international flights.

General Aviation

The occupational distribution for general aviation differs considerably from that of the scheduled airlines. General aviation aircraft typically are small and, in addition to carrying passengers, are used to perform services, not done by the airlines, such as crop dusting. Nearly all of the estimated 64,000 general aviation workers are employed as pilots, copilots, or airplane mechanics.[34] Flight engineers, flight attendants, and aircraft and traffic servicing workers are rarely employed in general aviation activities because of the small size and limited seating capacity of airplanes ordinarily used.[35]

Employment for each general aviation segment was approximated by summing the estimates for occupations within each segment. The relationship between pilots, aircraft, and the aircraft utilization rate for crop dutsing,[36] the only general aviation activity for which all three factors were known, served as a guide in establishing pilot and copilot employment ratios in the other general aviation segments. Estimates for other occupations were based largely on the number and type of aircraft used (i.e., single engine or multiengine), the nature of the activities within the segment, and interviews with general aviation operators.

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[34]The estimates in this bulletin of the number of pilots and copi lots employed outside the airlines are considerably higher than the number of "airplane pilots and navigators," shown in the *U.S. Census of Population:1960 Subject Reports; Occupation by Industry* (U.S. Bureau of the Census) Final Report PC (2) - 7C, for industries outside of air transportation. The major reason for this difference is that the pilot and copilot employment estimates in this bulletin include part-time pilots and copilots, whereas the Census data do not. Another reason is that some aircraft owners who pilot their planes professionally are classified in the Census in the "managers, officials, proprietors" group rather than among "airplane pilots and navigators." In this report, such persons are classified as professional pilots. However, BLS employment estimates in this bulletin for pilots and copilots may be slightly overstated because they are based on the number of FAA aircraft registrations. In a recent study done by the Aircraft Owners and Pilots Association *(General Aviation Aircraft Operations-1961,* Aircraft Owners and Pilots Association Foundation, Inc.,), it was found that a few thousand aircraft owners had scrapped, exported, or otherwise eliminated their aircraft but had failed to cancel their FAA registrations. Despite these difficulties, the pilot and copilot employment estimates in this bulletin are considered to be reasonable indicators of magnitude.

[35]In 1960, about 90 percent of general aviation aircraft were single-engine planes and 43 percent of these had one, two, or three seats. *FAA Statistical Handbook of Aviation,* op. cit., p. 35.

[36]In crop-dusting activities, aircraft were each utilized an average of 172 hours, in 1957. A ratio of 0.8 pilots for each aircraft existed in this activity.

Independent certificated repair stations are the largest employer of general aviation workers. Of the 26,000 workers employed in 1960 in establishments certificated by the FAA to perform various types of aircraft repair and maintenance operations, about 25,000 were mechanics and supervisors.[37] These workers repaired and maintained the 46,000 aircraft classified in business, commercial, instructional, and test, ferry, and other flying; the 30,400 aircraft used for pleasure flying; and the many transport aircraft used by the military.

More than 90 percent (15,000) of the 16,000 workers employed in business flying in 1960 were pilots or copilots. This estimate is based on the size and composition of the business flying fleet in 1960 (table A-2), the number of corporate owned planes flown by professional pilots (table 12),[38] and the average aircraft utilization in 1957. Few airplane mechanics are believed to be employed in business flying, because the small size of the typical business flying fleet makes it more efficient generally for maintenance work to be handled by specialized repair stations.[39] More than three-quarters of all business flying aircraft in 1960 were single-engine planes,[40] which are simpler to operate than multiengine aircraft and helicopters. They are flown less than half the number of hours in the course of a year as are other types of aircraft,[41] either because their operators prefer not to fly in marginal weather or these operators require only limited use of their aircraft. Because of this low utilization rate, it is assumed that few are flown by professional pilots. Based on these factors, and on information obtained from field contacts, an average of less than one professional pilot is employed for each single-engine business aircraft. On the other hand, for multiengine planes, some of which are operated by a copilot, between one and two professional pilots and copilots are needed and for each helicopter, one pilot is needed. Evidence indicates that, on the average, less than one worker in a nonflying occupation (including employees such as mechanics and refuelers) was employed for each multiengine plane and helicopter. This estimate is based on the planes' high utilization rates, and their consequent high maintenance requirements. Employment of ground personnel in 1960 was about 1,300.

More than 70 percent of the 14,000 workers engaged in commercial flying activities, were estimated to be pilots or copilots. Virtually all of the workers in crop-dusting, and patrol and survey flying, were pilots. Employment in for-hire operations was about equally distributed between pilots and copilots, and ground personnel.

Crop-dusting is the largest commercial flying activity, on the basis of the number of aircraft operated. In 1960, about half of all commercial flying aircraft, and nearly one-third

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[37]The employment estimate for mechanics and supervisory workers is based largely on FAA unpublished records. No data are available on other employment in independent certificated repair establishments, but clerical workers are believed to account for the bulk of remaining employment in these establishments. An indication of the magnitude of clerical worker employment was obtained by assuming that these workers were the same proportion of total certificated repair establishment employment as clerical and kindred workers were of miscellaneous repair service employment in 1960. *1960 Census of Population,* "Supplementary Reports," PC(S1)-27 (U.S. Department of Commerce, Bureau of the Census), Nov. 21, 1962, table 209, pp. 7 and 8.

[38]All operation of individually owned aircraft used in business flying is assumed to be by individuals on their own business. In this report, such individuals are not classified as professional pilots.

[39]The National Business Aircraft Association reported that the average business aircraft fleet consists of 1.9 aircraft. Special Report No. 63-1, *Business Flying* (National Business Aircraft Association, Inc.), Washington, D. C., February 1963, p. 2.

[40]A detailed description of the procedures used to estimate the composition of the various fleets appears in appendix A.

[41]In 1957, on the average, one and two place single-engine planes were flown 154 hours a year, while large single-engine planes were flown 198 hours a year. Multiengine planes averaged between 316 and 451 hours of utilization with the larger multiengine planes being operated more than the smaller ones. Helicopters were utilized an average of 400 hours a year.

(about 4,100--all pilots)[42] of all commercial flying workers were employed in this activity. A very small number of additional workers are employed in ground occupations.

For-hire operators employed the largest number of commercial aviation workers and flew the second largest number of commercial aircraft. Of the 7,600 employees of these operators, half were pilots or copilots. This estimate is based on the composition and utilization of the for-hire fleet, and field contacts. About three-quarters of the airplanes flown by for-hire operators were single-engine planes, seating three people or more.[43] The average annual utilization rate for these aircraft and the need of for-hire operators to employ professional pilots because of the nature of the operations indicate an approximate ratio of one pilot to one single-engine plane. Because a copilot is employed on some multiengine planes, for each such plane between one and two pilots and copilots are estimated to be employed. A 1 to 1 ratio of pilots to helicopters is estimated on the basis of the complexity of these aircraft and their relatively high average annual utilization. Very few flight attendants are employed by for-hire operators because of the small size of the aircraft operated. Flight attendants are required only on airplanes with seating capacity for 20 or more passengers. However, some operators of smaller aircraft employ stewardesses.[44] It is estimated that 1 mechanic was needed for each aircraft used by a for-hire operator in 1960, or a total of about 3,200 mechanics. This estimate is based on trade association information and on the nature of the operations. Some for-hire operators, particularly large air taxi operators,[45] provide scheduled service around the clock, and must have their planes available at all times. These operators employ their own mechanics to perform necessary repairs and maintenance operations rather than leave their plane in a repair shop where they might not get the prompt attention that would be necessary. Fewer than 500 ground workers, other than mechanics, are employed mainly by those for-hire operators who operate two or more planes.

Patrol and survey flying operations accounted for the smallest number of commercial flying workers and the fewest aircraft. About 2,300 pilots and copilots were employed in this activity. Although the aircraft used were the same basic size as those used in crop dusting activities, differences in average annual utilization and in the type of activity indicated a ratio of pilots and copilots to aircraft that was higher than for crop dusting. For single-engine planes and helicopters, which can usually be operated by one person, a 1 to 1 ratio was used. For multiengine planes, between one and two pilots and copilots per aircraft was estimated, because these planes have higher utilization rates than single-engine planes and because some require a copilot. Few mechanics are employed in patrol and survey flying because a relatively small number of multi-engine planes and helicopters are used.

About 7,000 employees, all pilots, were estimated to be employed in instructional flying. An estimated half of this group are employed part time. About 27,000 men had flight instructor certificates in 1960, but most of them were not actively engaged in flight instruction. Aircraft used in

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[42] *Aircraft in Agriculture, 1960* (FAA), September 1962, p. 2.

[43] Of the 1,440 single-engine planes operated by for-hire operators in 1957, about 1,300 could carry 3 or more passengers. *General Aviation Aircraft Use,* op. cit., p. 27.

[44] New York Times, June 1, 1962, p. 42.

[45] Of the 2,700 FAA certified air-taxi operators, 180 of the larger ones, members of the National Air Taxi Conference (NATC), operated 427 aircraft including 140 multiengine planes. Between October 1959 and September 1960, NATC members carried about 81,000 passengers. The average load was only about two passengers per flight. "Air Taxi Fleet Doubles in Five Years," *Aircraft Magazine,* May 1961, pp. 108-110. (For a further discussion of these services, see the *Official Airline Guide,* pp. C-402-408.)

Table 12. Ownership of business aircraft, by type of aircraft, 1957

Type of aircraft	All business aircraft		Corporate owned				Individually owned		Government owned	
			Total		Flown by professional pilots					
	Number	Percent	Number	Percent	Number	Percent of corporate owned	Number	Percent	Number	Percent
All types.....	21,520	100.0	13,470	100.0	4,400	100.0	7,800	100.0	250	100.0
Single-engine....	17,220	80.0	9,630	71.5	1,550	35.3	7,400	94.9	190	76.0
Multiengine.....	4,240	19.7	3,790	28.1	2,790	63.7	390	5.0	60	24.0
Helicopters and other aircraft	60	0.3	50	0.4	50	1.1	10	0.1	(1)	—

[1]Less than 5 aircraft.

Note: Because of rounding, sums of individual items may not equal totals.

Source: *General Aviation Aircraft Use: 1957* (FAA), September 1959.

instructional flying, which are mainly small, have a higher utilization rate than any other general aviation segment. Based upon this and trade association information, an average of slightly more than one pilot per aircraft was estimated.

Test, ferry, and other flying operations was the smallest general aviation activity, employing an estimated 800 workers--almost all pilots and copilots. The relatively large number of complex aircraft included in these activities had a very low utilization rate. On the other hand, a relatively large number of the multiengine planes in these operations require a copilot.

FAA and CAB

The FAA and CAB employ workers in a variety of civil aviation occupations including some in which employees perform work similar to that done by their counterparts in the airlines and general aviation. For example, the FAA and the CAB employed 850 pilots, copilots, and mechanics in 1960. However, the vast majority of Federal civil aviation workers was employed in occupations different from those found in the other divisions of civil aviation.

Of the 40,500 workers employed by the FAA and the CAB in 1960, the largest occupational category was air traffic servicing, with 17,500 employees. The largest air traffic servicing occupation was air traffic controller, with 11,400 workers.[46] The number of workers at centers and airports, who are employed to direct airplanes between and around airports, increased more than 300 percent between 1952 and 1960 (table 13). The rapid increase in employment in this occupation was due mainly to the increase in aircraft speed, which makes control work more difficult. As a result, the average number of aircraft handled annually by each controller directing airplanes between airports decreased from 2,400 in 1957 to 1,400 in 1960; the average number of operations handled annually by each controller directing aircraft around airports decreased from 10,500 in 1952 to 5,600 in 1960. Other reasons for the rise in the number of controllers include the almost 30-percent increase in the number of FAA airport control towers, between 1950 and 1960, the introduction of radar to control traffic, and the increase in the number of airline and other flights subject to control.[47]

An additional 4,000 air traffic service personnel were employed in flight service stations in 1960 to relay air traffic control information, and provide other flight assistance to pilots, such as search and rescue operations. The great majority of these personnel were flight service station specialists who operated radio telephones and teletype machines. The others were administrative, clerical, or supervisory personnel.

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[46] This and other air traffic servicing employment estimates in this section of the report are based on data from *Number of Major Aeronautical Facilities and Services and Other Data* (Federal Aviation Agency, Dec. 31, 1961), pp. 10 and 11. The number of air traffic controllers was obtained by subtracting employment of clerical, administrative, and supervisory personnel from total employment in air traffic centers and terminal facilities.

[47] The number of instrument approaches to traffic control centers, which require additional work for the controller, increased by 134 percent between 1952 and 1960. *Statistical Handbook of Civil Aviation, 1961 ed.*, op cit., p. 31. During this period, the number of aircraft arrivals and departures at terminals with FAA control facilities increased by two-thirds and the number of instrument approaches increased by 145 percent.

Table 13. FAA air traffic service employment, by place of employment, and employment of air traffic controllers, fiscal years 1952-60

Year	Total employment	Place of employment				Number of air traffic controllers
		Centers	Airports	Stations	Other	
1952.....	7,400	1,500	1,800	3,800	340	2,700
1953.....	7,700	1,600	2,000	3,700	345	3,100
1954.....	7,500	1,700	2,100	3,500	255	3,200
1955.....	7,500	2,000	2,200	3,100	240	3,500
1956.....	8,000	2,300	2,400	3,100	265	4,000
1957.....	10,800	3,500	3,400	3,400	410	6,100
1958.....	12,500	4,400	4,000	3,600	540	7,400
1959.....	16,500	6,900	5,000	3,900	770	10,700
1960.....	17,500	7,200	5,400	4,000	830	11,400

Note: Because of rounding, sums of individual items may not equal totals.

Source: *Number of Major Aeronautical Facilities and Services and Other Data* (FAA, Oct. 31, 1961).

Employment in flight service stations decreased as the number of stations declined from 415 in 1952 to 358 in 1956,[48] with the introduction of improved long-distance communications equipment. Between 1956 and 1960, when the number of flight service stations remained relatively stable, employment increased, as additional services were performed for general aviation pilots.[49]

In 1960, more than 14,000 workers were employed by the FAA to maintain, repair, and install the electronic devices that make up the Federal Airways--the invisible structure of electronic navagational guides, and visual navigational components. A little more than half of these workers were electronic technicians. The other major occupations, with a total employment of 1,400, were electrical engineer, airways engineer, and civil engineer.[50] The remaining Federal Government civil aviation workers were employed in executive and clerical jobs in the FAA or the CAB.

[48] *FAA Statistical Handbook of Aviation,* op. cit., p. 24.

[49] *First Annual Report* (FAA, 1959), p. 10, and *Second Annual Report* (FAA, 1960), p. 29.

[50] Unpublished FAA data.

Chapter III. Employment Outlook, 1970

Making judgments about future manpower developments is difficult and hazardous. Manpower needs can be affected by a great variety of possible events, including new scientific discoveries and inventions, worldwide political developments, natural catastrophes, and the vagaries of consumer preferences. Even if these exogenous factors were not in the background and economic influences were all that had to be considered, the task would still be difficult since our knowledge of past economic trends in civil aviation and of the forces governing economic relationships in this industry is imperfect, and in some cases, hardly more than rudimentary. As a result, many of the employment forecasts appearing in this chapter had to be based on indirect evidence in addition to judgments regarding the limited data available. Where data were not available, employment projections had to be based on assumptions consistent with knowledge of the industry. This bulletin does not assess the adequacy of the supply of trained personnel to meet future manpower requirements. This problem is currently being investigated by the Aviation Human Resources Study Board (see p. 1).

Economic and Technological Framework

The employment projections developed in this study are based on a series of assumptions regarding the national economy and technological innovations. Different sets of assumptions would result in different conclusions. One major assumption of this study is that war or other cataclysmic event which would substantially alter the rate of our economic growth will not occur. It is also assumed that relatively high levels of economic activity and full employment will be realized during the period covering our projections.

Consistent with the above assumptions, the gross national product (GNP) is estimated to increase by more than 50 percent between 1960 and 1970 and, in line with historical trends, the transportation sector of the GNP is estimated to increase by 30 percent, both according to *Report of the Task Force on National Aviation Goals--Project Horizon.*[51] Air transportation will play an increasingly important role in the national transportation system, and by 1970, is expected to account for about 14 percent of transportation national income, contrasted with about 7 percent in 1960.[52]

Although the nature of air transportation may change so completely that there will be little relationship between employment and causal factors such as the number of aircraft or volume of traffic, this is not expected to occur within the decade covered by the employment projections in this study. Some experimental work now underway is concerned with aircraft that can be operated without a pilot; rocket transportation; and other radical innovations.[53] Successful developments in such fields could eliminate existing flight occupations and create new occupations.

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[51] Many of the projections used by the FAA to prepare *Report of the Task Force on National Aviation Goals--Project Horizon* (FAA, September 1961), and *Selected Characteristics of U.S. Air Carrier, General Aviation, and Military Flying Activity--Historical and As Projected through 1970* (Annex to Project Horizon), (FAA, November 1961), have been accepted in this study because they are more recent and comprehensive than comparable projections. (This comprehensive FAA report was prepared to aid in the establishment of national aviation goals between 1961 and 1970.) However, the latest forecasts of revenue passengers and revenue passenger-miles in *Aviation Forecasts, Fiscal 1963-1968* (FAA Office of Policy Development, November 1962) were adopted. (See footnote 63 for a listing of other forecasts of the number of aircraft and aviation activity.)

[52] *Survey of Current Business* (U.S. Department of Commerce, Office of Business Economics) July 1962, p. 11. *U.S. Income and Output* (U.S. Department of Commerce, Office of Business Economics) November 1958, p. 131. Air transportation national income for 1970 was estimated by extending the 1950-60 relationship between air transportation national income and total transportation national income.

[53] See "New Blind Landing Aid is Demonstrated," *Aviation Week and Space Technology,* Sept. 14, 1962, p. 144, and New York Times, June 9, 1959, p. 12.

The discussion of the outlook for future technological developments in civil aviation was also adapted from *Project Horizon*. Those technological developments which could directly affect employment are as follows:

1. The supersonic transport plane (SST).[54] The SST is not expected to be operational until after 1970.[55]

When the SST does become operational, there are indications that the total number of flight personnel employed by the airlines will decline. The same size flight crew which operates today's modern jet plane probably will be necessary to operate the SST.[56] Since the SST will fly many times faster and carry more passengers than today's jets, a reduction in total flight crew employment will result. Because of the limited market for the SST, its introduction will not affect flight crew employment as greatly as the transition to turbojet planes.[57]

2. The short/medium range jet plane. This plane, which will become operational during the latter half of the 1960's, will require the same size flight crew (two men) as the light turboprop and piston engine planes which they will replace. These planes should help the local service airlines to expand their medium- and short-haul service, particularly in cities they already serve, as well as to provide service to cities no longer served by the trunk airlines.

3. Pure jet cargo planes. During the 1960's, the scheduled airlines will place into service a long-range, jet plane especially designed to carry only cargo and capable of bringing about "very substantial reductions in the price asked for air freight service"[58] and a corresponding large increase in air freight volume and employment. This assumption appears to be conservative because two all-cargo airlines have already placed into service new turboprop planes specifically designed for cargo movement, and several airlines have placed into service jet passenger planes modified to carry only cargo.[59] The direct operating costs for the new turboprop planes are more than 40 percent lower than the most economical piston engine planes now used for cargo movement. According to one source, pure jet planes especially designed to transport cargo, which will be introduced later in the decade, can reduce operating costs by another 25 percent.[60]

54A few airlines recently announced orders for SST's for delivery in 1970 or earlier, although precise delivery dates are uncertain. However, even if deliveries are made prior to 1970, it is assumed that the number of SST's in operation by 1970 will be so limited as to have little effect on employment requirements.

55In addition to *Project Horizon*, several other sources anticipate that the SST will not be introduced into airline use until the early 1970's. For example, see "Timetable For The Mach 3 Jetliner," *Business/Commercial Aviation*, June 1959; *Contemporary and Future Aeronautical Research*, Hearings Before the Committee on Science and Astronautics, U.S. House of Representatives (87th Cong., 1st sess.) August 1,2,3, and 8, 1961.

56"U.S. Profile of an SST," *Airlife Magazine*, January 1961, p. 23. For a discussion of changes in job content for flight occupations, maintenance and communications occupations, and air traffic controllers, that will result from the introduction of a SST, see *The Technical, Economic and Social Consequences of the Introduction Into Commercial Service of Supersonic Aircraft* (International Civil Aviation Organization--ICAO), August 1960, pp. 85-87.

57A discussion of the need by U.S. airlines for SST's appears in *Contemporary and Future Aeronautical Research*, op. cit.

58*Project Horizon Annex*, op. cit., p. VI.

59"CL 44 Expanding Cargo Carriers' Market," *Aviation Week and Space Technology*, Nov. 20, 1961, p. 72 and "Carriers Begin First Move into Jet Cargo," *Aviation Week and Space Technology*, Mar. 11, 1963, p. 170.

60Harold H. Wein, *Domestic Air Cargo: Its Prospects*, Occasional Paper No. 7 (Bureau of Business and Economic Research, University of Michigan, Ann Arbor, Mich., 1962), p. 14.

4. Larger helicopters. Although many improved helicopters will become operational during the mid-1960's, service will not be conducted in many cities. Large, twin-turbine helicopters were being introduced into scheduled airline service in 1962. These aircraft can carry 25 persons (nearly twice the passenger-carrying capacity of helicopters previously used), and reduce seat mile costs by 20 to 50 percent.[61]

Scheduled helicopter service is currently provided in four cities and operators in 80 other cities have requested permission to begin service. As of late 1963, the CAB had not approved these applications because of the continued necessity for Government subsidy.

5. Pure jet aircraft for general aviation use. Several types of pure jet aircraft, specifically designed for general aviation, will become operational during the mid-1960's. Many airplane manufacturers took orders for turbojet general aviation aircraft as early as 1961. One manufacturer anticipates that the demand for these aircraft for business flying alone will be about 1,000 in 1970.[62]

Employment Projections

The major projections of total employment in civil aviation and its principal divisions are as follows: Total employment is projected to increase by nearly 80,000 between 1960 and 1970 (table 14). About 46 percent of the additional employment probably will be in the airlines, which will expand their passenger and cargo traffic greatly. Although the number of additional jobs estimated for general aviation (36,000) is about the same as for the airlines, employment in general aviation will grow at a faster rate than in the other civil aviation divisions.

Table 14. Employment in civil aviation, 1960 and estimated 1970

Division	1960	1970	Percent change, 1960-70
All divisions	280,500	359,200	+28.1
Airlines	176,000	212,200	+20.6
Scheduled	167,300	200,000	+19.5
Supplemental	2,300	1,200	-47.8
Foreign-flag	6,400	11,000	+71.9
General aviation	64,000	100,000	+56.3
Business flying	16,000	25,000	+56.3
Commercial flying	14,000	26,000	+85.7
Instructional flying	7,000	10,700	+52.9
Test, ferry, and other flying	1,000	1,300	+30.0
Independent certificated repair stations	26,000	37,000	+42.3
FAA and CAB	40,500	47,000	+16.0

Sources: 1960--see tables 3, 5, and 7; 1970--BLS estimates.

[61] *The Helicopter and Other V/STOL Aircraft In Commercial Transport Service* (FAA, Nov. 1960), p. 44.
[62] "Turbine Power Speeds the Company Plane", *Business Week*, Oct. 7, 1961, p. 80.

Large increases in the number of aircraft are anticipated in business, for-hire, and other general aviation activities. FAA and CAB employment is expected to increase slowly; only about 6,500 new jobs may be added. The Government will need additional workers to ease the strain that will be placed on the Nation's airways and control facilities by increasing speed and number of airplanes.

Scheduled Airlines.

Substantial increases in scheduled airline activity are projected during the 1960's. Revenue passenger-miles are expected to increase by nearly 85 percent between 1960and 1970 (to about 70 billion),[63] or about 6 percent a year--about half the average annual growth rate during the 1950's. This expectation is consistent with projected increases in gross national product, population, and real family income. The projections of revenue passenger-miles referred to in footnote 63, generally more optomistic than the one used in this bulletin, were not used to project total airline employment because they are limited to domestic passenger traffic, do not extend to 1970, or do not reflect recent experience. Passenger seat miles are expected to increase somewhat less rapidly than revenue passenger-miles.

Air cargo traffic is projected to be nearly four times greater in 1970 than in 1960 because of anticipated reductions in cargo rates.[64] Domestic air cargo rates are expected to decline by 45 percent and international air cargo rates by 60 percent. Domestic air cargo is projected to oncrease four-fold--from less than one-half billion ton-miles to two billion. International air cargo handled by U.S.-flag airlines is projected to increase even more rapidly --from 226 million ton-miles to 1.8 billion.

In spite of large increases in passenger and cargo traffic, the size of the airline fleet is expected to be slightly smaller in 1970 than in 1960.[65] The decline will result from the substitution of large, fast, and more efficient planes for smaller planes now in use. Between 1960 and 1965, the scheduled airline fleet is expected to decline and then by 1970, will increase to nearly the 1960 level. By 1970, jets will comprise 70 percent of the fleet.

Projections of total scheduled airline employment in this report were made in two ways. The first method involved summing the employment projections for the individual occupational categories. The second method involved correlating past employment with revenue passenger-miles and extending the trend line. Both methods yielded employment projections of similar magnitude.

These employment projections do not take into account recent airline merger proposals pending before the CAB in late 1963. Such mergers, if effected, could result in lower employment through eliminating duplicate physical facilities and routes, and combining accounting and other administrative functions.

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[63] *Aviation Forecasts, Fiscal Years 1963-1968,* op. cit., p. 14. For other projections see, *Forecast of Airline Passenger Traffic In The United States, 1959-1965,* Staff Research Report No. 1 (Civil Aeronautics Board, December 1959); *Comparison of Curtis Report (National Requirements for Aviation Facilities: 1956-1975) Forecasts With Research Division Estimates--Air Carrier* (FAA, Traffic Analysis Branch, April 1960); and *Aviation Forecasts--Fiscal 1962-1967* (FAA, Economics Branch, October 1961); and *Domestic Air Traffic Forecast,* by T. F. Comick and W. H. Don Wallace (The Boeing Company Transport Division, Renton, Wash., August 1961). This latter report includes a summary of the forecasts of revenue passenger-miles for 1965, made by the 11 domestic trunk airlines. The forecasts of 10 of these airlines are higher than the forecast used in this bulletin.

[64] Projections relating to air cargo and rates are taken from *Project Horizon Annex,* op. cit., pp. 21 and 23. These projections of domestic and international air cargo volume are higher than other projections for the 1960-70 decade. For example, Harold H. Wein, op. cit., anticipates an increase of 150 percent in domestic air cargo traffic.

[65] *Project Horizon Annex,* op. cit., p. 30-35 and 39.

Total employment in the scheduled airlines was projected to increase by about 20 percent between 1960 and 1970, with more than half of this growth occuring in the second half of the decade. Occupational employment projections in the scheduled airlines generally are consistent with trends during the late 1950's.

Aircraft and traffic servicing workers are expected to be the fastest growing occupational category and may account for nearly one-third of all scheduled airline workers by 1970 (table 15). Employment of flight attendants is also expected to grow rapidly. The number of other flight personnel (mainly pilot-qualified flight engineers) will remain about the same over the decade. One assumption of the employment projections for other flight personnel and also for pilots and copilots is that the scheduled airline flight crew on most airplanes weighing more than 80,000 pounds will be made up of three men--a flight crew complement now employed by a majority of the scheduled airlines.[66] For purposes of this report, the third man is considered a flight engineer and not a copilot even though he has some copilot qualifications, because Civil Air Regulations require the third man to have only a flight engineer's certificate. Although employment of office workers will decline relative to total scheduled airline employment, they are projected to increase numerically over the decade. The number of maintenance workers, pilots and copilots, and communications workers is expected to remain about the same.

Table 15. Scheduled airline employment, by occupational group, 1960 and estimated 1970

Occupation	1960		1970	
	Number	Percent	Number	Percent
All occupations	167,300	100.0	200,000	100.0
Aircraft and traffic servicing workers	43,500	26.0	63,500	31.8
Office workers	35,600	21.3	39,500	19.8
Maintenance workers	34,500	20.6	35,000	17.5
Flight attendants	10,700	6.4	14,500	7.3
Pilots and copilots	13,600	8.1	13,500	6.7
Other flight personnel	3,900	2.3	3,900	1.9
Communications workers	4,200	2.5	4,000	2.0
Other workers	21,300	12.7	26,000	13.0

Note: Because of rounding, sums of individual items may not equal totals.

Source: 1960--See table 8; 1970--BLS estimates.

Employment of aircraft servicing workers depends mainly on the number of passenger seat-miles and cargo ton-miles flown by the scheduled airlines. The anticipated switch to fast, large jet planes during the 1960's, which will result in great increases in passenger and cargo capacities,

[66] "The Labor Month in Review," *Monthly Labor Review*, June 1962, pp. III-IV. Pilot and copilot employment would increase substantially if the flight crew controversy is resolved in either of two ways: (1) a fourth flight crew member--a pilot--is added to airline flights, or (2) the third member of the flight crew--the holder of the flight engineer certificate--is reclassified as a copilot. Pilot and copilot employment would be reduced more substantially than shown in table 15 if those few airlines currently operating with three pilots and one flight engineer reduce their flight crews to two pilots and one engineer.

will cause substantial employment growth for aircraft servicing workers. However, employment of these workers will rise more slowly than passenger and cargo capacity because technological innovations and new procedures for aircraft cleaning, fueling, and other functions are expected to continue during the remainder of the 1960's.[67]

Employment of traffic servicing workers, which depends on the number of revenue passenger-miles and cargo ton-miles, is expected to grow tremendously during the 1960's. However, traffic servicing employment will not grow as fast as passenger and cargo traffic for several reasons. In areas of high traffic density, increases in shuttle service[68] will reduce baggage handlers' work, because on shuttle flights passengers are permitted to carry their baggage on board the plane. Improvements are also being introduced in baggage handling equipment and procedures,[69] cargo packaging methods, and loading equipment and procedures. On one airline, for example, installation of a mechanized cargo-handling system increased the number of pounds loaded per man-hour from 2,300 to more than 40,000.[70]

Employment of aircraft and traffic servicing workers is expected to increase by about 4 percent annually between 1960 and 1970--a little slower than the estimated annual rate of increase in passenger traffic. By 1970, the scheduled airlines are expected to employ about 63,500 aircraft and traffic servicing workers.

Because more than half of all office workers are employed as ticket agents and clerks, total employment in this group depends largely upon the number of passengers transported by the scheduled airlines. The number of revenue passengers transported by the scheduled airlines is projected to increase from 58 million in 1960 to about 83 million in 1965 (an increase of 43 percent) and to nearly 103 million in 1970 (an increase of 24 percent over 1965).[71] These gains will be slightly less than those expected for revenue passenger-miles because of the continuing trend to longer average trip length.

Office worker employment is not anticipated to increase as rapidly as the number of revenue passengers. Expansion of air shuttle service, or similar developments, during the 1960's, is expected to have a dampening effect on the employment of ticket and reservations personnel because reservations are not needed for shuttle service and shuttle passengers may buy their tickets from a stewardess on board the plane. The increasing use of automatic reservations system for passengers and cargo may slow down the growth of office worker employment. The number of office personnel is projected to increase by about 10 percent during the 1960's--to about 39,500 in 1970--with only one-quarter of the new jobs developing in the second half of the decade.

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[67] "Equipment For Servicing Jets Becomes Costly Burden For Airlines," New York Times, July 2, 1961, p. 34.

[68] The rapid growth of shuttle service since its introduction in April 1961 may be illustrated by its increased importance in the Boston-New York-Washington market. Of the 380,000 passengers who flew between Boston, New York, and Washington during the first 2 months of 1962, about 170,000 (45 percent) flew on shuttle flights. "Shuttle Provides Big Competitive Boost," *Aviation Week and Space Technology,* April 9, 1962, pp. 38-41.

[69] "Jet Advent Stresses Ground Handling Lag," *Aviation Week and Space Technology,* May 1, 1961, p. 151.

[70] "What's Holding Back Air Freight," a paper presented by Robert Prescott, President, Flying Tiger Line, to a symposium sponsored by the Connecticut General Life Insurance Co., Nov. 1, 2, and 3, 1961, New Haven, Conn.

[71] Based on data in *National Airport Plan; Requirements For Fiscal Years 1962-1966* (FAA, April 1961), p. 6.

Employment of airplane mechanics (maintenance workers) will show little change from the 1960 level. The ratio of mechanics to aircraft remained fairly constant throughout the 1950's (averaging about 18.9 mechanics per aircraft) despite the introduction of jets and other new aircraft types.[72] This ratio is not expected to change significantly during the 1960's, even though airlines are expected to continue converting their existing fleets to jet planes; consequently, employment projections for mechanics were made by multiplying the projected number of airline aircraft by 18.9. On this basis, about 35,000 mechanics (approximately the same number as in 1960) will be employed by the scheduled airlines in 1970.

The number of pilots and copilots in 1970 is expected to be about the same as in 1960 because the ratio of pilots and copilots to aircraft (about 7 to 1 in 1960) probably will be about the same. The jet aircraft in the 1970 fleet are expected to be mainly of the same basic type as those in operation today. However, jets will be a greater proportion of tomorrow's fleet than they were in 1960 and, as a result, average aircraft speed will increase greatly between 1960 and 1970. The number of hours flown by pilots and copilots during a month probably will decline during the 1960's at about the same rate as the 1950's.[73] As a result of these offsetting trends, the pilot-aircraft ratio is anticipated to remain stable during the 1960-70 decade.

The 1970 employment estimate was made by multiplying the projected number of aircraft by 7. On this basis, about 13,500 pilots and copilots are expected to be employed in 1970.

Employment of stewardesses and other flight attendants is expected to grow more than one-third by 1970. In the past, employment in this occupational group has been largely determined by the number and class of revenue passenger-miles flown by the scheduled airlines. During the 1960's, the growth in the number of revenue passenger-miles flown by the scheduled airlines will cause flight attendant employment to increase, although a continuation of the shift to coach, economy, and shuttle traffic (which offer a few in-flight services), and increased airplane speed, will tend to retard this growth. The number of coach and economy class revenue passenger-miles is projected to increase from about 20 billion in 1960 to about 60 billion in 1970. First class revenue passenger-miles will probably decline from 18 billion in 1960 to 10 billion in 1970. By 1970, coach and economy class air transportation is expected to be 86 percent of passenger air transportation, contrasted with 53 percent in 1960. Increased airplane speed will also enable flight attendants to fly more revenue passenger-miles in a working month in 1970 than in 1960. For example, among the U.S.-flag international airlines, employment of flight attendants remained nearly constant between 1958 and 1960 despite a nearly one-third increase in revenue passenger-miles, mainly because the introduction of jet aircraft increased average aircraft speed by nearly 20 percent. Because of these factors, the number of revenue passenger-miles flown by a flight attendant is projected to increase by about 35 percent between 1960 and 1970.[74]

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[72]In 1960, nearly one-third of the U.S.-flag international fleet was jet powered. That same year, there were 33.6 mechanics to each airplane flown by these airlines. This ratio deviated from the 1950-60 mean ratio by only 2.9; the average deviation from the mean during the 1950-60 period was 3.4.

[73]"Pay Practices for Flight Employees in the U.S. Airlines," *Report of the Presidential Railroad Commission* (Washington, February 1962), Appendix, Vol. IV.

[74]The increase in revenue passenger-miles per flight attendant, 1960-70, was extrapolated on the basis of the 1957-60 rate of growth because the earlier period had many of the characteristics that will determine flight attendant employment between 1960 and 1970. During the 1957-60 period, there was a rapid increase in aircraft speed (20 percent) and a continuation of the trend towards the use of coach and economy class transportation (from 43 percent of total revenue passenger-miles in 1957 to 53 percent in 1960).

The major determinant of employment of other flight personnel between 1948 and 1960 was the number of aircraft requiring flight engineers (those planes weighing more than 80,000 pounds). By 1970, there will be about 1,300 such planes (70 percent of the scheduled airline fleet).[75] These large aircraft will be similar to those in operation today. The ratio of other flight personnel to aircraft over 80,000 pounds is expected to decline slightly during the first half of the 1960's because navigators will be replaced by electronic navigation equipment ("Doppler Radar") which can be operated by either the pilot or copilot.[76] Navigators were needed in 1960 only aboard those planes operated on over-water flights--nearly 200 operated mainly by the U.S.-flag international airlines. The ratio of other flight personnel to aircraft over 80,000 pounds was 3 to 1 in 1960 and is not expected to vary significantly during the 1960-70 decade because reductions in navigator employment are expected to be offset by increases in flight engineer employment. The increase in the number of scheduled airline aircraft weighing more than 80,000 pounds will about offset the elimination of planes where navigators must be present. Employment of flight engineers--3,500 in 1960--is projected to rise to about 3,900 in 1970. As indicated previously, the third man in the flight crew is considered to be a flight engineer even though he has some pilot qualifications.

In the event that a flight engineer is employed on the new, light, short-range jet planes scheduled for introduction about 1965,[77] an estimated 1,000 additional flight engineers will be employed during the latter half of the 1960's.[78]

Employment of communications workers is expected to remain at about 4,000 throughout the 1960's. In some communications occupations, such as ground radio operator, employment is expected to decline, mainly because of improved long-distance communications equipment. In addition, in recent years, many airlines have contracted their communications functions to a company which is outside of civil aviation as defined in this study.[79] Because it is more efficient for this company (which is owned mainly by the airlines) to perform airline communications functions, increases in airline communications needs during the 1960's probably will be met by this company. Employment declines in communications occupations, however, will be offset by anticipated increases in other airline occupations associated with communications functions, such as typist.

The number of scheduled airline personnel designated as other workers (for example, hotel, restaurant, and food service personnel), is expected to grow by about 20 percent between 1960 and 1970--as in the past, slightly faster than total employment in the other seven airline occupational categories, combined. The same factors that accounted for the growth of the "other worker" category between 1957 and 1960--such as the increasing number of passengers and the introduction of new aircraft--will be influential during the 1960's.

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[75]During the 1960's, many light planes weighing less than 80,000 pounds will continue to be replaced by heavier aircraft. However, this transition will be slower than in the past because some of the replacement aircraft will be small jet planes, weighing less than 80,000 pounds. To project the relative number of aircraft over 80,000 pounds, a free-hand second-degree trend line was fitted to a time series representing the percentages that aircraft over 80,000 pounds were of the total airline fleet, between 1948 and 1960.

[76]"TWA Navigators Await Flight to Oblivion," New York Times, Jan. 7, 1962, Sec. I, p. 87.

[77]"FAA Enters Jet Crew Complement Fight," *Aviation Week and Space Technology,* June 18, 1962, p. 20.

[78]The market for this plane is estimated to be about 400 planes. "Douglas 2086 Fate Hinges on 125 Orders," *Aviation Week and Space Technology,* Apr. 16, 1962, pp. 40 and 41; "Douglas to Build DC-9 Despite Order Lack," *Aviation Week and Space Technology,* Mar. 11, 1963, p. 70.

[79]Aeronautical Radio, Inc. ("ARINC") is a communications company that specializes in air-ground-air aeronautical mobile service and point-to-point aeronautical fixed service. The airlines are the principal users as well as the principal owners of ARINC.

Certificated Supplemental Airlines.

By 1965, employment in the supplemental airlines is projected to decline to about half of the 1960 level (which was 2,300) and then remain stable through the second half of the decade. As in the past, the single most important determinant of employment will be the size of the supplemental airline fleet, which is expected to decline by 50 percent between 1960 and 1965, and remain about the same between 1965 and 1970. Legislation passed in mid-1962 prohibits the supplemental airlines from engaging in any scheduled service and establishes additional aircraft maintenance requirements and stricter financial regulation. The supplemental airlines of the 1960's will be limited largely to charter flying services, and consequently, will need fewer planes.

Foreign-Flag Airlines.

On the basis of limited available data, the number of U.S. citizens working for foreign-flag air carriers probably will increase rapidly during the 1960's--by more than 70 percent, to about 11,000. This increase will stem mainly from the growing passenger demand for international air transportation. Assuming the foreign-flag air carriers maintain their share of the U.S. overseas market, they will fly more than twice as many revenue passenger-miles in 1970 as in 1960.

Americans employed by foreign-flag air carriers work mainly in aircraft and traffic servicing, and office jobs. Consequently, the same factors that affected employment of these workers in the U.S. scheduled airlines probably will affect employment on the foreign-flag air carriers. For example, improved baggage handling equipment and procedures, reservations systems, and aircraft servicing equipment and procedures will limit the growth of ground workers on foreign air carriers.

General Aviation.

Indications are that general aviation employment will increase faster than either airlines' employment or combined FAA and CAB employment as greater acceptance of small aircraft leads to more widespread demand for general aviation services. Employment in general aviation may increase by more than 50 percent--to about 100,000 by 1970.[80] Within general aviation, commercial flying activities will be the fastest growing segment, with employment rising by 12,000--about 85 percent over the 1960 level (table 14). Employment in independent certificated repair establishments, and in business flying, will also increase rapidly--by about 10,000 jobs in each segment. Only a relatively small number of jobs will be added in instructional flying, and test, ferry, and other flying, even though these activities will grow very rapidly.

Employment of pilots and copilots and airplane mechanics will grow rapidly and continue to account for nearly all general aviation employment, as shown in the following tabulation:

	1960	1970
Total	64,000	100,000
Pilots and copilots	33,000	53,000
Airplane mechanics	28,300	43,000
Others	2,700	4,000

The number of aircraft and their complexity are the two principal factors determining future general aviation employment. The number of aircraft is anticipated to increase by more than one-third and the number of multiengine planes, which are relatively complex, will nearly double. The fleets of all general aviation segments (except pleasure flying) will become larger and more complex during the 1960's. Appendix A provides a detailed projection of the various general aviation fleets. A discussion of employment outlook in each general aviation segment follows.

Employment in independent certificated repair stations, the largest employer in general aviation, is expected to increase rapidly--to 37,000 in 1970. According to FAA projections, the number of certificated repair stations is expected to increase by about 42 percent over the decade with most of the growth occurring during the first half of the decade. The growth in the number of stations will result from greater maintenance requirements of bigger aircraft and an increase in the general aviation fleet. The 1970 employment estimate of mechanics and supervisors was made by multiplying the average number of these personnel in independent certificated repair stations in 1960 (32) by the estimated number of independent certificated repair establishments in 1970. Nonmechanic personnel were assumed to constitute the same proportion of total certificated repair stations employment in 1970 as in 1960.

Employment in business flying is also expected to show rapid growth, reaching about 25,000 in 1970. Pilots and copilots will continue to comprise about 90 percent of all workers in business flying. Higher employment will result from large increases in the number of business aircraft, as companies increasingly operate their own aircraft for convenience and to save time, and to speed up their marketing and sales procedures. By 1970, almost half of all general aviation aircraft are projected to be used in business flying. In spite of the present widespread use of business flying, there is considerable room for expansion. For example, according to one estimate, of the 3,000 leading industrial and commercial companies in the United States, less than 12 percent have airplanes.[81]

Aircraft used in business flying are expected to become larger and more complex during the 1960's. For example, it is anticipated that the number of multiengine planes will increase more than 80 percent and, by 1970, a few hundred aircraft will be turbine powered.[82] Increased use of instrumentation, and the ability of these larger planes to withstand turbulent air, will allow operation in almost any kind of weather. The ratio of pilots and copilots to multiengine airplanes is expected to increase during the 1960's because an increasing number of these relatively complex planes will require a copilot.

The operating characteristics of helicopters used in business flying are expected to remain the same over the decade, and the ratio of pilots to helicopters is expected to remain unchanged. In contrast, the ratio of pilots to single engine planes probably will decline because these planes are expected to become simpler to operate and, as a result, many additional businessmen will fly company aircraft without a professional pilot. For example, the increasing use of tricycle landing gear will make planes simpler to land and take off, and radio navigation equipment will simplify navigation.

Commercial flying employment is also expected to show substantial growth in the 1960's, reaching about 26,000 by 1970. Pilots and copilots will continue to account for nearly three-fourths of commercial flying employment throughout the decade. The major reason for the projected employment growth in commercial flying activities is the expected increase in the number of aircraft that will be used to perform a growing amount of commercial flying services.

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[80]The general aviation employment projections were based largely on Project Horizon projections of the general aviation fleet size. In the spring of 1964, manufacturers of general aviation aircraft indicated that the production of such aircraft during the latter part of the 1960's might grow rapidly in contrast to the relative stability in the level of production since the mid-1950's. Should such rapid growth occur, then the size of the general aviation fleet in 1970 could significantly exceed that anticipated in Project Horizon, Consequently, the employment estimate for general aviation in this bulletin would be somewhat understated. To use an extreme illustration, if the average annual increment in the general aviation fleet between 1965 and 1969 should be 6000 planes--double the increment projected in Project Horizon--employment in 1970 would be roughly 10 percent above the 100,000 projected in this bulletin.

[81]"A Look at 'General Aviation'," *Sperryscope,* First Quarter 1961, pp. 12-14.

[82]"Turbine Power Speeds the Company Plane," *Business Week,* 9ct. 7, 1961, p. 82.

Most of the employment increase in commercial flying is expected to be in for-hire (charter) activities where the demand for air transportation in communities not serviced by the airlines will probably increase somewhat, although not enough to warrant scheduled airline service.[83] Employment by for-hire operators may more than double over the 1960-70 decade--increasing to nearly 17,000. By 1970, employment in this activity may be nearly two-thirds of all commercial flying employment, contrasted with only about half in 1960. The introduction of more efficient planes that will lower seat-mile rates and thus broaden the potential market will also spur the growth of for-hire operations. Employment will also be stimulated by new services performed by aircraft, such as the use of helicopters for transport of large, preassembled building parts to construction sites. The relatively large increase projected in the number of for-hire, multiengine planes, many of which will require a copilot, is expected to cause employment to grow slightly faster than the number of for-hire aircraft. Consequently, the ratio of pilots and copilots to multiengine planes will increase slightly. The ratio of professional pilots to single-engine planes is expected to remain the same even though these planes will become simpler to operate. However, the employment effect of growing simplicity of operation will tend to be offset by the need to hire professional pilots to meet greater safety requirements and to operate single-engine planes in poor weather when some amateur pilots lack either the ability or the inclination to fly.

Employment in crop-dusting activities will increase by about 50 percent--to about 6,000 in 1970--the same rate as the increase in fleet size. Crop-dusting will expand as farms continue to grow larger, making aerial application practical.[84] Single-engine planes will remain the predominant type of aircraft used in crop dusting.

Substantial employment growth is also expected in patrol and survey flying. By 1970, employment will reach about 3,500. The pipeline industry is just one example of a growing industry that will cause an expansion of patrol and survey flying. Multiengine planes and helicopters will become increasingly important in the patrol and survey flying fleet.

Federal Aviation Agency and Civil Aeronautics Board.

By 1970, 47,000 civil aviation workers will be employed by the Federal Government compared with about 40,500 in 1960.[85] The FAA will continue to employ practically all of these workers.[86] In order to estimate FAA employment in 1970, FAA employment projections for each of the 17 FAA services and offices for the 1964-68 period were utilized.[87] These projections were modified by later unpublished projections made to 1969 by the FAA for its total employment, and were then extended to 1970. On this basis, employment of air traffic control workers is expected to increase by nearly 25 percent, to about 22,000 in 1970. Within this group, airport traffic controllers will be the fastest growing occupational group, increasing by nearly 50 percent to about 8,000. The number of center and station controllers is expected to increase more slowly, to 8,000 and 5,000 respectively in 1970 as compared with 7,200 and 4,000 in 1960. Stable em-

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[83]"Light-Twin Gains Public Approval," *Aviation Week and Space Technology*, July 23, 1962, p. 28, "Skiers, Tourists Boost Operations of Third-Level Carriers", *Aviation Week and Space Technology*, Feb. 11, 1963, p. 45.

[84]*Aircraft in Agriculture, 1960* (FAA, September 1962), p. 1.

[85]Because these projections are based on data which became available in mid-1964, they differ from projections for FAA and CAB employment appearing in "Outlook and Trends in Aviation Employment," *Monthly Labor Review*, Nov. 1963, p. 1290.

[86]For a discussion of the changing patterns of FAA employment, see *Summary, Five Year Budget Program, 1964-68* (FAA, May 1963).

[87]These projections appear in *Summary, Five Year Budget Program, 1964-68 Op. cit.*

ployment levels are expected of the remaining workers in the air traffic controller group, mainly supervisory and administration personnel. Employment of air traffic control workers will grow because of anticipated increases in air traffic and in services that will be offered.[88] However, employment growth will be partially offset by the introduction of an automation system for the control of enroute air traffic, and the reduction in the number of air route traffic control centers and flight service stations due to consolidation.

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[88]For example, the principal workload indicators for airport traffic controllers are aircraft operations and instrument operations. The number of aircraft operations is projected to increase by 34 percent (from 26.4 million operations annually in 1960 to 35.5 million in 1968) and the number of instrument operations by 47 percent (from 6.4 million to 9.4 million). *Ibid.* p. 23.

APPENDIX A.

Methodology Used to Estimate General Aviation Aircraft

Estimated 1960

Aircraft, by Segment.

The 1960 distribution of aircraft (table A-1) for most segments is based on FAA data, both published and unpublished. However, the 1960 estimates of aircraft classified in commercial flying, and in test, ferry, and other flying (two general aviation activities for which 1960 FAA estimates are not available) are based on an extrapolation of 1954-57 trends, modified by judgments concerning industry developments. The FAA estimate of the total general aviation fleet size in 1960 served as a control total. The same rates of change that occurred in commercial flying, and test, ferry, and other flying fleets between 1954 and 1957 (table A-1) were extended to 1960 because the rates of change in the number of miles and hours flown in both of these segments were constant throughout the 1954-60 period. Within the commercial flying segment, estimates were made separately for crop dusting, for-hire operations, and patrol and survey flying because of vast differences in these activities. The number of crop dusting aircraft in for-hire flying was based on unpublished FAA information on the number of operators licensed to conduct these operations. Patrol and survey flying aircraft were estimated to be approximately the same percent of the commercial flying fleet in 1960 as in 1957 and 1954.

It was assumed that the number of aircraft used in instructional flying activities increased slightly between 1957 and 1960--consistent with a projection of the instructional flying fleet made by the FAA.

Aircraft, by Type.

The 1960 estimates in table A-2 are based on trends in the number and type of aircraft, by segment, between 1954 and 1957, modified by judgments concerning industry developments and using FAA data on the aggregate number of various aircraft types for control totals.[90]

Projected 1970

Aircraft, By Segment.

The 1970 projections of the general aviation fleet, by segment, are based on projections made in the Curtis Report, modified by changes that occurred between 1954 and 1960. Between 1960 and 1970, the business flying fleet is expected to increase by 63 percent and become general aviation's largest fleet. The commercial flying fleet will grow slightly faster--by 74 percent. The instructional flying fleet will also grow rapidly, increasing by nearly 50 percent, while the number of pleasure aircraft will remain about the same throughout the 1960-70 period.

The distribution of the commercial fleet in 1970 into for-hire operations, crop dusting, and patrol and survey flying was based on an extrapolation of historical trends, modified by a projection of hours flown.[91]

Aircraft, By Type.

The historical trends in the number of aircraft by type used in each general aviation segment, were extended to 1970 and modified by anticipated changes in the functions performed by aircraft in the various segments. Forecasts of the total number of aircraft by type in *Project Horizon,* served as control totals.

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[90] *National Requirements For Aviation Facilities, 1956-1975*, vol. IV, Forecasts of Aviation Activity (Curtis Report). Prepared by the Aeronautical Research Foundation, for Edward P. Curtis, Special Assistant to the President for Aviation Facilities Planning, 1957, p. 17.

[91] *Aviation Forecasts, Fiscal Years 1963-1968*, op. cit., p. 22. FAA projections of hours flown extend only to 1968. These projections were extended to 1970 by drawing trend lines for 1957-67 data and extending them to 1970.

Table A-1. General aviation aircraft, by segment, actual 1954 and 1957, estimated 1960 and 1970

Segment	1954		1957		1960		1970	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All segments	61,180	100.0	66,520	100.0	76,350	100.0	105,000	100.0
Business	18,570	30.4	21,520	32.4	29,000	37.9	47,250	45.0
Commercial	7,850	12.8	8,800	13.2	10,300	13.5	17,900	17.0
Crop-dusting	4,210	6.9	4,960	7.5	5,100	6.7	7,200	6.9
For-hire	2,060	3.4	2,030	3.1	3,200	4.2	7,200	6.9
Patrol and survey flying	1,580	2.6	1,810	2.7	2,000	2.6	3,500	3.2
Instructional	4,720	7.7	5,680	8.5	6,000	7.9	8,900	8.5
Test, ferry, and other	690	1.1	670	1.0	700	.9	1,050	1.0
Pleasure	29,350	48.0	29,850	44.9	30,350	39.8	29,900	28.5

Note: Because of rounding, sum of individual items may not equal totals.

Sources: 1954: Based on *The Airplane at Work For Business and Industry*, op. cit.
1957: *General Aviation Aircraft Use: 1957*, (FAA), op. cit.
1960: Business and Pleasure Aircraft and 1970 Total Aircraft: *Project Horizon*, op. cit.
1970: Total Aircraft: Based on *FAA Statistical Handbook of Civil Aviation*, 1961 ed.
Other 1960 and 1970 data: BLS estimates.

Table A-2. General aviation aircraft, by segment and type of aircraft, actual 1954 and 1957, estimated 1960 and 1970

Segment	Single-Engine				Multiengine				Helicopters and other aircraft			
	1954	1957	1960	1970	1954	1957	1960	1970	1954	1957	1960	1970
All segments . .	58,240	60,650	68,035	88,000	2,640	5,370	7,670	14,000	300	500	645	3,000
Business	16,480	17,220	22,650	35,000	2,080	4,240	6,250	11,300	10	60	100	950
Commercial	7,510	7,860	9,050	14,500	240	750	1,000	2,200	100	190	250	1,200
Crop-dusting . .	4,180	4,890	5,000	6,900	10	30	50	150	20	40	50	150
For-hire.	1,900	1,440	2,350	5,300	140	530	750	1,600	20	60	100	300
Patrol and survey flying .	1,430	1,530	1,700	2,300	90	190	200	450	60	90	100	750
Instructional.	4,670	5,590	5,880	8,700	50	60	70	100	–	30	50	100
Test, ferry, and other	510	460	455	700	90	180	200	300	90	30	45	50
Pleasure	29,070	29,520	30,000	29,100	180	140	150	100	100	190	200	700

Source: 1954: *The Airplane at Work For Business and Industry*, op. cit.
1957: *General Aviation Aircraft Use:* 1957, op. cit.
1960: Based on *FAA Statistical Handbook of Civil Aviation*, op. cit.
1970: Totals, *Project Horizon*, op. cit.
Other 1970 data: BLS estimates.

Table A-3. Percent distribution of general aviation aircraft, by segment, actual 1954 and 1957, and estimated 1960

Segment	1954				1957				1960			
	Total	Single-engine	Multi-engine	Helicopters and other aircraft	Total	Single-engine	Multi-engine	Helicopters and other aircraft	Total	Single-engine	Multi-engine	Helicopters and other aircraft
Business	100.0	88.7	11.2	0.1	100.0	80.0	19.7	0.3	100.0	78.1	21.6	0.3
Commercial	100.0	95.7	3.1	1.3	100.0	89.3	8.5	2.2	100.0	87.9	9.7	2.4
Instructional . . .	100.0	98.9	1.1	-	100.0	98.4	1.1	0.5	100.0	98.0	1.2	0.8
Test, ferry, and other	100.0	73.9	13.0	13.0	100.0	68.7	26.9	4.5	100.0	65.0	28.6	6.4
Pleasure	100.0	99.0	.6	.3	100.0	98.9	.5	.6	100.0	98.8	.5	.7

Note: Because of rounding, sums of individual items may not equal 100 percent.

APPENDIX B.

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Appendix C.

Glossary

Active aircraft. Aircraft which have been issued valid airworthiness certificates by the FAA and are available for service.

Air carrier. See certificated airline.

Air coach. Transport service established for the carriage of passengers with fares and quality of service below that of first-class service, but higher than, or superior to, the level of economy service.

Airlines. See certificated airline.

Air-taxi operator. An air carrier operating small, light aircraft (under 12,500 pounds) which engages in a wide variety of nonscheduled and scheduled transportation services with no necessarily fixed routes.

Air traffic control center. A site from which aircraft are directed as they move between airport vicinities.

All-cargo line. A certificated route carrier primarily engaged in the transportation of freight and express cargo. It may carry passengers on a nonscheduled basis.

Business flying. The use of company-owned or leased aircraft to transport executives and other personnel or cargo in the conduct of a business.

Cargo ton-mile. One ton of freight or express flown 1 mile.

Certificated airline. A common air carrier, permitted by the CAB to operate under a certificate of public convenience and necessity, which flies passengers, freight, express, and sometimes, mail using certificated aircraft with no necessarily fixed route or schedule.

Certificated route airlines. A certificated airline which provides scheduled operations for passengers, mail, freight, and express over specified routes.

Certificated supplemental airlines. A certificated airline, operating under unlimited interstate charter rights to provide transportation service to persons and property, and military plane load contract flights with certain backhaul civil charter rights. May engage in limited transportation of individually ticketed passengers, individually waybilled cargo, and overseas and foreign charter service.

Charter flying service. An air transport service which gives the party or organization receiving the transportation exclusive use of the aircraft.

Civil aircraft. Nonmilitary air vehicles, including airplanes, helicopters, gliders, balloons, and dirigibles.

Coach air transportation. See Air coach.

Commercial flying. Passenger and cargo transportation for-hire (exclusive of airline service), crop dusting, and patrol and survey flying.

Crop-dusting. The use of aircraft to distribute chemicals or seeds upon land or crops.

Domestic trunk airlines. The group of certificated route airlines that operate primarily with the geographical limits of the 48 conterminous States of the United States over routes serving primarily the larger communities.

Excess baggage revenue ton-mile. One ton of passenger baggage in excess of a free weight allowance flown 1 mile.

Express ton-mile. One ton of property flown one mile under tariffs filed on the basis of agreements between REA express and the airlines.

Ferry flying. The movement of aircraft from manufacturer to distributors and dealers, from seller to buyer, or for maintenance or other nonrevenue purposes.

For-hire operator. The operator of an aircraft who makes himself and his aircraft available for any flying service.

Freight ton-mile. One ton of property, other than express, flown 1 mile.

General aviation. All civil flying except that done by the airlines.

Instructional flying. Flight training of civilians in dual and solo flying under an instructor's supervision.

Independent certificated repair station. An establishment licensed by the FAA to perform repair and maintenance services on aircraft, excluding establishments operated by the FAA or an airline.

Irregular carrier. See Certificated supplemental airline.

Load factor. The number of revenue passenger-miles or revenue ton-miles flown, divided by the available capacity.

Local service airlines. The group of certificated route airlines that operate within the United States along routes of lesser density between the smaller traffic centers and between those centers and principal cities.

On-line passenger trip length. The length of a passenger trip calculated by dividing the number of revenue passenger-miles by the number of revenue passenger originations.

Operation. An aircraft arrival or departure from an airport.

Passenger seat-mile. The seating capacity for one passenger flown 1 mile.

Patrol and survey flying. The use of a moving aircraft as an elevated observation point for the human eye, cameras, or electronic devices.

Pleasure flying. The use of an aircraft for a variety of personal uses.

Revenue passenger-mile. One paying passenger transported 1 mile.

Revenue passenger originations. The unduplicated count of passengers originating journeys on the lines of each reporting entity with the return portion of a round trip counted separately as an initial origination.

Route miles. The shortest distance of travel over authorized flight paths, by which all operated points on a carrier's operation could be served.

Scheduled airline. See certificated route airline.

Scheduled freight and express ton-mile. One ton of freight or express flown one mile in scheduled service.

Scheduled revenue passenger-mile. One revenue passenger-mile flown in scheduled service.

Shuttle service. Air transportation of passengers with no reservations necessary, provided on a high-frequency basis between city pairs.

Supersonic transport plane (SST). A commercial airplane capable of flying in excess of the speed of sound.

Supplemental airline. See certificated supplemental airline.

Test flying. Flights of new aircraft by the manufacturer, and of other aircraft in connection with inspection, maintenance, and installation of equipment.

Trunk airline. See Domestic trunk airline.

Utilization rate. The number of hours that an aircraft is used during the course of a year.

Weight load factor. The percent that total revenue ton-miles (passenger plus nonpassenger) are of available ton-miles in revenue services, representing the proportion of the overall capacity that is actually sold and utilized.

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