AVIATION FACTS and FIGURES

OFFICIAL PUBLICATION OF THE AIRCRAFT INDUSTRIES ASSOCIATION • PRICE $1.00

AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC.

AVIATION FACTS AND FIGURES 1955

Compiled by

RUDOLF MODLEY
Consultant

THOMAS J. CAWLEY
Special Consultant for Statistics

Edited by

BEN S. LEE
Director of Publications

Lincoln Press, Inc. • PUBLISHERS
1143 NATIONAL PRESS BUILDING • WASHINGTON 4, D. C.
STERLING 3-1944

PRINTED IN THE UNITED STATES OF AMERICA
THE MONUMENTAL PRINTING COMPANY, BALTIMORE, MARYLAND

PREFACE

The United States Aircraft Industry has become what future historians will perhaps consider the most dominant force in the shaping of the nation's economy and security. It has given, and will continue to contribute, in large measures to the freedom and well being of the world.

Today we live in a four-dimensional universe of space and time. Aviation has provided this fourth-dimensional aspect in the annihilation of space and time separating the nations around the earth.

Indeed, aviation has not only revolutionized transportation, but it has forced international isolationism into discard. It has opened new channels of travel and intercourse. It has enhanced the standard of living and the tempo of living.

The development of the airplane has exerted such a profound effect on national and world affairs that only time and the studious analysis of events by historians will enable us to view the first half-century of aviation in its proper perspective.

The time is not far off when any place on this earth can be reached from any other in less than one day. No longer may we consider the North American Continent an island surrounded by friendly nations and ocean barriers. We know, all too well, that the air above us has become an invisible thoroughfare over which not only the peaceful flights of commerce ply, but also supersonic aerial weapons of incredible destruction.

Because of the ever increasing technical advances of aircraft as vehicles of commerce, as well as weapons of defense, public understanding of aviation is of extreme importance.

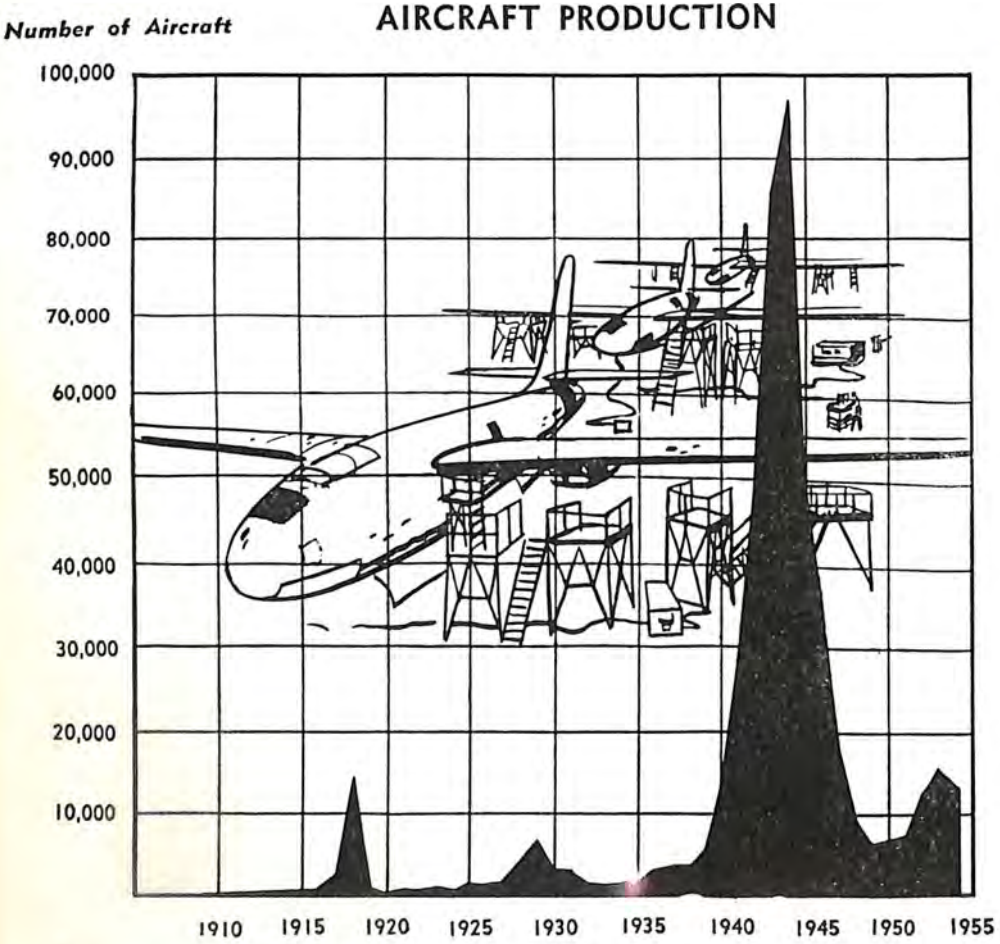
The contents of this 1955 volume of Aviation Facts and Figures are not works of original research. They represent a compilation of facts gleaned from hundreds of sources in the world of aviation during the past year which have been considered of importance or interest.

It is hoped that this edition may serve as a standard aviation reference work of value to legislators, administrators and managers in government and industry, writers and editors, analysts and students.

President, Aircraft Industries Association
D. C. RAMSEY, ADMIRAL, USN (RET.)
April, 1955

CONTENTS

AIRCRAFT PRODUCTION



The past history of the aircraft industry has been one of dramatic peaks and valleys. Today, coordinated Defense Department long-range planning aims at the maintenance of substantial modern air forces and stable industry production levels.

PRODUCTION AND FACILITIES

The United States aircraft industry in 1954, was the largest manufacturing employer of all industry in the nation. Today, nearly 800,000 men and women are engaged in producing aircraft—the nation's prime tool of commerce *and* of defense against aggression.

The military annual purchase of aeronautical products accounts for between 85 and 90 percent of industry's annual volume. Civil aviation production provides a large measure to the productive economy of the nation; indeed, to the world. But commercial aircraft production still represents only a small percentage of the industry's annual output.

Throughout the industry's half century of history the principal difficulties that have beset it have resulted from rapid rises to peak production efforts in wartimes and dramatic production cutbacks in peacetime. Despite the lessons of previous wars—the waste and costliness of rebuilding air power—the industry was all but demobilized and the machinery of research and development of new aviation products virtually halted in early post World War II years.

Between the years 1947 and 1949, despite continual warnings from thoughtful men, there was a steady decline in the total unit output of the aircraft industry. When the Korean War broke with sudden fury in June, 1950, we were caught producing only 215 military aircraft per month—nearly 3,500 aircraft per year *less than we were building in 1940.*

In 1950 and 1951 we had practically no jet bombers, and few jet fighters, as against the thousands of jet fighters and bombers of the Communists. As in the past, it was only by herculean efforts on the part of the industry and government that aircraft production was able to step up and meet and beat the Communist threat in Korea.

With the lesson that air power *is* peace power propounded in World War I, steeped in World War II, and proven a few short years later in Korea, the nation has learned that maintenance of a stable, healthy aircraft industry is the key to the security of America. But only in recent months has the nation and its military forces been able to extricate themselves from the dangerous position of air power low in quantity and quality as a result of post World War II cutbacks.

The modern aircraft, particularly the military weapon, with all its

electronic equipment and arsenal of weapons is the most highly developed instrument of power devised by human ingenuity. The history of the airplane has been one of continuing increases in performance and size, resulting in greater complexity and infinite precision in the manufacturing operation. With each new advance in aeronautical progress new techniques, and methods, and tools, and processes, have been necessary. And usually, this progress can be measured by the necessity for, and intensity of, research and development efforts into completely unexplored fields of human knowledge.

U. S. Aircraft Production
1909 to Date
(Number of aircraft)

Year	Total	Military	Civil
1909	N.A.	1	N.A.
1910	N.A.	—	N.A.
1911	N.A.	11	N.A.
1912	45	16	29
1913	43	14	29
1914	49	15	34
1915	178	26	152
1916	411	142	269
1917	2,148	2,013	135
1918	14,020	13,991	29
1919	780	682	98
1920	328	256	72
1921	437	389	48
1922	263	226	37
1923	743	687	56
1924	377	317	60
1925	789	447	342
1926	1,186	532	654
1927	1,995	621	1,374
1928	4,346	1,219	3,127
1929	6,193	677	5,516
1930	3,437	747	2,690
1931	2,800	812	1,988
1932	1,396	593	803
1933	1,324	466	858

(*Continued on next page*)

U. S. Aircraft Production
1909 to Date
(Number of aircraft)

Year	Total	Military	Civil
1934	1,615	437	1,178
1935	1,710	459	1,251
1936	3,010	1,141	1,869
1937	3,773	949	2,824
1938	3,623	1,800	1,823
1939	5,856	2,195	3,661
1940	12,804	6,019	6,785
1941	26,277	19,433	6,844
1942	47,836	47,836	—
1943	85,898	85,898	—
1944	96,318	96,318	—
1945	49,761	47,714	2,047
1946	36,670	1,669	35,001
1947	17,717	2,100	15,617
1948	9,586	2,284	7,302
1949	6,089	2,544	3,545
1950	6,520[E]	3,000[E]	3,520
1951	7,877[E]	5,400[E]	2,477
1952	12,509[E]	9,000[E]	3,509
1953	15,134[E]	11,000[E]	4,134
1954	12,989[E]	9,600[E]	3,389

N.A.—Not available.
E Estimate.

Sources: 2, 3, 9, 17, 23, 32, 34, 47, 75, 82.

The American aircraft industry has produced more than 521,000 aircraft in its 50 year history. Present production ranges from small 110 mile-per-hour utility planes which cost approximately $5,000 to huge supersonic jet bombers costing several million dollars.

Lead Time for Production

The production of aircraft, following research and development and ultimate decision to produce, involves thousands of inter-related actions and months of time in assembling needed parts, materials and components. Some elements of production time are irreducible; others already have been shortened by the aircraft industry through continuing advances in manufacturing techniques.

This very complexity of the aircraft manufacturing process is, per-

haps, the prime factor in the time consuming operation in the production of an aircraft. This nation's latest heavy jet bomber, for example, upon which the United States Air Force will spearhead its strategic air capability for the next several years, took nine years incubation from drawing board O.K. to first production roll out.

The time factor involved in the production of a modern military warplane, among others, includes: (a) the time required for military experts to establish strategic requirements and to translate these requirements into performance specifications, (b) the time required for design competitions and for contract awards, (c) the time to build experimental models and test them, (d) the time to prepare the production plan—a project that requires knowledge of the production time needed for each of the thousands of parts and materials that go into the finished aircraft (*in one giant bomber flying today there are over 184,000 separate parts*) and, (e) the time required to test, analyze, and sometimes modify, the first production aircraft.

Production Facilities

The expansion of the aircraft industry which followed the outbreak of the Korean War, is largely complete. While the 1950 buildup required

COST OF EMERGENCY FACILITIES EXPANSION, AIRCRAFT INDUSTRY
SECOND WORLD WAR AND RECENT EXPANSION
(Millions of Dollars)

	TOTAL	Privately Financed	Federally Financed
TOTAL EXPANSION			
1940–1945	$3,894	$ 420	$3,474
1950–1953	3,528[E]	1,204	2,324[E]
Structures			
1940–1945	1,556	212	1,344
1950–1953	1,085[E]	805	280[E]
Equipment			
1940–1945	2,338	208	2,130
1950–1953	2,443[E]	399	2,044[E]

E Estimate.

Sources: 2, 16, 78.

The cost of new machines and buildings in the recent expansion, which began with the Korean buildup, almost equalled that of the Second World War. The aircraft industry provided a third of the funds for expansion. By January, 1955, facilities expansion was virtually completed.

FLOOR SPACE OF AIRFRAME, ENGINE AND PROPELLER FACILITIES, 1939 TO DATE
(Millions of Square Feet)

Date	TOTAL	Airframe	Engine	Propeller
Jan. 1, 1939	9.5	7.5	1.7	.3
Jan. 1, 1940	13.1	9.6	3.0	.5
Jan. 1, 1941	25.5	17.9	6.5	1.1
Jan. 1943	117.1	77.5	31.8	5.2
Dec. 1943	175.0	110.4	54.2	6.8
Dec. 1944	167.4	103.0	54.9	7.9
1947 (estimate)	54.1	39.0	13.5	1.6
1950 (estimate)	63.5	47.5	14.0	2.0
June 30, 1952	122.8	82.3	38.4	2.1
June 30, 1953	135.8	91.1	42.1	2.6
Sept. 30, 1954[E]	127.5	91.0	33.7	2.8

E Estimate.

Sources: 2, 4, 14, 76.

The floor space of aircraft industry plants is a rough index of the industry's readiness for emergency production. The post-Korea expansion has ended with floor space at about 75 per cent of the World War II peak.

a broad-scale expansion of aircraft production facilities—land, buildings, machinery and equipment—the job, though difficult, fortunately was made easier because of the immediate experience drawn from World War II, only a decade earlier.

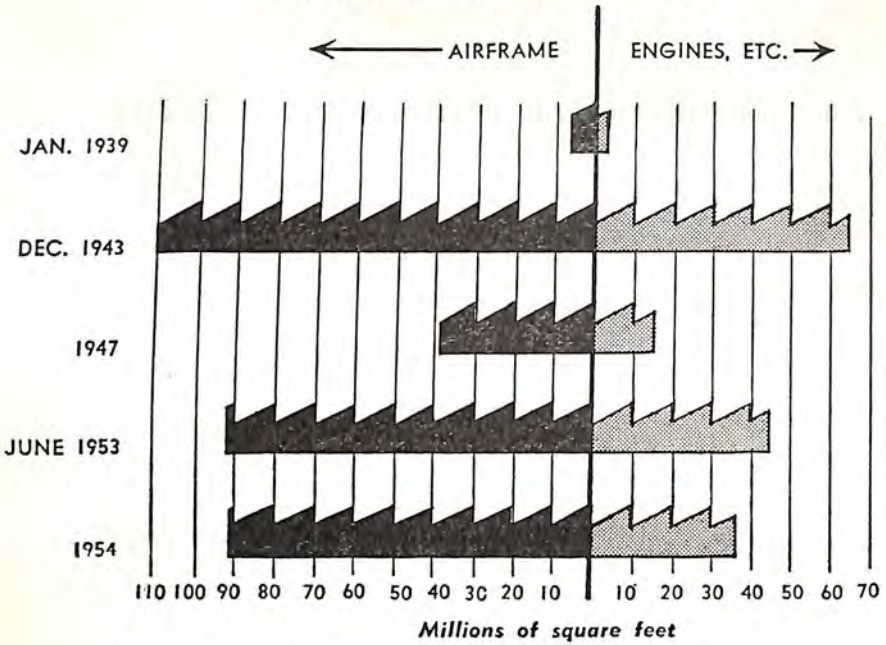
There were considerable facilities still in "stand-by" status dating from the global war. However, a substantial number of these had been made obsolete by technological advances in the physical sciences embraced by the aircraft industry.

Despite the fact that in 1950 we were producing less aircraft per month than we were in 1940, the floor space required for aircraft production in 1950 had increased greatly. In June, 1950, approximately 60 million square feet were being used in the manufacture of aircraft as compared to just under 10 million square feet in 1939.

Overall floor space available for the manufacture of jet fighters, bombers, guided missiles and civilian aircraft of all types, is approximately 127.5 million square feet—about twice that used in 1950.

However, pilotless aircraft and guided missiles as production weapons are just now beginning to join the military services in operational quantities. With the increasingly heavy emphasis laid by the military on these supersonic aerial weapons there will undoubtedly be considerable new facilities construction in widely dispersed areas of the nation for their highly specialized production.

FLOOR SPACE OF AIRCRAFT FACILITIES



SALES OF AIRCRAFT, AIRCRAFT ENGINES, PROPELLERS AND PARTS
1948 TO DATE
(Millions of Dollars)

Year	Total	Complete Aircraft and Parts			Aircraft Engines and Parts			Aircraft Propellers and Parts			Other Products and Services
		Total	U.S. Military	Other	Total	U.S. Military	Other	Total	U.S. Military	Other	
1948[a]	$1,158	$ 748	$ 626	$122	$ 265	$ 222	$ 43	$ 48	$ 36	$12	$ 97
1949	1,781	1,098	927	171	508	461	47	62	50	12	113
1950	2,274	1,416	1,255	161	583	519	64	75	62	13	200
1951	3,456	1,883	1,657	226	879	779	100	110	89	21	584
1952	6,497	3,897	3,442	455	1,609	1,440	169	148	122	26	843
1953	8,511	5,179	4,661	518	2,378	2,189	189	203	176	27	751
1954	8,248	5,226	4,626	600	2,044	1,868	176	183	151	32	795

[a] Total for last three quarters of 1948 only.

Source: 25.

The aviation products charted represent the sales of some 50 major manufacturers of complete aircraft, complete aircraft engines, and complete aircraft propellers. Because other manufacturers also sell some aviation products directly to users, total sales actually are much larger than shown here.

VALUE OF AIRCRAFT AND PARTS PRODUCED
1914 TO DATE (Thousands of Dollars)

Year	Cost of Materials, Supplies, Fuel, Purchased Electric Energy, etc.	Value Added by Manufacture	Value of Products or Sales
1914	$ 134	$ 656	$ 790
1919	7,127	7,246	14,373
1921	2,407	4,235	6,642
1923	3,829	9,116	12,945
1925	2,870	9,655	12,525
1927	7,517	13,645	21,162
1929	27,368	43,785	71,153
1931	13,101	27,177	40,278
1933	7,957	18,503	26,460
1935	14,361	30,986	45,347
1937	56,556	93,144	149,700
1939	96,250	183,247	279,497
1947	N.A.	954,575	1,200,000[E]
1949	N.A.	1,344,068	1,781,000[a]
1950	N.A.	1,550,551	2,274,000[a]
1951	N.A.	2,662,993	3,456,000[a]
1952	N.A.	4.404,823	6,497,000[a]
1953	N.A.	5,764,300	8,510,000[a]
1954	N.A.	5,600,000[E]	8,246,000[a]

E Estimate.
N.A.—Not available.
[a] Sales.
Sources: 2, 20, 22, 25.

Aircraft industry production ranks second in dollar volume of all industries in the country. The "Value Added" column shows the real economic contribution of the industry in know-how, labor, wear and tear on machines and buildings, etc.

A TYPICAL AIRCRAFT MANUFACTURER'S 1954 PURCHASES FROM SMALL BUSINESS

	Percent of Dollar Volume	
Total purchases from all concerns	100.0	
From small business[a]	55.0	
Concerns with less than 50 employees		20.7
Concerns with 50 to 199 employees		22.1
Concerns with 200 to 499 employees		12.2
From large business	45.0	
Purchases not obtainable from small business		32.0
Purchases on which small business was not competitive		13.0

[a] Small business concerns are those having less than 500 employees.
Source: 86.

CONSUMPTION OF SELECTED MATERIALS BY AIRCRAFT AND PARTS INDUSTRY
1947–1953
(Short Tons)

Year	All Metal-working Industries	Aircraft and Parts Industries	Aircraft and Parts As Percent of All Metal-working
CARBON STEEL			
1947	36,411,380	22,934	.1
1949	36,707,265	51,279	.1
1950	43,025,011	72,474	.2
1951	47,381,914	120,608	.3
1953	44,104,294	327,942	.7
STEEL ALLOYS			
1947	2,670,257	24,017	.9
1949	2,789,855	41,464	1.5
1950	3,853,858	53,716	1.4
1951	4,563,142	112,672	2.5
1953	4,041,774	137,754	3.4
ALUMINUM			
1947	461,001	33,936	7.4
1949	460,315	40,098	8.7
1950	712,233	59,884	8.4
1951	662,844	116,529	17.6
1953	846,793	164,137	19.4
COPPER AND COPPER-BASE ALLOYS			
1947	942,902	326	.1
1949	1,027,118	N.A.	N.A.
1950	1,334,222	3,102	.2
1951	1,393,821	9,705	.7
1953	1,159,787	10,554	.9

N.A.—Not available.

Source: 22.

The aircraft industry, in 1954, consumed almost 20 per cent of all aluminum used in metal working industries. It used 2.2 pounds of aluminum, 1.8 pounds of steel alloys, and 4.3 pounds of carbon steel for every pound of airframe weight produced (excluding spares). These figures show the metals consumed not only for the airframe but also for the power plant and for fixed equipment and spare parts. They also take into account the metal that goes into jigs and dies, rejections, scrap and losses in terminated contracts.

U. S. AIRFRAME WEIGHT PRODUCTION, 1939 TO DATE

Year	Weight in Millions of Pounds (Excluding Spares)		
	TOTAL	Military	Civil
1939	12.5	10.1	2.4[E]
1940	27.8	23.1	4.7[E]
1941	86.1	81.4	4.7[E]
1942	275.9	275.9	—
1943	654.7	654.7	—
1944	962.4	962.4	—
1945	542.2	540.5	1.7
1946	38.4	12.9	25.5
1947	29.3	11.4	17.9
1948	35.3	25.2	10.1
1949	36.5	29.8	6.7
1950	42.2[E]	36.2[E]	6.0
1951	55.0[E]	50.0[E]	5.0
1952	114.3[E]	105.0[E]	9.3
1953	150.4[E]	140.0[E]	10.4
1954	148.0[E]	137.5[E]	10.5

E Estimate.

Sources: 2, 23, 34, 36, 43.

Airplanes vary in size from "very small" to "very big." Because of this, industry and government consider airframe weight, rather than aircraft units, to be the best index of production. Military airframe weight production is now leveling off at one-seventh of the World War II 1944 peak.

AIRFRAME WEIGHT OF U. S. MILITARY PLANES, BY TYPE, 1944 AND 1954
(Pounds)

Type	1944	1954
Heavy bombers	49,000	115,000
Medium bombers	10,100–24,700	55,000
Light bombers	7,800–14,700	25,000
Fighters—day	5,000	8,000– 12,000
Fighters—all weather	10,000	12,000– 20,000
Heavy transports	20,100–61,800	55,000–100,000
Medium transports	7,800–16,400	30,000– 55,000
Light transports	2,300– 3,800	20,000– 30,000
Trainers	600–16,800	1,500– 22,000

Sources: 2, 7.

Because of the ever increasing performance of U.S. aircraft (see p. 42), airframe weights are still on the increase. The average weight per military aircraft produced in 1939, was 4,600 pounds; in 1944, 10,000 pounds; in 1954, 14,300 pounds.

AIRCRAFT ENGINE PRODUCTION, 1917 TO DATE

Year	TOTAL	Military	Civil
1917–1919	N.A.	44,453	N.A.
1926	N.A.	842	N.A.
1927	N.A.	1,397	N.A.
1928	3,252	2,620	632
1929	7,378	1,861	5,517
1930	3,766	1,841	1,925
1931	3,776	1,800	1,976
1932	1,898	1,085	813
1933	1,980	860	1,120
1934	2,736	688	2,048
1935	2,965	991	1,974
1936	4,237	1,804	2,433
1937	6,084	1,989	4,095
1938	N.A.	N.A.	3,800[E]
1939	11,172	N.A.	N.A.
1940	30,167	22,667	7,500[E]
1941	64,681[E]	58,181	6,500[E]
1942	38,089[E]	138,089	—
1943	1227,116	227,116	—
1944	256,911	256,911	—
1945	111,650[E]	109,650	2,000[E]
1946	43,407	2,585	40,822
1947	21,159	4,808	16,351
1948	N.A.	N.A.	9,032
1949	N.A.	N.A.	3,982
1950	N.A.	N.A.	4,314
1951	N.A.	N.A.	4,580
1952	32,382[E]	27,000[E]	5,382
1953	41,647[E]	35,000[E]	6,647
1954	30,519[E]	25,000[E]	5,519

N.A.—Not available.
E Estimate.

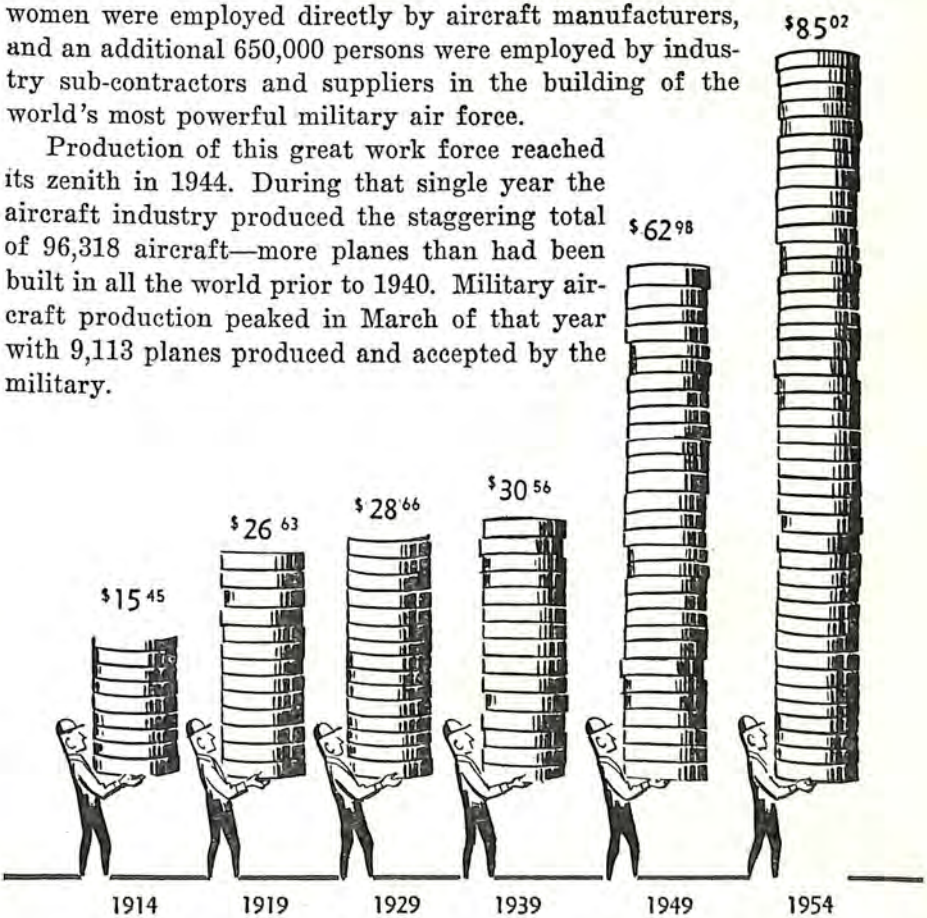
Sources: 2, 3, 20, 23, 24, 34, 47.

U.S. aircraft engine manufacturers for the first time, in 1954, began producing more jet than piston engines. Airframe manufacturers are building 91 different models of aircraft. Of this number 65 are military types and about half of these are jet powered.

LABOR

During World War II, more Americans worked to build military aircraft than had been engaged in any other single manufacturing effort in history. Statistically, the industry rose from 41st in rank among U.S. employers to first. By year-end 1943, 1,342,500 men and women were employed directly by aircraft manufacturers, and an additional 650,000 persons were employed by industry sub-contractors and suppliers in the building of the world's most powerful military air force.

Production of this great work force reached its zenith in 1944. During that single year the aircraft industry produced the staggering total of 96,318 aircraft—more planes than had been built in all the world prior to 1940. Military aircraft production peaked in March of that year with 9,113 planes produced and accepted by the military.



Average Weekly Earnings In Aircraft Industry

Weekly earnings of aircraft industry employees are five and a half times what they used to be forty years ago. "Real earnings," which take consumer price changes into account have more than doubled over the same period while hours were cut.

With the defeat of Nazi Germany in May, 1945, and the capitulation of Japan four months later, in September, the dismantling of the world's largest production machine and disintegration of its trained manpower teams began.

By March of 1946, employment in the aircraft industry had dwindled to just slightly more than 219,000 persons.

In 1948, because United States airpower was at a dangerously low level—even for "peacetime operations"—the Congress voted appropriations building toward a 70-group Air Force and a proportionate buildup of naval aviation.

AVERAGE WEEKLY EARNINGS IN AIRCRAFT AND PARTS PLANTS
1939 TO DATE
(Includes Overtime Premiums)

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	N.A.	N.A.	$36.93	N.A.	N.A.
1940	N.A.	N.A.	38.82	N.A.	N.A.
1941	N.A.	N.A.	47.65	N.A.	N.A.
1942	N.A.	N.A.	60.14	N.A.	N.A.
1943	N.A.	N.A.	61.24	N.A.	N.A.
1944	N.A.	N.A.	62.68	N.A.	N.A.
1945	N.A.	N.A.	55.34	N.A.	N.A.
1946	N.A.	N.A.	55.66	N.A.	N.A.
1947	$54.98	$53.99	56.30	$59.68	$56.50
1948	61.21	60.21	63.40	62.13	63.59
1949	63.62	62.69	65.24	66.83	68.08
1950	68.39	67.15	1.40	73.90	70.81
1951	78.40	75.78	85.81	89.17	78.66
1952	81.70	79.66	86.92	92.25	81.22
1953	83.80	82.19	87.29	85.90	85.17
1954[E]	85.02	85.06	85.05	82.37	85.63

E Estimate.
N.A.—Not available.

Sources: 2, 69, 70.

The size of aircraft industry employee weekly earnings depends upon two factors—the hourly rate and the number of hours worked. Overtime at premium rates pushed earnings up considerably during World War II.

AVERAGE HOURLY EARNINGS IN AIRCRAFT AND PARTS PLANTS
1939 TO DATE
(Includes Overtime Premiums)

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	N.A.	N.A.	$0.83	N.A.	N.A.
1940	N.A.	N.A.	.83	N.A.	N.A.
1941	N.A.	N.A.	1.00	N.A.	N.A.
1942	N.A.	N.A.	1.21	N.A.	N.A.
1943	N.A.	N.A.	1.26	N.A.	N.A.
1944	N.A.	N.A.	1.31	N.A.	N.A.
1945	N.A.	N.A.	1.28	N.A.	N.A.
1946	N.A.	N.A.	1.34	N.A.	N.A.
1947	$1.38	$1.36	1.41	$1.44	$1.41
1948	1.49	1.47	1.55	1.57	1.55
1949	1.57	1.55	1.60	1.63	1.61
1950	1.64	1.62	1.70	1.73	1.70
1951	1.79	1.75	1.89	1.93	1.80
1952	1.90	1.87	1.98	2.05	1.88
1953	2.00	1.99	2.03	2.05	1.99
1954[E]	2.08	2.08	2.09	2.09	2.08

E Estimate.
N.A.—Not available.

Sources: 2, 69, 70.

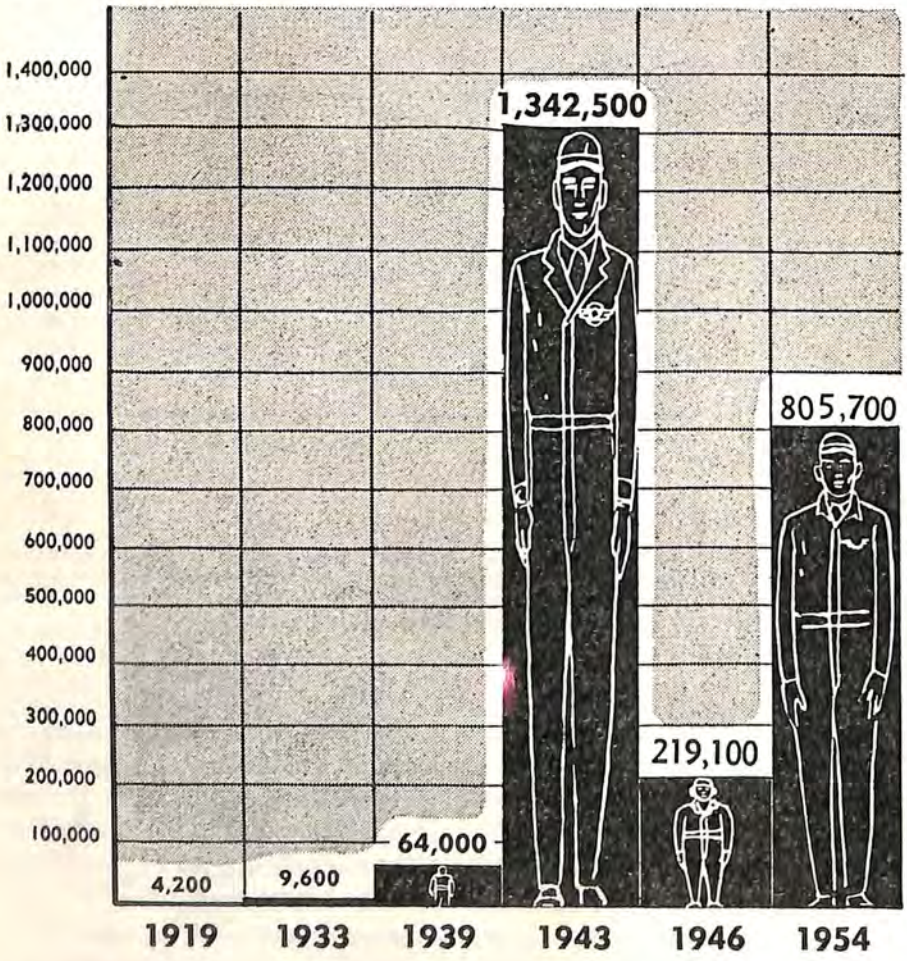
Average hourly earnings of aircraft industry employees have gone up despite the continuous reduction, since 1951, of overtime and overtime premiums. The average hourly rate, excluding overtime premiums in 1954, was about 2 cents lower for the entire industry than the earnings shown here.

By 1950, the uneasy peace between the free world and the Communist Bloc was becoming more restive. Eruption of war in Korea in June, 1950, resulted in a sharp acceleration in preparedness efforts. The Defense Department rapidly increased orders for military aircraft. And, to meet these high demands, the aircraft industry was called upon for the second time in a decade to enter upon a vast manpower program.

Generally speaking, the aircraft industry experienced no severe shortages of production line skills during the Korean buildup—except in a very few areas which had comparatively tight labor situations prior to the war (for example, San Diego, Wichita and Hartford).

The greatest manpower shortages which existed in June, 1950, and which have grown continually more critical since, are in the highly skilled lines: engineers, scientists, technicians and craftsmen. Today, one in 11 aircraft employees is in engineering. The proportion of engineers needed in the aircraft industry grows, as the need for research accelerates and increasingly complex aircraft require greater numbers of engineering man hours.

EMPLOYMENT IN THE AIRCRAFT INDUSTRY



The aircraft industry in 1954 was the largest employer of the nation. While employment in the past has fluctuated greatly, current military planning indicate stability for the future.

LABOR TURNOVER IN THE AIRCRAFT AND PARTS INDUSTRY, 1950 TO DATE
(Rates per 100 Employees per Year)

Date	Total		Aircraft (Airframes)		Aircraft Engines and Parts		Aircraft Propellers and Parts		Other Aircraft Parts and Equipment	
	Accessions	Separations	Accessions	Separations	Accessions	Separations	Accessions	Separations	Accessions	Separations
1950	62.8	33.8	67.2	37.1	48.2	21.3	32.0	17.6	59.6	27.6
1951	94.8	50.0	97.5	52.4	86.9	39.6	52.7	27.6	89.6	44.5
1952	63.1	45.9	64.1	49.0	60.1	40.8	49.1	25.1	65.3	41.3
1953	47.5	42.7	47.2	42.7	47.4	43.2	33.2	28.3	52.7	47.8
1954[E]	27.2	31.5	28.4	29.2	22.0	35.9	13.2	39.9	32.9	38.2

E Estimate.

Sources: 2, 69, 70.

Aircraft industry hiring (Accessions) and Separations have been dropping generally and steadily since 1951, indicating the return to a more normal employment situation. In 1954, for the first time since Korea, separations were greater than accessions. About half of these separations are "quits."

In 1949, 47,000 engineers were graduated from the nation's engineering schools. Since 1950, there has been a steady decline in the numbers of technical graduates from U.S. schools. In June, 1954, the colleges and universities of the United States graduated less than 25,000 engineers and scientists.

In 1954, the average worker in the aircraft industry worked 40.9 hours per week, and his weekly earnings were $85.02—about $3.00 per week more than his 1952 wage. In most cases, rate of pay is based upon a job classification analysis which sets a rate-range for each of the thousands of different jobs existing in the industry. Employees can advance within the rate-ranges through merit or length of service, or both.

Most aircraft industry employees receive a paid vacation and other fringe benefits, such as seven or eight paid holidays per year, insurance, hospitalization benefits and pension plans.

Most of the aircraft industry is organized by labor. Most workers are affiliated with the International Association of Machinists (which entered the aircraft industry in 1934) or the United Automobile Workers (which received a charter covering aircraft workers in 1937).

WOMEN EMPLOYEES IN THE AIRCRAFT INDUSTRY, 1942 TO DATE

Date	Number (thousands)	Percent
Jan. 1942	23.1	5.0
Nov. 1943	486.1	36.7
Oct. 1947	28.5	11.8
Sept. 1949	33.3	12.5
Sept. 1950	36.2	12.4
Sept. 1951	88.6	17.7
Sept. 1952	117.9	18.0
Sept. 1953	133.4	17.6
June 1954	136.7	17.0

Sources: 21, 69, 70, 71.

One out of six aircraft industry employees is a woman. The greatest influx of women occurred during the Second World War when 40 per cent of all airframe employees were women. The Korean War brought another, though less dramatic, increase.

WORK-INJURY RATES FOR THE AIRCRAFT AND ALL MANUFACTURING INDUSTRIES 1939 TO DATE

Year	Aircraft Industry		Aircraft Parts Industry		All Manufacturing	
	Injury-Frequency Rates[a]	Severity Rates[a]	Injury-Frequency Rates[a]	Severity Rates[a]	Injury-Frequency Rates[a]	Severity Rates[a]
1939	12.9	1.9	[b]	[b]	14.9	1.4
1940	15.8	1.3	[b]	[b]	15.3	1.6
1941	10.4	1.4	[b]	[b]	18.1	1.7
1942	11.4	0.7	9.5	0.9	19.9	1.5
1943	9.7	0.7	11.7	0.8	20.0	1.4
1944	8.8	0.6	10.1	0.6	18.4	1.4
1945	9.4	1.2	10.6	1.7	18.6	1.6
1946	5.2	0.8	13.7	2.1	19.9	1.6
1947	4.8	0.7	11.1	0.6	18.8	1.4
1948	4.9	0.8	10.2	0.8	17.2	1.5
1949	4.3	1.0	9.2	1.0	14.5	1.4
1950	4.0	0.9	5.9	0.6	14.7	1.2
1951	4.5	0.6	7.1	0.9	15.5	1.3
1952	3.7	0.3	6.7	0.4	14.3	1.3
1953	3.8	0.6	6.3	0.5	13.4	1.2
1954	2.9	N.A.	5.4	N.A.	11.5	N.A.

N.A.—Not available.

[a] The injury frequency rate is the average number of disabling work injuries for each million employee-hours worked.
The severity rate is the average number of days lost as a result of disabling work injuries for each 1,000 employee-hours worked. The computations of days lost include standard time charges for fatalities and permanent disabilities.

[b] Included with "Aircraft."

Sources: 68, 74.

The aircraft industry is one of the safest industries in which to work. Continual employee education in safety habits has brought the industry far below the (all industry) average.

GEOGRAPHICAL DISTRIBUTION OF EMPLOYMENT IN THE AIRCRAFT AND PARTS INDUSTRY, 1939 TO DATE
(In Percent of Totals)

Date	TOTAL	East Coast	Central	West Coast
1939	100.0	54.5	4.5	41.0
Nov. 1943	100.0	30.8	43.5	25.7
June 1950	100.0	32.0	28.8	39.2
Feb. 1953	100.0	29.3	40.1	30.6
June 1954	100.0	31.0	34.4	34.6

Sources: 20, 34, 66

Aircraft industry employment, presently, is almost evenly distributed between East Coast, West Coast, and Central Regions. During past national emergencies Central Region employment has tended to grow more rapidly than that on the Coasts.

WORK STOPPAGES IN THE AIRCRAFT AND PARTS INDUSTRY
1927–1953

Year	Number of Strikes	Number of Workers Involved	Man-Days Idle in Year
1927–1933	4	1,153	18,965
1934	4	3,207	111,048
1935	1	1,700	6,800
1936	—	—	—
1937	6	9,390	90,964
1938	N.A.	N.A.	N.A.
1939	2	1,263	85,419
1940	3	6,270	36,402
1941	29	28,422	112,549
1942	15	6,584	12,416
1943	60	52,481	130,112
1944	103	189,801	386,371
1945	85	150,200	581,000
1946	15	21,300	557,000
1947	10	3,520	67,900
1948	8	21,400	1,100,000
1949	10	10,300	451,000
1950	18	23,900	145,000
1951	29	48,800	765,000
1952	44	81,000	927,000
1953	31	57,800	1,350,000

N.A.—Not available.
Source: 67.

The year 1953 was the most serious to the aircraft industry in loss of man-days through strikes. While the average workers involved lost more than 23 days, the entire industry lost about 2½ days per production worker.

AIRCRAFT AND TOTAL MANUFACTURING EMPLOYMENT, 1914 TO DATE

Year or Month	Aircraft Employment (in thousands)	Total Manufacturing Employment (in thousands)	Aircraft as Percent of Total Manufacturing
1914	.2	7,514	[a]
1919	4.2	9,837	[a]
1921	2.0	7,557	[a]
1929	18.6	9,660	.2
1933	9.6	6,558	.2
1939	64.0	9,527	.7
Dec. 1941	423.0	13,817	3.1
Nov. 1943	1,342.5	17,858	7.5
Aug. 1945	351.4	15,343	2.2
Including subcontractors			
Dec. 1941	567.0	13,817	4.1
Nov. 1943	2,101.6	17,858	11.8
Aug. 1945	519.9	15,343	3.4
1948	237.7	15,321	1.6
1950	281.8	14,967	1.9
1953	790.3	17,259	4.6
Dec. 1954	791.4	16,095	4.9

[a] Less than .05 percent.

Sources: 19, 20, 34, 69, 70.

One out of every 20 employees in manufacturing works in the aircraft industry. Post World War II employment in the industry reached its peak early in 1954 and has remained almost stable, somewhat below 800,000, since August 1954.

CENSUS FIGURES ON SALARIES AND WAGES IN THE AIRCRAFT INDUSTRY
1914 TO DATE
(Thousands of Dollars)

Year	TOTAL	Salaries	Wages of Production Workers	Average Weekly Earnings
1914	$ 196	$ 61	$ 135	$15.45
1919	6,908	2,001	4,907	26.63
1921	3,235	1,033	2,202	30.36
1923	6,160	1,638	4,522	29.97
1925	N.A.	N.A.	4,222	30.06
1927	9,146	2,289	6,857	29.82
1929	31,448	9,524	21,924	28.66
1931	N.A.	N.A.	15,481	30.16
1933	13,824	3,516	10,308	25.36
1935	21,475	6,582	14,893	25.16

(Continued top next page)

CENSUS FIGURES ON SALARIES AND WAGES IN THE AIRCRAFT INDUSTRY
1914 TO DATE
(Thousands of Dollars)

Year	TOTAL	Salaries	Wages of Production Workers	Average Weekly Earnings
1937	46,867	13,514	33,353	26.72
1937[a]	N.A.	N.A.	43,827	27.74
1939	108,286	30,798	77,488	30.56
1947	703,693	227,396	476,297	56.33
1949	956,189	311,821	644,368	62.98
1950	1,132,017	371,773	760,244	69.12
1951	2,102,913	642,821	1,460,092	77.42
1952	3,140,534	1,003,510	2,137,024	81.05
1953	3,941,133	1,301,286	2,639,847	84.50
1954	4,150,000[E]	1,500,000[E]	2,650,000[E]	N.A.

N.A.—Not available.
E Estimate.
[a] This line and all following lines include data for aircraft engine manufacturers which are not available for prior years.

Sources: 2, 19, 20, 22.

From less than $200,000 in 1914, the aircraft industry payroll has grown to the country's largest, exceeding four billion dollars in 1954—or $200,000 every 25 minutes. Almost two thirds goes for wages, more than one third for salaries.

PRODUCTION WORKERS IN THE AIRCRAFT AND PARTS INDUSTRY
1939 TO DATE
(Thousands of Production Workers)

Monthly Average for the Year	TOTAL	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	49.2	34.5	9.5	N.A.	N.A.
1940	117.0	78.4	26.6	N.A.	N.A.
1941	275.9	181.9	65.2	N.A.	N.A.
1942	669.0	429.5	168.8	N.A.	N.A.
1943	1,080.4	685.0	279.8	N.A.	N.A.
1944	1,006.9	609.8	291.4	N.A.	N.A.
1945	585.0	356.7	165.5	N.A.	N.A.
1946	159.5	111.8	34.1	N.A.	N.A.
1947	175.1	116.1	36.6	5.1	17.2

(Continued top next page)

PRODUCTION WORKERS IN THE AIRCRAFT AND PARTS INDUSTRY
1939 TO DATE
(Thousands of Production Workers)

Monthly Averagefor the Year	TOTAL	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1948	173.6	116.1	35.0	5.1	17.3
1949	194.7	130.8	38.6	5.5	19.8
1950	206.4	138.9	40.0	5.5	22.1
1951	341.9	232.3	63.7	7.6	38.3
1952	483.5	311.6	98.8	10.4	62.7
1953	576.8	347.8	126.5	13.2	89.3
1954[E]	571.1	350.5	114.2	11.8	94.5

E Estimate.
N.A.—Not available.
Sources: 2, 69, 70.

In the aircraft industry only 71 out of every 100 employees are production workers, i.e., engaged in fabricating, processing, assembling and other services closely associated with production. The 29 other workers are: engineers, scientists, clerical workers, etc.

AVERAGE WEEKLY HOURS IN AIRCRAFT AND PARTS PLANTS
1939 TO DATE

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	N.A.	N.A.	44.6	N.A.	N.A.
1940	N.A.	N.A.	46.6	N.A.	N.A
1941	N.A.	N.A.	47.6	N.A.	N.A.
1942	N.A.	N.A.	49.7	N.A.	N.A.
1943	N.A.	N.A.	48.6	N.A.	N.A
1944	N.A.	N.A.	47.7	N.A.	N.A.
1945	N.A.	N.A.	43.2	N.A.	N.A.
1946	N.A.	N.A.	41.6	N.A.	N.A.
1947	39.9	39.7	39.9	41.5	40.1
1948	41.0	41.1	40.9	39.7	41.0
1949	40.6	40.5	40.7	41.0	40.0
1950	41.6	41.4	42.1	42.4	41.7
1951	43.8	43.3	45.4	46.2	43.7
1952	43.0	42.6	43.9	45.0	43.2
1953	41.9	41.3	43.0	41.9	42.8
1954[E]	40.9	40.9	40.8	39.4	41.2

E Estimate.
N.A.—Not available.
Sources: 2, 69, 70.

EMPLOYMENT IN THE AIRCRAFT AND PARTS INDUSTRY, 1939 TO DATE
(Thousands of Employees)

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	63.2	45.1	11.3	N.A.	N.A.
1940	148.6	101.8	31.4	N.A.	N.A.
1941	347.1	234.6	75.3	N.A.	N.A.
1942	831.7	549.6	192.0	N.A.	N.A.
1943	1,345.6	882.1	314.9	N.A.	N.A.
1944	1,296.6	815.5	339.7	N.A.	N.A.
1945	788.1	489.9	210.9	N.A.	N.A.
1946	237.3	159.0	49.9	N.A.	N.A.
1947	239.3	158.5	50.1	7.8	23.0
1948	237.7	158.0	48.6	7.7	23.3
1949	264.1	175.3	53.5	8.2	27.0
1950	281.8	188.4	55.8	8.3	29.3
1951	463.6	313.3	90.8	10.8	48.8
1952	641.6	413.9	134.7	14.0	79.1
1953	790.3	479.1	177.3	18.0	115.9
1954[E]	805.7	497.1	166.8	16.6	125.2

E Estimate.
N.A.—Not available.
Sources: 2, 69, 70.

Of every 100 aircraft industry employees, 62 work in airframe plants, 21 in engine plants, and 2 in propeller plants. The rest work in plants producing aircraft parts and equipment. World War II and the Korean emergency created a substantial demand for overtime work of aircraft industry employees. Between 1946 and 1950, and since early 1954, weekly hours have been close to the normal 40 hours per week.

FINANCE

The aircraft manufacturing industry, in financial parlance, is a "contracting industry" and is capitalized accordingly. This requires that the capitalization of companies (1) provide the credit stability and financial strength needed to support a high volume of sales and, yet (2) avoid the costly burden of over-capitalization during the prolonged periods of low volume.

Furthermore, as is the case with other contracting industries, the most economical and efficient method of financing production is for the customer (whether a commercial airline or the U.S. Government) to provide some of the financing needed for performance of the contract. If such were not the practice, and if contracting industries were capitalized to handle their infrequent peak volume, it would be necessary during years of low volume for the price of the end product to include the carrying costs of excess capitalization.

During World War II the customer provided financing in the form of "advances" or contract deposits. During the Korean buildup, customer financing was provided primarily on a "pay-as-you-go" basis of progress payments.

Data contained in the tables in this chapter cover financial activities of the 12 major airframe manufacturers, based upon sales volume for each of the years 1937 through 1954.

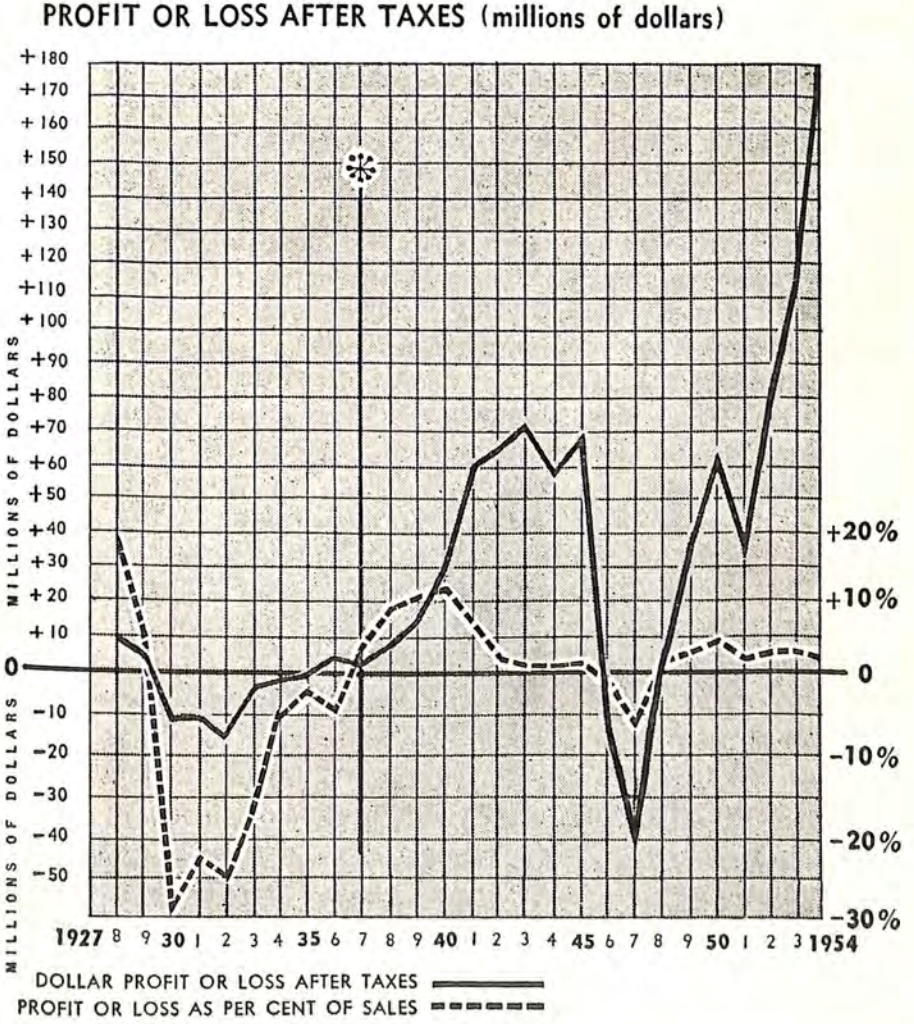
Effect of Emergency Production Expansion on Financial Condition

The degree to which a suddenly expanded military production program affects the financial condition of the industry is shown by the following changes in the financial status of the 12 major airframe companies during the period 1950-1954.

	(in Millions of Dollars)	
	1950	*1954*
Net Worth	$ 380.0	$ 641.5
Working Capital	287.7	442.1
Inventory Net	208.3	592.1
Receivables	227.4	461.9
Plant	82.8	186.4
Sales Volume	1,388.2	4,926.8
Working Capital Turnover (Times)	4.8	11.1

Between 1950 and 1954, the total net worth of the 12 companies was increased by $261.5 millions, most of which represented reinvested earnings. A major portion of this increased capitalization went into needed production facilities—both brick and mortar, as well as machine tools and equipment.

Working capital in the same period increased $154.4 millions. With this expansion of working capital, these companies were able to finance a $618.3 million increase in accounts receivable and inventory. To accom-



*Prior to 1937 all corporations producing aircraft; 1937 to date, twelve major airframe manufacturers.

plish this financing, working capital turnover was increased from 4.8 times per year to 11.1 times per year.

Because of the nature of the aviation product with its inevitably high unit cost and 16 to 30 month manufacturing cycle, working capital turnover of this magnitude requires careful and close control—both of the amount of the working capital and the manner in which it is used. Under these conditions, the length of time between receipt of cash and its disbursement is extremely short and any disturbance in the flow of incoming cash inevitably has a serious effect upon an individual company's—or an industry's—entire operations.

Control of Accounts Receivable and Inventories

Control of the manner in which working capital is used requires that constant effort be exerted to keep the amount of funds tied up in accounts receivable and inventories at an absolute minimum and thus to retain in the form of cash sufficient amounts to meet vastly expanded payrolls and to keep on a current basis with mercantile creditors. As an example of the effects of such control, the $227.4 million in accounts receivable at the end of 1950 represented an average collection period of 60 days, based upon a sales volume of $1,388.2 million; by 1954, the average collection period for accounts receivable had been reduced to 34 days.

Inventory figures shown in this chapter are net, after deducting progress payments received from the customer during performance of the contracts. The turnover of total gross inventory (not shown in the accompanying tables) was 3.3 times in 1950 at the start of the production buildup, and had slowed to 2.4 times in 1954. In the overall program, however, this inventory turnover has improved considerably. For the year 1955 as the production program continues to level out and deliveries in volume are made to the military services. The inventory picture will improve even more.

Aircraft Industry Earnings

The earnings of the aircraft industry are subject to a number of profit control measures, including renegotiation, price redetermination clauses, and various types of cost disallowances. During 1954, the average aircraft industry rate of profit to sales of 3.8 per cent was less than the average rate of profit on sales earned by all manufacturers. This comparatively low rate of earnings is not unusual (See Page 31, covering the years 1950 to date). The average earnings for the 12 major

airframe manufacturers from 1950 to 1954 inclusive was 3.1 per cent on sales. During the same period all manufacturing industries reported a return of 6.1 percent.

COMPOSITION OF CURRENT ASSETS, 1937–1954, 12 MAJOR AIRFRAME COMPANIES
(In Percent of Total)

Year	Total	Cash and Securities	Inventories	Receivables	Miscellaneous
1937	100.0	17.6	35.2	46.6	.6
1938	100.0	35.1	33.8	30.3	.8
1939	100.0	37.9	48.9	13.1	.1
1940	100.0	46.4	35.7	12.2	5.7
1941	100.0	23.2	52.3	24.4	.1
1942	100.0	25.1	33.8	40.9	.2
1943	100.0	27.6	25.5	45.9	1.0
1944	100.0	26.7	22.7	49.1	1.5
1945	100.0	34.1	13.7	48.9	3.3
1946	100.0	32.9	43.8	23.2	.1
1947	100.0	18.6	54.9	25.6	.9
1948	100.0	23.9	40.1	35.3	.7
1949	100.0	26.8	41.6	30.5	1.1
1950	100.0	23.3	36.2	39.6	.9
1951	100.0	18.4	40.8	39.4	1.4
1952	100.0	17.8	42.4	38.3	1.5
1953	100.0	19.0	41.6	37.5	1.9
1954	100.0	23.1	42.6	33.3	1.0

Sources: 5, 6.

NET PROFIT AS PERCENT OF SALES,
Seven Selected Industries,
1950 TO DATE
(After Taxes)

Industry	1950	1951	1952	1953	1954
Nonferrous Metals	9.8	8.8	7.7	6.9	7.3
Petroleum Products	10.8	11.5	10.5	10.6	10.7
Autos and Trucks	8.9	5.2	5.5	4.4	6.4
Railway Equipment	5.5	4.8	3.8	3.3	4.1
Iron and Steel	8.1	5.8	5.0	5.7	6.0
AIRCRAFT AND PARTS	4.5	2.2	2.4	2.4	3.8
Total Manufacturing	7.7	6.2	5.4	5.3	5.9

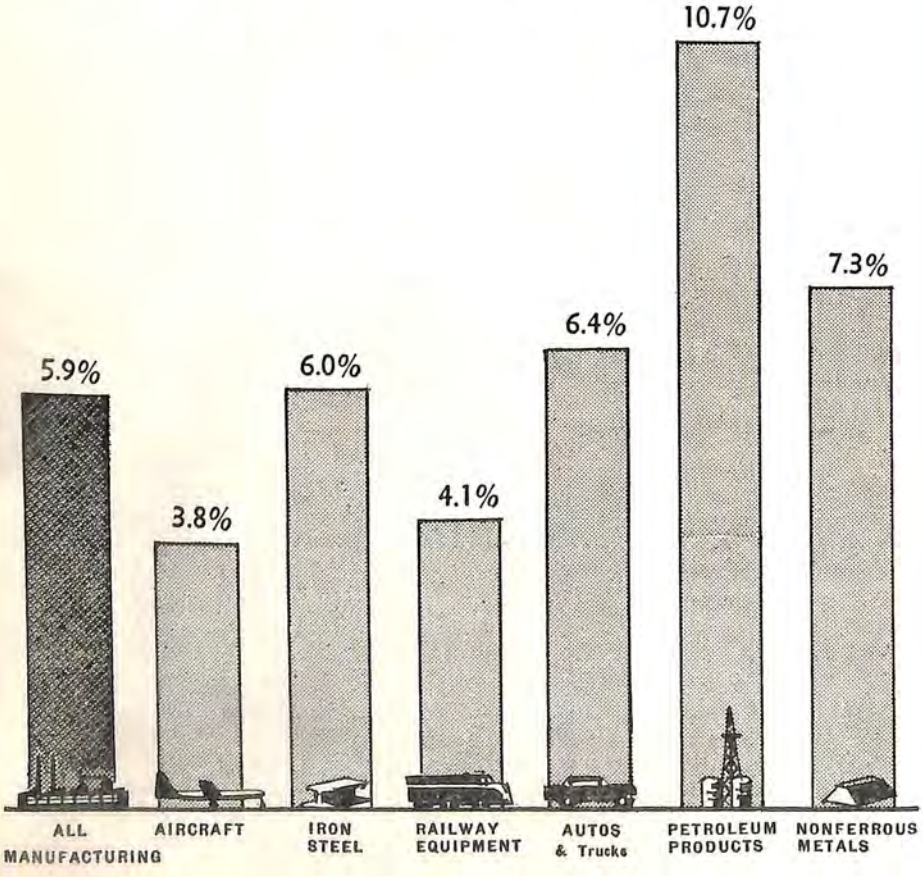
Source: 51.

BACKLOG OF ORDERS REPORTED BY MANUFACTURERS OF COMPLETE AIRCRAFT, ENGINES AND PROPELLERS, 1948 TO DATE
(Millions of Dollars)

December 31	Total	Aircraft and Parts	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Products and Services
1948	$3,104	$2,094	$ 786	$103	$121
1949	3,010	2,013	749	91	157
1950	5,039	3,102	1,470	145	322
1951	12,665	8,126	3,531	241	767
1952	17,653	11,222	5,172	298	961
1953	16,753	11,604	4,080	218	851
1954	14,769	10,625	2,910	190	1,044

Source: 25.

NET PROFIT AS PERCENT OF SALES 1954



GROSS SALES AND NET PROFITS OF CORPORATIONS PRODUCING AIRCRAFT AND PARTS[a], 1928–1936
(Dollar Figures in Millions)

Year	Total Number of Corporations	Total Gross Sales	Total Net Profit or Loss before Federal Taxes	Total Net Profit or Loss after Federal Taxes
1928	145	$ 59.6	$ 11.1	$ 9.5
1929	194	90.8	4.9	3.4
1930	157	74.8	(14.1)	(14.7)
1931	132	47.6	(13.2)	(13.3)
1932	102	29.1	(9.0)	(19.0)
1933	95	24.3	(5.1)	(5.1)
1934	112	51.3	(3.0)	(3.2)
1935	117	50.0	(1.4)	(1.8)
1936	123	85.8	4.9	3.9

Figures in parentheses indicate loss.
[a] Including engines.
Source: 90.

INCOME ACCOUNTS, 12 MAJOR AIRFRAME COMPANIES, 1937–1954
(Millions of Dollars)

Year	Net Sales	Total Income	Total Federal Taxes, net	Net Profit
1937	$ 61.8	$ 3.6	$ 1.3	$ 2.3
1938	88.5	10.1	2.1	8.0
1939	141.0	19.1	4.5	14.6
1940	247.4	45.1	13.3	31.8
1941	812.6	168.7	108.6	60.1
1942	2,788.9	341.8	281.2	60.6
1943	5,209.0	429.8	357.0	72.8
1944	5,766.3	322.1	263.5	58.6
1945	3,965.3	215.1	147.7	67.4
1946	519.0	(37.0)	26.3[cr]	(10.7)
1947	545.0	(115.4)	73.5[cr]	(41.9)
1948	843.4	24.2	21.8	2.4
1949	1,131.7	57.8	21.7	36.1
1950	1,388.2	111.1	48.5	62.6
1951	1,979.3	98.9	68.0	30.9
1952	3,731.1	220.5	138.8	81.7
1953	5,120.1	317.1	200.5	116.6
1954	4,926.8	371.0	188.4	182.6

[cr] Credit.
Figures in parentheses indicate loss.
Sources: 5, 6.

NET FEDERAL TAXES AS PERCENT OF TOTAL INCOME, 12 MAJOR AIRFRAME COMPANIES, 1937 TO DATE

Year	Percent
1937	26.5
1938	21.9
1939	19.8
1940	26.9
1941	59.5
1942	72.6
1943	72.0
1944	71.7
1945	57.5
1946	Not applicable
1947	Not applicable
1948	82.3
1949	37.5
1950	43.7
1951	68.6
1952	62.9
1953	63.2
1954	50.8

Sources: 5, 6.

NET PROFIT AS PERCENT OF SALES, 12 MAJOR AIRFRAME COMPANIES 1937 TO DATE

Year	Percent
1937	3.7
1938	9.1
1939	10.3
1940	12.9
1941	7.4
1942	2.2
1943	1.4
1944	1.0
1945	1.7
1946	(2.1)
1947	(7.7)
1948	0.3
1949	3.2
1950	4.5
1951	1.6
1952	2.2
1953	2.3
1954	3.7

Figures in parentheses indicate loss.

Sources: 5, 6.

BALANCE SHEET COMPARISONS, 12 MAJOR AIRFRAME COMPANIES
1949 TO DATE
(Thousands of Dollars)

	1949	1950	1951	1952	1953	1954
Assets						
Current assets:						
Cash	$109,365	$106,560	$ 159,676	$ 216,470	$ 261,932	$ 295,365
Securities	39,778	27,206	8,484	5,613	5,478	26,437
Receivables	165,877	227,443	360,165	479,506	526,400	461,910
Inventories	161,181	208,304	373,429	531,020	583,923	592,056
Miscellaneous	6,153	5,020	13,102	18,569	27,467	12,934
Total current assets	$477,354	$574,533	$ 914,856	$1,251,178	$1,405,200	$1,388,702
Total net plant	69,333	82,844	124,457	154,010	166,077	186,406
Investments	6,257	6,567	9,264	9,531	9,208	6,278
Development, etc., expenses	201	—	—	1,780	2,202	—
Deferred charges	4,557	4,745	13,271	11,932	13,644	19,731
Miscellaneous	12,478	12,743				
Total assets	$570,180	$681,432	$1,061,848	$1,428,431	$1,596,331	$1,601,117
Liabilities						
Current liabilities:						
Payables	$ 68,415	$121,124	$ 369,910	$ 541,006	$ 544,162	$ 396,217
Accruals—taxes—renegotiation—refunds due U. S.	88,916	113,860	209,048	297,102	406,906	409,039
Advances—contracts deposits	53,764	39,999	48,087	91,550	92,540	121,403
Reserve	6,904	6,206	4,923	3,618	3,458	8,851
Miscellaneous	3,827	5,624	8,474	9,577	8,347	11,112
Total current liabilities	$221,826	$286,813	$ 640,442	$ 942,853	$1,055,413	$ 946,622
Bank loans, etc.	10,511	12,722	27,782	30,763	8,648	8,589
Contingency reserve	1,150	—	—	500	—	—
Capital stock	57,414	61,939	66,164	94,831	95,460	125,706
Capital (paid) surplus	59,914	62,561	61,371	68,927	77,181	100,331
Earned surplus	215,408	255,516	260,828	283,366	353,885	415,443
Miscellaneous	3,957	1,881	5,261	7,191	5,744	4,426
Total liabilities	$570,180	$681,432	$1,061,848	$1,428,431	$1,596,331	$1,601,117
Net current assets	$255,528	$287,720	$ 274,414	$ 308,325	$ 349,787	$ 442,080

Source: 5.

MILITARY AVIATION

In 1945, despite hard learned lessons of two world wars, the sinews of United States air power withered. The aircraft industry was all but demobilized, its work forces dissipated, and even the machinery of research and development all but halted.

In 1946, Army and Navy combined were taking delivery of only 139 warplanes of all types per month. The industry suffered great financial loss as it tried to readjust too suddenly to a peacetime economy. It struggled to maintain the huge production facilities left in its charge.

With the demobilization of its men under arms virtually complete, the government turned to the Army Air Forces for the job of policing its far flung outposts—only to learn that this service *did not have even one operational group ready to defend the United States.* With that blunt truth the machinery of government began to move.

In 1947, the National Security Act gave air power equal status with military surface forces—naval and land forces. On September 18, of that year the United States Air Force was established.

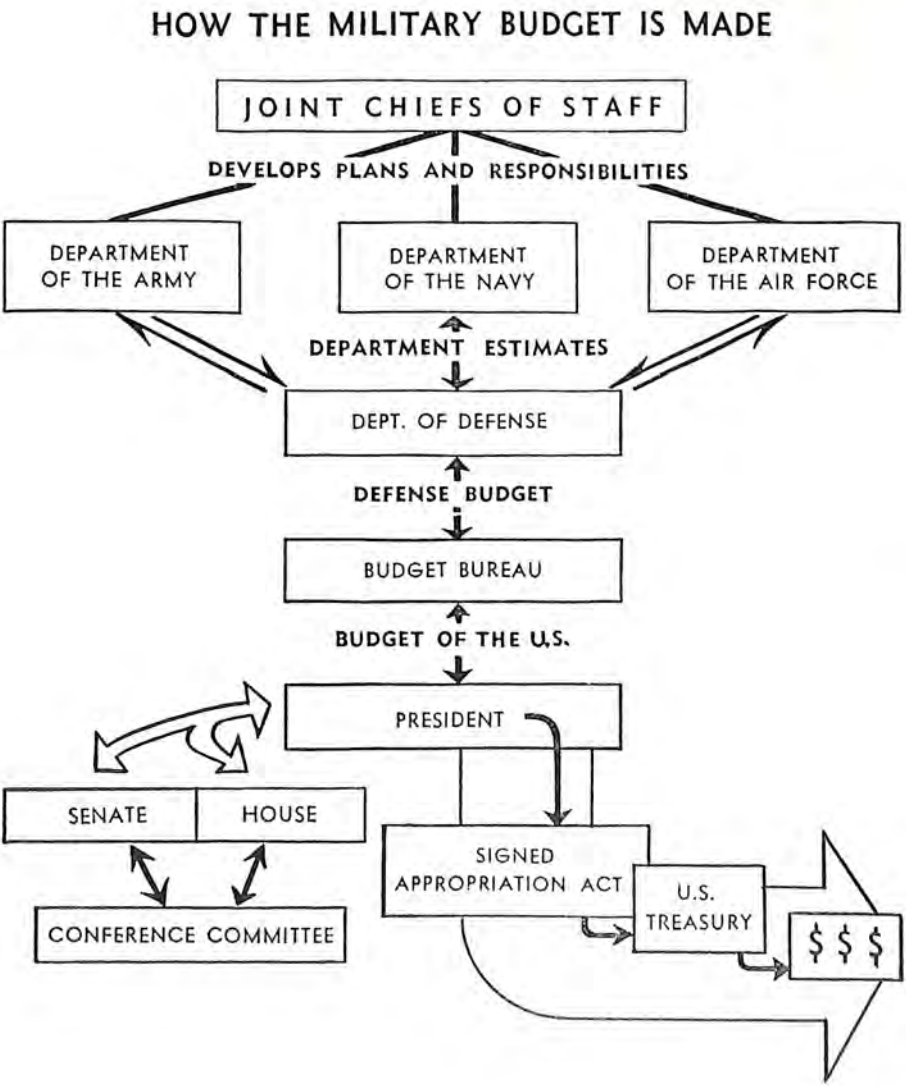
In that year, too, two separate groups were named to study and assist in revising old policies and in framing new ones, and serve as a guide for formulating a carefully considered national air policy. These groups were: The President's Air Policy Commission—composed of outstanding private citizens; and, the Congressional Aviation Policy Board—comprised of members of both houses of the United States Congress.

Both groups dealt at length with related problems that had long plagued the diverse elements in aviation. Aircraft production for the government has always been a stop-and-go proposition. The President's Air Policy Commission pointed out that a series of five-year procurement programs could save up to 20 per cent or 25 per cent in production costs, and recommended such a series. The Congressional Board concurred. Both groups called for the development and construction of early-warning radar networks, a satisfactory airport program, and better naviga-

tional and weather reporting facilities. Together, these reports alerted the public to the abyss into which military aviation had fallen.

Air Power Funds Appropriated, Impounded

In the spring of 1948, the Supplemental National Defense Appropriation Act of 1948 was passed, providing funds to step up aircraft procurement, research, development and operations. The industry received new orders, designed to raise the nation's military air strength, but

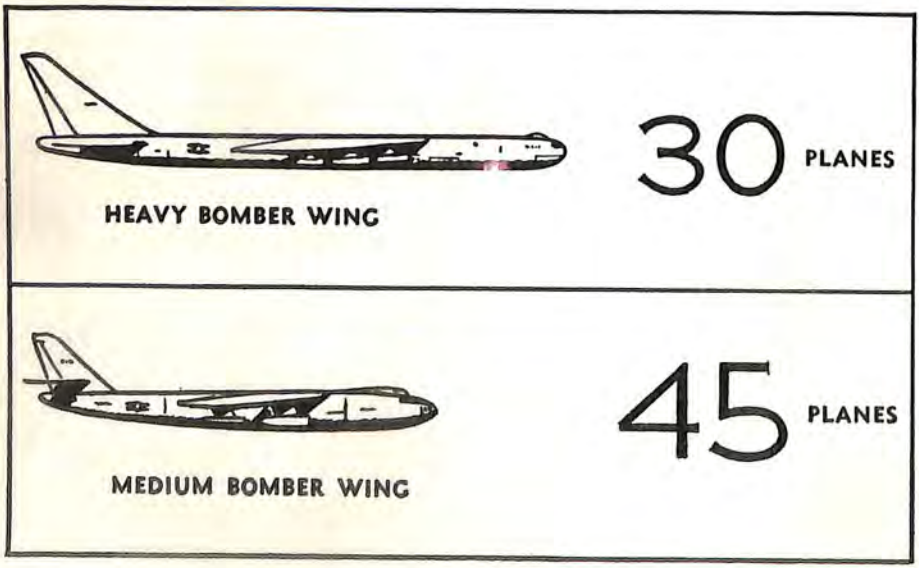


as 1948 rounded into 1949 a sizable proportion of the funds was impounded by Executive action—and many contracts were cancelled.

The Limited Mobilization

The great debate over air power was resolved less by agreement on principles than by the exigency of war—the North Korean attack across the 38th Parallel. As the buildup got underway under the lash of war in Korea, the military forces and the aircraft industry faced a multitude of problems that had not existed a decade earlier. The developments that grew out of World War II, and reached maturity in the years just after it, had to do with atomic energy, jet and rocket propulsion, guided missiles and electronics. As continuing advances were made in solving these new aeronautical problems, it became apparent that air arms capable of stopping attacks and delivering A- and H-bombs to the heart of the enemy must be maintained in America so long as the threat of war exists.

During 1956, the initial equipping of the 137-wing Air Force will be practically completed and thereafter production will level off at the rate needed to sustain and keep modern this force and its naval air equivalent. To sustain a 137-wing force of modern planes—aircraft far more complicated and expensive than pre-Korea models will require an annual investment in new aircraft comparable to the *entire* Air Force budget of 1950.



LIGHT BOMBER WING

48 PLANES

DAYFIGHTER WING

75 PLANES

ALL WEATHER FIGHTER WING

75 PLANES

100 TO 137 AIRCRAFT

LARGE AIRCRAFT CARRIER (CVA)

80 TO 90 AIRCRAFT

ESSEX CLASS CARRIER (CVA)

The complement of planes aboard aircraft carriers vary with plane size and military mission. Obviously more fighters than bombers may be accommodated. Essex Class (33,000 ton) is "medium" in size. Midway Class (55,000 ton) is "large". Forrestal Class (60,000 ton) is "super" in size. Initials "CV" designate aircraft carrier. "A" designates "attack" for mission. There are other types.

Budgeting for Military Air Power

The determination of the size of each fiscal year's appropriations, and of the manner in which these funds will be spent, is a time-consuming and complicated process.

The roles, missions and responsibilities of the military services result from studies of the Joint Chiefs of Staff, following which the individual services determine the number of planes, airfields, personnel and other equipment required to accomplish these objectives.

With requirements determined, an estimate of financial cost is assigned to each of the force levels—and the development of these dollar amounts results in the detailed defense budget.

Months of military hearings, within the Services and the Department of Defense, follow—during which the budget is explained, defended, cut, adjusted, and changed. It is then presented by the President of the United States to the Congress.

At this point, additional hearings begin in Congress before Subcommittees and Committees; Conference Committees compromise differences between House and Senate. Finally, an Appropriations Bill is passed by the Congress. The amount finally appropriated frequently differs substantially from the amounts originally requested by the Services. In

AIRCRAFT ACCEPTED BY THE USAF AND NAVY
1946–1953

Calendar Year	USAF		Navy[a]	
	Number of Aircraft	Airframe Weight, Excluding Spares (Thousands of Pounds)	Number of Aircraft	Airframe Weight, Excluding Spares (Thousands of Pounds)
1946	650[b]	7,799[b]	759	4,908
1947	1,197[b]	5,586[b]	920	5,855
1948	1,055	15,821	1,149	8,485
1949	1,475	23,149	815	6,455
1950	1,670	26,803	985	9,138
1951	4,148[b]	40,000[b]	1,373	11,659
1952	6,973[b]	88,000[b]	2,311	19,422
1953	8,204[b]	109,908[b]	2,426	28,488

[a] Includes USAF acceptances for Navy, excludes Navy acceptances for USAF and Army.
[b] Includes USAF acceptances for other agencies. The duplication in acceptances accounts partly fo the difference between this table and the table on page 9.

Sources: 8, 54, 82.

AIRCRAFT ON HAND
1939 TO DATE

Year	U. S. Air Force				Navy Total[b]
	Total[a]	Tactical	Trainers	Transport & Other	
1939	2,546	1,647	761	138	2,098
1940	3,961	1,760	2,069	132	2,166
1941	12,297	4,477	7,340	480	5,233
1942	33,304	11,607	17,607	4,653	11,772
1943	64,232	27,448	26,051	10,733	25,588
1944	72,726	41,961	17,060	13,705	36,100
1945	44,782	26,077	7,617	11,088	29,714
1946	30,035	17,186	6,297	6,552	19,301
1947	23,814	13,118	5,714	4,982	14,976
1948	20,068	8,888	6,177	5,003	14,894
1949	17,222	7,863	5,811	3,548	14,015
1950	17,337	7,854	5,961	3,522	13,412
1951	19,021	8,135	6,556	4,330	13,213
1952	N.A.	N.A.	N.A.	N.A.	13,694
1953	N.A.	N.A.	N.A.	N.A.	13,308
1954	N.A.	N.A.	N.A.	N.A.	13,285
1955	N.A.	N.A.	N.A.	N.A.	13,191[E]

N.A.—Not available.
E Estimate.
[a] As of December 31.
[b] As of June 30 from 1935-1939; as of December 31 from 1940 to 1952; as of June 30 from 1953-1955.
Sources: 4, 8, 12, 82, 83.

The present objective for an active aircraft inventory, in combat and supporting units of the Air Force, Navy, and Marine air forces is close to 40,000. Actual strength was 34,000 on June 30, 1954, and will be 36,000 on June 30, 1956.

such cases, the Services must then re-program to operate within the limitations set by available funds.

With long lead-time items such as military aircraft, it is normal for expenditures to follow obligations by two or three years.

Organizations of Wings, Air Groups

Air Force: The basic organizational unit of the United States Air Force is the "wing". A wing is comprised of a combat group and necessary administrative and service units. The number of airplanes in a wing depends on its mission; for example, a group of heavy bombers has 30 planes, a medium bomber group has 45, a light bomber group 48, a day fighter group 75, an all-weather fighter group 36-75—depending

upon type of plane and operational mission. The USAF also operates separate squadrons for rescue, support and in-flight refueling. Aircraft comprising these squadrons vary from 8 to 25 planes depending upon type of plane and squadron mission.

Navy and Marines: Navy carrier air groups usually are composed of four fighter and one attack squadrons, and another unit is comprised of night fighters, minelaying aircraft, helicopters and other aircraft. Aircraft carriers (CV) have a complement of from 80 to 137 aircraft depending upon the size of the carrier and the type and size of plane carried. Super aircraft carriers of the *Forrestal* Class (60,000 tons) have 117 to 137 aircraft. Large *Midway* Class (55,000 tons) carriers have from 100 to 137 aircraft while medium size carriers of the *Essex* Class (33,000 tons) have a complement of 80-90 aircraft. Anti-submarine squadrons attached to light and escort carriers average about 23 aircraft and shore-based patrol squadrons have nine planes each. Marine fighter squadrons are assigned 24 aircraft.

Army: The United States Army currently has approximately 4,000 light liaison and utility airplanes and helicopters for support of its ground units. That number includes some 600 aircraft which are assigned to National Guard activities. During the next two years Army aviation complement will see about a 20 per cent increase in numbers of helipcopters. During the current fiscal year 1955 Army will obligate approximately $200 millions for aircraft.

WARPLANE PROGRESS SINCE THE SECOND WORLD WAR
1945 AND 1955

	1945	1955
Fighter.	P–51	F-100
Speed	470 mph	Supersonic. 755.149 mph*
Range	Over 2,000 miles	Over 1,000 miles
Fire power	Six 50-cal. guns in wings. Can carry ten 5-inch HVAR with zero launchers or two 1,000-lb. bombs.	20 mm cannons
Bomber.	B–17	B-47
Speed	285 mph	600 mph class
Range	2,500 miles	Over 3,000 miles
Fire power	Twelve 50-cal. machine guns	20 mm cannons in tail
Bomb load	12,800 pounds	Over 20,000 pounds

* Salton Sea, Calif., Oct. 29, 1953.

Sources: 11, 46.

Maintaining American air supremacy, in peace and in war, is the principal means of assuring the national security. The United States aircraft industry in continual research effort strives unceasingly to improve performance aspects of its products. These are: speed, range, rate of climb, cargo capacity, ceiling, maneuverability. This table shows the progress of two types of planes in the short span of ten years.

TOTAL FEDERAL EXPENDITURES AND EXPENDITURES FOR MILITARY AIRCRAFT AND RELATED PROCUREMENT
1922 TO DATE
(Dollar Figures in Millions)

Fiscal Year	Total Federal Expenditures	Total Military Expenditures:	Expenditures for Aircraft	Percent Aircraft of Total Federal	Percent Aircraft of Military
1922	$ 3,373	$ 935	$ 6	.2	.6
1923	3,295	730	7	.2	1.0
1924	3,049	689	10	.3	1.5
1925	3,063	717	10	.3	1.4
1926	3,098	677	12	.4	1.8
1927	2,974	688	14	.5	2.0
1928	3,103	732	22	.7	3.0
1929	3,299	791	29	.9	3.7
1930	3,440	839	31	.9	3.7
1931	3,652	832	31	.8	3.7
1932	4,535	834	29	.6	3.5
1933	4,623	784	25	.5	3.2
1934	6,694	706	13	.2	1.8
1935	6,521	924	23	.4	2.5
1936	8,493	1,147	44	.5	3.8
1937	7,756	1,185	58	.7	4.9
1938	6,938	1,240	67	1.0	5.4
1939	8,966	1,368	68	.8	5.0
1940	9,183	1,799	205	2.2	11.4
1941	13,387	6,252	587	4.4	9.4
1942	34,187	22,905	2,915	8.5	12.7
1943	79,622	63,414	10,072	12.6	15.9
1944	95,315	75,976	12,828	13.5	16.9
1945	98,703	80,537	11,521	11.7	14.3
1946	60,703	43,151	1,649	2.7	3.8
1947	39,289	14,769	593	1.5	4.0
1948	33,791	11,983	703	2.1	5.9
1949	40,057	13,988	1,248	3.1	8.9
1950	40,156	13,440	1,705	4.2	12.7
1951	44,633	20,821	2,536	5.7	12.2
1952	66,145	38,967	5,712	8.6	14.7
1953	73,982	47,565	8,605	11.6	18.1
1954	67,772	40,336	9,247	13.6	22.9
1955[E]	63,504	34,375	8,300	13.1	24.1

E Estimate.

Sources: 8, 29, 30, 49, 82.

More than one dollar out of every eight spent by the Federal Government is spent for airplanes. Nearly one quarter of the entire defense expenditures is made for the same purpose; this is the highest ratio ever reached and illustrates the increasing importance of air power to the national security.

APPROPRIATIONS AND EXPENDITURES FOR MILITARY AVIATION
1899 TO DATE
(Millions of Dollars)

Fiscal Year	U. S. Air Force		Naval Aviation	
	Total Cash Appropriations	Expenditures	Total Cash Appropriations	Expenditures
1899	$ .05	N.A.	$ —	N.A.
1909	.03	N.A.	—	N.A.
1912	.12	N.A.	.03	N.A.
1913	.10	N.A.	.01	N.A.
1914	.17	N.A.	.01	N.A.
1915	.20	N.A.	.01	N.A.
1916	.80	N.A.	1.0	N.A.
1917	18.7	N.A.	3.8	N.A.
1918	735.0	N.A.	61.5	N.A.
1919	952.3	N.A.	220.4	N.A.
1920	28.1	N.A.	25.7	N.A.
1921	35.1	$ 30.9	20.0	N.A.
1922	25.6	23.1	19.1	$ 14.3
1923	13.1	18.1	14.8	14.2
1924	12.6	11.0	14.7	14.3
1925	13.5	11.7	15.7	15.5
1926	15.9	14.9	18.2	18.1
1927	15.3	16.8	22.4	22.0
1928	21.1	19.4	20.3	19.8
1929	28.9	23.3	32.3	32.1
1930	34.9	28.1	31.6	31.1
1931	38.9	38.7	32.1	31.0
1932	31.9	33.0	31.2	31.7
1933	25.7	22.1	25.4	31.2
1934	31.0	17.6	29.8	15.5
1935	27.9	20.5	32.1	17.2
1936	45.6	32.2	40.8	20.5
1937	59.6	41.3	38.9	27.5
1938	58.9	51.1	51.6	59.8
1939	71.1	83.4	48.2	47.9
1940	186.6	108.5	111.8	50.8
1941	2,173.6	605.9	453.0	193.6
1942	23,049.9	2,555.2	6,190.0	993.1
1943	11,317.4	9,392.4	5,258.0	3,966.4

(*Continued top next page*)

This table shows all the funds made available and spent by the Air Force for aircraft, maintenance and operation, personnel, research, etc., and by the Navy for aircraft, and maintenance and operations of aircraft and facilities.

APPROPRIATIONS AND EXPENDITURES FOR MILITARY AVIATION 1899 TO DATE—*Continued*
(Millions of Dollars)

Fiscal Year	U. S. Air Force		Naval Aviation	
	Total Cash Appropriations	Expenditures	Total Cash Appropriations	Expenditures
1944	23,656.0	13,087.7	4,583.7	4,490.1
1945	1,610.7	11,357.4	2,539.6	5,166.0
1946	.5	2,519.4	795.0	1,065.7
1947	1,200.0	854.3	770.8	749.1
1948	608.1 [a] 829.8	1,199.1	906.0	747.9
1949	939.8	1,830.7	588.3	875.1
1950	4,139.4	3,669.1	1,041.5	989.4
1951	15,791.1	6,549.4	3,815.3	1,237.3
1952	22,979.0	12,594.9	5,266.5	2,205.2
1953	22,081.7	15,267.8	4,873.0	3,061.3
1954	11,410.5	15,539.6	2,322.0	3,235.0
1955[E]	11,564.8	15,284.0	2,755.0	2,625.0

N.A.—Not available.
E Estimate.
[a] FY 1949 Construction of Aircraft & Related Procurement appropriation enacted in FY 1948.

Sources: 4, 8, 49, 82.

"Appropriations" are Congressional authorizations to incur obligations, and "expenditures" are the amounts of liability incurred for materials received. Actual payments are called disbursements.

NAVAL AVIATION PERSONNEL[a], 1941 TO DATE

Year as of June 30	TOTAL	Pilots	Enlisted Aviation Rates	Aviation Ground Officers
1941	23,148	6,300	14,848	2,000
1944[b]	299,968	47,276	228,356	24,336
1950	91,298	12,978	76,349	1,971
1951	162,214	18,287	139,838	4,089
1952	194,730	20,944	168,486	5,300
1953	196,813[c]	22,903	163,673	4,930
1954	179,783[c]	21,316	147,670	4,725
1955[d]	165,243[c]	21,352	133,424	4,885

[a] Navy and Marine.
[b] Pilots as of Aug. 31; others as of October 31.
[c] Includes non-pilots in flying status and formerly designated pilots.
[d] As of January 1.
Sources: 84, 95.

PERSONNEL IN THE UNITED STATES AIR FORCE, 1912 TO DATE

As of June 30	TOTAL	Officers	Aviation Cadets	Airmen
1912[a]	51	12	—	39
1914	122	18	—	104
1916	311	63	—	248
1918[b]	195,023	20,708	—	174,315
1920	9,050	969	—	8,081
1922	9,642	958	113	8,571
1924	10,547	884	119	9,544
1926	9,674	954	142	8,578
1928	10,549	1,055	280	9,214
1930	13,531	1,499	378	11,654
1932	15,028	1,659	325	13,044
1934	15,861	1,545	318	13,998
1936	17,233	1,593	328	15,312
1938	21,089	2,179	342	18,568
1940	51,165	3,361	1,894	45,910
1941	152,125	10,611	8,627	132,887
1942	764,415	55,956	50,213	658,246
1943	2,197,114	205,874	99,672	1,891,568
1944	2,372,292	333,401	82,647	1,956,244
1945	2,282,259	381,454	16,764	1,884,041
1946	455,515	81,733	7	373,775
1947	305,827	42,745	53	263,029
1948	387,730	48,957	1,338	337,435
1949	419,347	57,851	1,860	359,636
1950	411,277	57,006	2,186	352,085
1951	788,381	107,099	2,476	678,806
1952	978,000	131,000	9,000	838,000
1953	973,000	128,000	7,000	838,000
1954	947,918	129,752	9,072	809,094

[a] As of November 1.
[b] As of November 11.
Sources: 8, 9.

The average number of all military personnel in the fiscal year 1955 will be about 3.2 million. Almost two out of every five military personnel are in the Air Force or Naval Aviation.

GUIDED MISSILES

The use of guided missiles as weapons of war and aids to commerce is not new. The Chinese, inventors of gunpowder, used rockets, and with some success, as weapons of war against the Tartars in the 13th century. The rocket has been used for signal purposes for hundreds of years, in war and in peace.

In the years between World Wars I and II, considerable advance was made, both in the United States and in Europe, in the field of rocketry and guided missiles. But the true value in the development of the unmanned aeronautical product was lost in our haste to develop man-carrying aircraft.

Although "unmanned vehicles" were flown in this country as early as 1918, serious U.S. military emphasis has been focused on their potential use as weapons only since 1945, when in January, the Guided Missiles Committee of the Joint Committee on New Weapons and Equipment of the Joint Chiefs of Staff was established.

During World War II the significance of pilotless aircraft began to be a vital factor in the international Order of Battle. Both sides developed free-flight rockets in the air-to-surface, air-to-air, surface-to-air, and surface-to-surface categories. Similarly, both began application of "guidance systems" to bomb-like and plane-like devices.

Late in World War II, the Nazi-developed hypersonic V-2, with its powerful liquid fuel and oxidant motor, came close to being the decisive weapon that Hitler expected it to be. It rates as one of the greatest technological achievements of the World War II period.

World War II ended with an ominously firm conviction, on the part of nations, that guided missiles would play a most important role in any future conflict. United States research and development into this "new" field during the first few years following World War II was erratic. For one thing, it was beset by the same financial starvation as all other aircraft industry research, development and production. Then, too, it called for research into hitherto largely unknown fields.

The last eight years, in retrospect however, have seen great strides in guided missiles research and development—and in the last two years, of

production. Currently, defense expenditures in research and development activities related to guided missiles have been equalled in magnitude only by research and development of piloted aircraft.

In the fiscal year 1954, the Defense Department obligated $269,853,375 for research and development of aircraft and $231,394,133 for research and development of guided missiles. In the same fiscal year the Defense Department obligated $503,545,000 for procurement of guided missiles and during fiscal 1955 will obligate an estimated $518,445,000 for this procurement.

The guided missile, regardless of its employment, is an aerial weapon. Responsibility for its development, then, logically has been a charge of the aircraft industry.

Because complete coordination of contributions from greatly diverse fields of technical knowledge was, and is, necessary in the successful design and development of a guided missile, contract for the *complete system* has nearly always been called for by the cognizant military service. It is here that the "weapons system concept" in aircraft research, development and production probably found its actual beginning.

The guided missile, operationally, is a weapon of great flexibility. Many require little or no especially prepared launching aprons and may be fired from almost any vantage points the using agency could select—on land, at sea, or in the air.

There are five categories of military operations into which the guided missile fits, whether the service is Army, Navy, or Air Force: Air De-

EXPENDITURES FOR THE PROCUREMENT OF GUIDED MISSILES
(Million Dollars)

Fiscal Year June 30	TOTAL DEFENSE DEPARTMENT	Air Force	Navy	Army
1951	$ 21.0	$ 15.5	$ 5.1	$ .4
1952	168.9	66.4	56.1	46.4
1953	295.0	81.1	94.8	119.1
1954	503.5	175.9	141.1	186.6
1955[E]	518.4	258.5	144.9	115.0

E Estimate.

Sources: 41, 42.

The Air Force has taken the lead in procurement of guided missiles. In 1955, it will spend more money on guided missiles than the Army and Navy together. However, Army procurement is expected to approach Air Force levels again in 1956.

FUNDS AVAILABLE FOR THE PROCUREMENT OF GUIDED MISSILES
DECEMBER 31, 1954
(Million Dollars)

	Unexpended Balance	Unpaid Obligations	Unobligated Balance
TOTAL — DEFENSE DEPARTMENT	$1,840	$1,097	$811.5
Air Force	802	282	520.2
Navy	436	301	135.0
Army	602	514	156.3

Sources: 40.

Because of the very rapid growth of the aircraft industry-military missiles program much of the money made available in current and past years has not yet been obligated for specific contracts or, if obligated, is yet unpaid because the contracts are not completed.

fense, Combat Air Support, Land Combat, Sea Combat, and Strategic Offense.

As a team, the aircraft industry, science and government, despite making great strides in the myriad fields of guided missile research, have only scratched the surface of this aeronautical frontier. There are an imposing number of problems, many only partially solved and a great deal more still only theory. Nearly every field of human technical knowledge enters into the research and development and operational applications of the weapon — aerodynamics, thermodynamics, power plants, fuels, combustion, ceramics, meteorology, ballistics, electronics, nuclear physics, servos and control equipment, launching methods, guidance systems, and thousands of others.

Guidance Systems

The guided missile is, in light of other expendable weapons, very expensive. Measured in terms of "hits," the cost factor is largely academic. In terms of a "miss" it represents substantial loss. Probably the most expensive item in the fabrication of the weapon is its guidance system. Considering the fact that the value of the weapon, in final analysis, can only be measured in terms of its accuracy, guidance systems have become the object of most of the intensive research.

Guidance methods, under development and in operational use, are of two general categories—electronic and non-electronic. The non-elec-

tronic systems are, of course, far less susceptible to enemy intercept countermeasures. This type of guidance system falls into two general categories—celestial and inertial. Guidance systems of this type generally make use of several gyroscopes. As with the simple gyroscopes that may be purchased in any toy store, in physical operation, a guid-

PLANNED OBLIGATIONS FOR RESEARCH AND DEVELOPMENT ON GUIDED MISSILES AND ON AIRCRAFT—DEPARTMENT OF DEFENSE
(Million Dollars)

Fiscal Year	Guided Missiles	Aircraft and Related Equipment
1954	$231.4	$269.8
1955[E]	254.1	263.0
1956[E]	242.4	281.2

E Estimate.

Source: 49.

In the five fiscal years, 1951 through 1955, approximately 1.6 billion dollars have been provided for research and development of guided missiles systems. Such funds now almost equal research and development funds for aircraft.

ance system gyroscope maintains a constant orientation on its axis in three-dimensional space. This factor in guidance provides a reference system for guidance, and is the basis of the "inertial" system.

The system of devices enabling guidance to be controlled by automatic star tracking, eliminates any interference from surface countermeasures and is called "celestial."

The most obvious type of electronic guidance is "radar homing" on an enemy target. There are three primary types of this system. "Active" homing is accomplished by the missile's radar antennae which continually indicates the target. "Semi active" homing is accomplished by a surface or airborne radar separate from the missile and transmitting guidance instructions. "Passive homing" is accomplished by letting the missile home on any pre-selected electrical device that the enemy target may be operating.

Another type of guidance is the "command" system. This is a system involving both radar and radio. In one type, ground radars are pointed at the missile and at the target. A computer receives electrical information from the radars and transmits guidance to the missile. In another, the computer is built into the missile and radio contact between ground and missile is eliminated.

Power Plants

Of extreme importance to the guided missile is the ability to preclude interception. In addition to the need for the missile's guidance system being capable of ignoring enemy countermeasures, speed is one of the surest ways to elude enemy interception.

While guided missile power plants today are of two general types—those requiring atmosphere in which to operate and those which do not—both are actually "rocket-like" in propulsive power. Both develop their forward drive from fuel, oxygen and ignition. The reaction of the expanding gasses as they escape through the rear of the engine provides the thrust power.

Guided missile engines used in today's operational weapons are generally satisfactory in relation to the overall state of guided missile art. However, one of the greatest problems confronting industry is efficient fuel utilization. The missile engine, whether it be jet or rocket, consumes tremendous quantities of fuel. As a result much research effort is placed in the development of new fuels and in the refinement of present fuels.

So far, the two principle types of engines—jet and rocket—are about equal in power plant application. Each have unique advantages not found in the other. The day will undoubtedly come when atomic energy will provide the motive power for either un-manned or manned ballistic

DEFENSE DEPARTMENT EXPENDITURES FOR THE PROCUREMENT OF GUIDED MISSILES AND AIRCRAFT
(Million Dollars)

Fiscal Year	Guided Missiles	Aircraft
1951	$ 21.0	$2,412.5[M]
1952	168.9	4,888.4[M]
1953	295.0	7,416.5[M]
1954	503.5	8,937.0
1955[E]	518.4	7,557.0[M]

E Estimate.
M Military Functions only; 1954 total includes Military Functions and Mutual Defense Assistant Programs.

Sources: 40, 41, 42.

Expenditures for the procurement of guided missiles (apart from research and development) have been growing at a rapid rate. In five years they grew 25-fold while aircraft expenditures grew only 3-fold.

or winged guided missiles, earth satellites and interplanetary space ships.

Virtually the entire aircraft industry is engaged in the development and production of guided missiles. And today these prime contractors are engaged in at least 27 separate and distinct projects for the military services.

U. S. MISSILES
(Excluding Target Drones)

Missile	Manufacturer	Service
A. *Surface-to-Air*		
Loki	Bendix	Army
Redstone	Chrysler	Army
Bomarc	Boeing	USAF
MX-1868	Oerlikon	USAF
Nike	Western Electric	Army
Talos	Bendix	Navy
Terrier	Convair	Navy
Matador III	Martin	USAF
Hawk	Raytheon	Army
B. *Surface-to-Surface*		
Lacrosse	Cornell Aero Lab	Army
Atlas	Convair	USAF
Honest John	Douglas	Army
Navajo	North American	USAF
Corporal	Firestone	Army
Matador I & II	Martin	USAF
Regulus	Chance Vought	Navy
Snark	Northrop	USAF
C. *Air-to-Underwater*		
Petrel	Fairchild	Navy
Dove	Eastman Kodak	Navy
D. *Air-to-Air*		
Sparrow	Sperry Douglas Raytheon	Navy
Falcon	Hughes	USAF
Sidewinder	Philco	Navy
E. *Air-to-Surface*		
Gorgon	Fairchild	Navy
Rascal	Bell	USAF
Bullpup	Martin	Navy

Sources: 1, 11, 14.

Most data on missiles are classified. The list of Manufacturers and Missiles has been prepared on the basis of published information only.

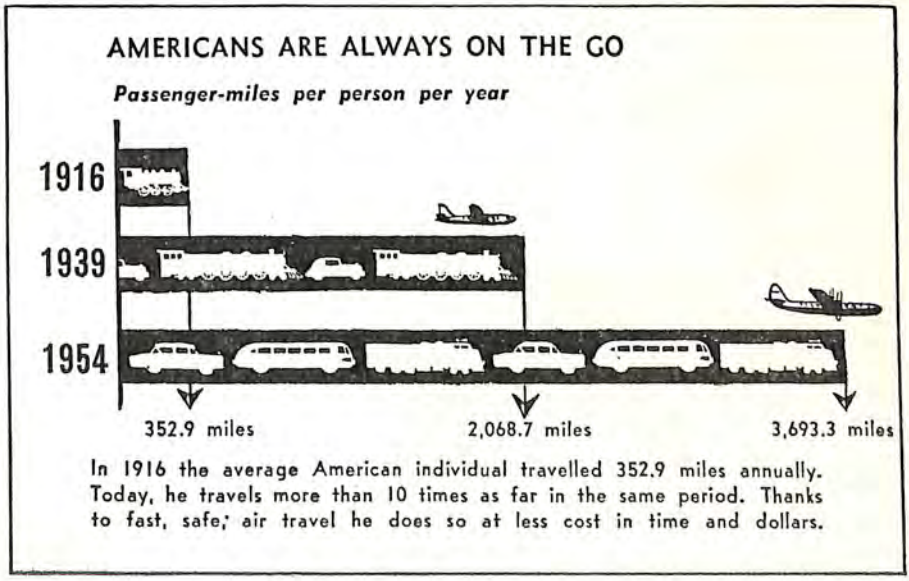
AIRLINES AND TRANSPORTATION

The United States airlines, on scheduled domestic and international routes, during 1954, flew a total of 34,131,000 passengers 20,411,884,000 passenger miles.

The airlines, in addition to establishing this all-time record of passengers carried, also proved that they are one of the safest means of transportation in the world. Between January 1954 and December 31, of that year they suffered only 16 passenger fatalities. This is the equivalent of flying 1.3 billion passenger miles for each passenger fatality.

The railroads, on the other hand, although they traveled considerably more passenger miles (29,270,000,000)—particularly with very short haul commuter travel—suffered 21 passenger fatalities, and recorded a .07 fatality rate per 100 million passenger miles against the airlines .08 fatality rate per 100 million passenger miles.

In 1954, the domestic scheduled airlines flew 16,700,000,000 pas-



In 1916 the average American individual travelled 352.9 miles annually. Today, he travels more than 10 times as far in the same period. Thanks to fast, safe, air travel he does so at less cost in time and dollars.

senger miles, while comparable railroad pullman travel amounted to only 7,300,000,000 passenger miles. In that same year, more than 60 per cent of all persons entering or departing from the United States traveled by airlines. United States international airlines carried 1,714,618 passengers and ocean voyaging steamships carried 1,112,117 passengers.

Already, the domestic airlines carry more passenger-miles of revenue traffic than the railroads comparable "pullman car." They also surpass railroad passenger traffic by "coach" (except commutation).

Speed and Cost

Wagon transport on the Philadelphia-Lancaster Turnpike (which was finished in 1794) moved at a snail's pace and at a cost of 13.5 cents per

AIR VS. RAILROAD PASSENGER TRAVEL
1937 TO DATE
(Passenger-Miles in Billions)

Year	Domestic Air Carriers			Railroads (excluding Commutation)			Air as Percent of Railroad
	TOTAL	Scheduled	Irregular	TOTAL	Pullman	Coach	
1937	.4	.4	—	21.6	9.2	12.4	1.9
1938	.5	.5	—	18.5	8.3	10.2	2.7
1939	.7	.7	—	19.6	8.5	11.1	3.6
1940	1.1	1.1	—	20.7	8.2	12.5	5.3
1941	1.4	1.4	—	26.2	10.1	16.1	5.3
1942	1.4	1.4	—	50.0	19.1	30.9	2.8
1943	1.6	1.6	—	83.8	25.9	57.9	1.9
1944	2.2	2.2	—	91.7	28.3	63.4	2.4
1945	3.4	3.4	—	86.7	27.3	59.4	3.9
1946	6.0	5.9	N.A.	59.7	20.7	39.0	10.1
1947	6.3	6.1	N.A.	41.2	13.5	27.7	15.3
1948	6.3	6.0	N.A.	36.5	12.2	24.3	17.3
1949	7.4	6.8	.6	30.8	10.5	20.3	24.0
1950	8.8	8.0	.8	26.6	9.2	17.4	33.1
1951	11.7	10.6	1.1	29.4	9.9	19.5	39.8
1952	13.8	12.5	1.3	29.1	9.3	19.8	47.4
1953	16.1	14.8	1.3	27.2	8.2	19.0	59.2
1954	17.8[E]	16.7	1.1[E]	25.0	7.3	17.7	70.4

E Estimate.
N.A.—Not available.
Sources: 2, 32, 38, 61.

Despite the heavy, very short-haul railroad commuter travel, U.S. airlines are rapidly approaching and nearly equal the passenger traffic volume of the railroads. In long- and medium-distance travel the airlines already carry most of the passengers. On shorter trips—below 250 miles—the railroads still carry the bulk of all passengers.

EMPLOYMENT, WAGES, AND AVERAGE ANNUAL EARNINGS IN THE TRANSPORTATION INDUSTRY, 1953

	ALL INDUSTRY	ALL TRANSPORTATION	Air Transportation (Common Carrier)	Railroads	Highway Transportation	Water, Pipeline, and Other Transportation
Full-Time Equivalent Employees (Thousands)	55,151	2,763	110	1,358	955	340
Wages and Salaries (Million Dollars)	$197,980	$12,270	$537	$5,985	$4,105	$1,645
Average Annual Earnings per Full Time Employee	$3,590	$4,441	$4,864	$4,407	$4,298	$4,838

Source: 18.

U.S. airlines have the smallest employment but the highest earnings per employee in the transportation system. The figures shown do not include government and industry employees and independent operators who build and maintain highways, operate service stations, maintain airways, etc.

ton-mile. Today, with a much cheaper dollar, railroad freight moves for about one and one-half cents per ton-mile and travels a few hundred miles per day, while air freight *crosses the continent* in less than a day's time for about *20 cents per ton-mile.*

A passenger who took the stagecoach from Pittsburgh to Philadelphia in 1812 had to spend six days on the road and paid 27 dollars for the trip. In 1834 he could cover the distance by rail, canal and stagecoach in less than four days for about $15. Today, when the dollar is worth much less, the fastest train will take him there in six hours for $11.81 by coach, or $18.25 by parlor car. If he takes a plane he can make the trip in *one hour* for $16.75.

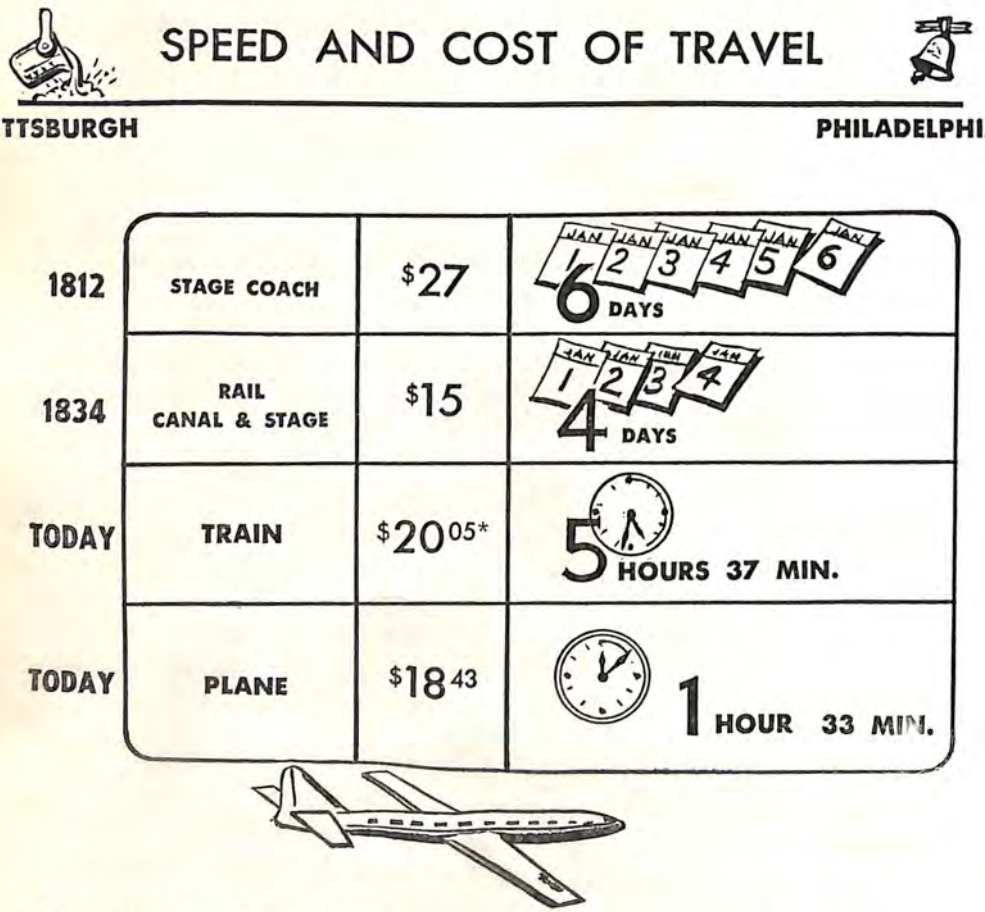
Government Experiments with All First Class Mail by Air

Since October of 1953, the scheduled airlines have been conducting an experiment for the Post Office Department which is bringing improved service to the public and at the same time reducing the Department deficit. The airlines are carrying first class mail by air on several routes —at first class postal rates—when air movement will give the fastest service.

For example, the airline run between New York and Chicago alone is realizing revenues for the Post Office Department of more than $2,000 per ton of mail flown. One ton of mail moved between the two points brings a gross revenue of $2,314.00 to the Department. Of that amount $134.66 is paid to the airlines; the balance, 94.2 per cent, is retained by the Post Office to pay for its operating ground expenses.

Military Air Travel

The Defense Department, responsible for the mass movement of personnel, is probably more conscious of efficiency and economy than any



Travel becomes faster, more convenient and, frequently, less costly. With travel over long distances, the savings in time and travel expense for food and accommodations possible through air travel become more important. Cheaper air tourist fares are available.

other "business" in the world. Prior to 1949, only two percent of the military establishment's official group movements of 15 or more individuals traveled by air. Today, more than half of all military group movements, in that quantity, are made by the airlines.

For example, in 1953, the scheduled airlines handled more than 818,000 military passengers. The fast movement of these officers and men saved the government 22,054,325 man hours, representing a manpower saving of approximately 8,797 men working 48 hours per week for an entire year. This is the equivalent to the productive time of more than one-half of an Army division. In terms of the base pay of an Army private, in productive time alone, the savings to the military would amount to $2,407,000.

The largest scheduled airline movement of military personnel to date involved over 3,000 men. Transcontinental air movements of 650 or more men are routine to the scheduled airlines.

TRANS-ATLANTIC PASSENGER TRAVEL BY AIR AND SEA, 1946 TO DATE

Year Ending June 30	By AIR (Regular Scheduled)			By SEA, PASSENGERS
	TOTAL PASSENGERS	U. S. Carriers	Other	
Westbound				
1946	46,475	43,953	2,522	112,943
1947	85,838	63,266	22,572	239,163
1948	126,138	89,780	36,358	314,714
1949	148,986	106,457	42,529	330,782
1950	161,091	106,908	54,183	427,113
1951	180,465	107,195	73,270	401,243
1952	194,914	114,659	80,255	458,427
1953	251,303	142,153	109,150	397,018
1954	309,648	177,124	132,524	419,559
Eastbound[a]				
1950	135,804	88,020	47,784	296,996
1951	137,733	82,990	54,743	262,378
1952	177,432	100,768	76,664	308,654
1953	245,718	143,928	101,790	354,494
1954	274,001	155,755	118,246	379,119

[a] Figures for eastbound passengers not available until 1950.

Source: 65.

Airlines carry more than two of every five passengers across the Atlantic and Westbound traffic remains heavier because of continued immigration. Foreign airlines are increasing their share of total passenger traffic.

Costs Rise, Fares Drop

Despite the spiraling upward costs of operation, travel fares continue to decrease. In 1937, a scheduled airline passenger traveled at 5.6 cents per passenger mile; now he can travel by air coach at 4.26 cents per passenger mile. This saving to the traveling American public has been achieved despite a 90 per cent increase in the general consumer price level since then. In addition, the vast improvement of service, comfort and safety is virtually incomparable.

AVERAGE REVENUE PER PASSENGER-MILE, 1926 TO DATE
(Cents)

Year	AIRLINES		RAILROAD		INTER-CITY BUS
	Domestic Scheduled	Domestic Non-Scheduled	Coach (Excluding Commuter)	Pullman (Total)	
1926	12.0	—	3.35	N.A.	2.96
1937	5.6	—	1.80	3.08	1.73
1947	5.1	—	2.02	3.53	1.70
1952	5.55	3.20	2.53	4.60	2.02
1953	5.45	3.20	2.53	4.68	2.06
1954	5.39	3.20[E]	2.50	4.66	2.08[E]

N.A.—Not available.
E Estimate.
Sources: 2, 4, 38, 62, 77.

Airline fares have remained almost unchanged (despite the upward spiraling U.S. cost index) for more than 20 years. Other common transportation fares during the same period have continued to rise.

AMERICA'S TRANSPORTATION NETWORK
(Thousands of Miles)

Medium of Transportation	1930	1954 (Est.)
Airways — Domestic	30	77
Railroads — Road Owned	249	222
Total Rural Roads	3,009	3,012
Surfaced	649	1,855
Federal-Aid Primary Highways	193	235
Petroleum Pipelines	89	134
Waterways and Great Lakes	28	28

Sources: 2, 13, 29, 30, 32, 39, 64.

America's people and goods travel by many different means. In the last quarter of a century, the most rapid growth has been in airways (see p. 65) and surface highways. Railroads and waterways have remained static.

ESTIMATED INTERCITY PASSENGER TRAFFIC, BY TYPE, 1916 TO DATE

Year	TOTAL	Domestic Air Carriers	Railroads[a]	Highways	Inland Waterways
Billions of Passenger-Miles					
1916	36.0	[b]	35.2	[b]	.8
1939	270.7	.7	22.7	245.9	1.5
1941	310.6	1.4	29.4	278.0	1.8
1944	233.9	2.2	95.7	134.1	1.9
1947	351.3	6.1	46.0	297.4	1.8
1951	449.1	11.6	35.3	400.8	1.4
1954	590.8	17.8	29.4	542.2	1.4
Percent					
1916	100.0	[b]	97.8	[b]	2.2
1939	100.0	.3	8.4	90.8	.5
1941	100.0	.4	9.5	89.5	.6
1944	100.0	1.0	40.9	57.3	.8
1947	100.0	1.7	13.1	84.7	.5
1951	100.0	2.6	7.9	89.2	.3
1954	100.0	3.0	5.0	91.8	.2

[a] Includes commutation and electrified divisions of steam railway companies, but excludes electric railways.
[b] Negligible.
Sources: 13, 15, 29, 32, 61.

Almost the entire growth in passenger travel has been due to two modes of travel—automobiles and airlines. The growth of air traffic has been enormous. Yet, because air travel is still limited to medium and long distance travel (see average length of trip, p. 63), highways carry the bulk of passenger travel.

THE TEN LEADING PASSENGER TRANSPORT COMPANIES, 1954
(Millions of Revenue Passenger Miles[a])

Pennsylvania Railroad	3,447
American Airlines	3,372
United Air Lines	3,135
New York Central System	3,041
Eastern Air Lines	2,847
Trans World Airlines	2,611
Atchison, Topeka & Santa Fe Railway System	1,948
Union Pacific Railroad Company	1,459
Southern Pacific Company	1,342
New York, New Haven & Hartford Railroad Company	1,274

[a] Excludes commuters and multiple ride passengers.
Sources: 38, 61.

Four of the ten leading passenger carriers are U.S. airlines. In 1955, American Airlines is expected to be the largest carrier in the country. The figures exclude commuter data.

SUMMARY OF U. S. AIR TRAFFIC TRENDS, 1948 TO DATE

Year Ending June 30	TOTAL[a]	Domestic Trunk Lines	Local Service Carriers	International Carriers	Territorial and Alaska	Other Carriers
Revenue Passenger-Miles (Millions)						
1948	7,913	5,931	64	1,868	N.A.	....
1953	18,481	13,398	371	3,261	115	1,336
1954	20,326	15,128	412	3,523	118	1,145
Cargo Ton-Miles (Millions)						
1948	137	89	[b]	46	N.A.	....
1953	450	182	2	89	3	174
1954	436	190	2	97	4	143
Mail Ton-Miles (Millions)						
1948	50	36	[b]	14	N.A.	....
1953	95	69	1	23	2	....
1954	107	76	1	29	1	....

N.A.—Not available.

[a] "Total" may exceed the listed components because subtotals for "Not Available" items may be included.

[b] Less than one-half million.

Source: 37.

During the last six years the activities of the major air carriers have grown at a very rapid rate. Passenger traffic increased almost three fold, cargo-miles more than tripled, and mail ton-miles doubled.

AVERAGE PASSENGER LOADS, 1939–1953
(Passenger-Miles per Vehicle-Mile)

Year	RR Coaches	Sleeping & Parlor Cars	All RR Passenger Cars	Class I Inter-City Busses	Scheduled Domestic Airliners
1939	17.0	9.3	13.4	16.4	7.9
1944	41.0	20.3	31.9	24.9	15.2
1949	23.6	11.0	18.1	18.4	19.2
1953[E]	23.9	10.2	17.8	18.7	29.2

E Estimate.

Sources: 2, 62.

On an average trip, an airliner carries more passengers than any other vehicle—almost thirty. This compares with only ten for the average Pullman Parlor Car or Sleeper, and 24 for railroad coaches.

U. S. Scheduled Airlines—Aircraft in Service by Make and Model
1941–1954

Domestic					International				
Aircraft Make & Model	1941	1952	1953	1954	Aircraft Make & Model	1941	1952	1953	1954
Bell									
B47D	..	6	6	6					
Boeing					Boeing				
247D	27	..	..	..	307	3	..	..	..
307	5	..	..	..	314	8	..	..	..
377	..	16	16	11	377	..	28	27	27
Convair					Convair				
240	..	99	90	92	240	..	14	14	10
340	..	25	103	121					
Douglas					Douglas				
DC-3, 3S	280	381	331	299	DC-2	3	..	..	..
DC-4	..	124	126	109	DC-3	45	21	24	22
DC-6, 6B	..	161	175	185	DC-4	..	46	45	31
DC-7	..	..	10	61	DC-6, 6A, 6B	..	25	42	62
Lockheed					Lockheed				
10	16	..	..	..	10	2	..	..	..
18	13	11	11	11	18	3	..	..	..
L49	..	37	37	37	L49	..	14	9	9
649	..	5	5	3					
749	..	59	62	62					
1049	..	24	31	37					
Martin					Martin				
2-0-2	..	21	25	25	130	1	..	..	..
4-0-4	..	96	100	100					
Sikorsky					Sikorsky				
S51	..	3	3	3	S42B	4	..	..	..
S55	..	5	8	11	S43	1	..	..	..
Total	341	1078	1139	1175	Total	70	148	161	161
Single Engine	..	9	17	20					
Twin Engine	336	643	660	648	Twin Engine	54	35	38	32
Four Engine	3	426	462	507	Four Engine	16	113	123	129

Sources: 32, 35.

Five airplane and two helicopter aircraft manufacturers in the United States supply all the airline aircraft now in domestic or U.S. international service. These aircraft represent a value (after depreciation) of about 500 million dollars.

PASSENGER RATES, 1954
Yield per Passenger-mile

Type of Airline Travel	Cents
Domestic Trunk Line	
All classes	5.39
Coach	4.26
Family Plan	4.62
All other	6.00
Local Service	6.04
International	6.83
Territorial (excluding Alaska)	7.27
Large Irregulars	3.20[E]

E Estimate.

Sources: 2, 38.

The scheduled airlines now offer service at rates which vary from slightly more than 4 cents per mile for coach to about six cents per mile for first class service. Non-scheduled airlines fares vary considerably, but their average is slightly more than 3 cents per mile.

TRANSPORTATION ACCIDENT DEATH RATES
1953

Kind of Transportation	Passenger Miles (Millions)	Deaths	Death Rate per 100,000,000 Passenger Miles
Passenger Deaths in—			
passenger automobiles and taxis	820,000	23,500	2.9
busses	55,000	70	0.13
railroad passenger trains	31,690	50	0.16
scheduled air transport planes	15,340	89	0.58
All Deaths connected with the operation of			
passenger automobiles and taxis	820,000	32,700	4.0
busses	55,000	500	0.9
railroad passenger trains	31,690	1,248	3.9
scheduled air transport planes	15,340	102	0.7

Source: 79.

1954 data for scheduled U.S. airlines show that the domestic and international airlines carried 34,000,000 passengers almost 20.5 billion passenger miles. During the 12 month period there were only 16 passenger fatalities. This all-time best safety record brings the fatality rate to an all-time low of .08 per million passenger miles flown.

DOMESTIC SCHEDULED AIRLINES—PASSENGER SERVICE, 1926 TO DATE

Year	Passengers Carried[a] (Thousands)	Passenger Seat-Miles Flown (Millions)	Revenue Passenger-Miles Flown[b] (Millions)	Revenue Passenger Load Factor (Percent)	Average Passenger Revenue per Passenger-Mile (Cents)	Average Length of Trip (Miles)
1926	5.8	N.A.	1.0	N.A.	N.A.	N.A.
1927	8.7	N.A.	3.0	N.A.	N.A.	N.A.
1928	48.3	N.A.	13.0	N.A.	11.0	N.A.
1929	161.9	N.A.	41.0	N.A.	12.0	N.A.
1930	384.5	N.A.	85.1	N.A.	8.3	221
1931	472.4	N.A.	107.0	N.A.	6.7	226
1932	476.0	303.6	127.4	N.A.	6.1	268
1933	502.2	373.8	174.8	N.A.	6.1	348
1934	475.5	367.8	189.9	N.A.	5.9	399
1935	678.5	577.7	316.3	N.A.	5.7	415
1936	931.7	686.2	439.0	N.A.	5.7	421
1937	985.1	836.2	411.5	49.22	5.6	418
1938	1,197.1	951.5	479.8	50.43	5.2	401
1939	1,734.8	1,215.2	682.9	56.20	5.1	394
1940	2,802.8	1,817.1	1,052.2	57.90	5.1	375
1941	3,848.9	2,341.9	1,384.7	59.13	5.0	360
1942	3,136.8	1,963.6	1,418.0	72.22	5.3	452
1943	3,019.7	1,857.0	1,634.1	88.00	5.3	541
1944	4,046.0	2,436.8	2,178.2	89.39	5.4	538
1945	6,476.3	3,815.6	3,362.5	88.12	5.0	511
1946	12,213.4	7,556.5	5,948.0	78.71	4.6	487
1947	12,890.2	9,373.8	6,109.5	65.12	5.1	474
1948	13,168.1	10,385.1	5,981.0	57.59	5.8	454
1949	15,080.7	11,672.9	6,752.6	57.85	5.8	448
1950	17,343.7	13,064.5	8,002.8	61.28	5.6	461
1951	22,652.2	15,565.7	10,566.2	67.88	5.6	466
1952	25,019.7	19,097.1	12,528.3	67.88	5.6	501
1953	28,722.7	23,268.6	14,760.3	63.43	5.5	514
1954	31,776.0	26,716.0	16,690.0	62.49	N.A.	N.A.

N.A.—Not available.

[a] 1926-1934: Duplicated revenue and nonrevenue passengers. 1935-1941: Duplicated revenue passengers. 1942 to date: Unduplicated revenue passengers.

[b] 1926-1936: Includes nonrevenue passenger-miles.

Sources: 32, 38.

Despite the enormous increase in carrying capacity of U.S. airlines almost two out of three plane seats are filled. While this is a substantial improvement over-pre-war figures, it is below the very high percentage of seats filled during the war. Passenger seat-miles flown will increase sharply as the airlines, now actually "long-distance" carriers, begin to capture the "short-distance" commuter market. So far, this potential is largely untouched.

U. S. International Scheduled Airlines—Passenger Service 1929 to Date

Year	Passengers Carried[a] (Thousands)	Passenger Seat-Miles Flown (Millions)	Revenue Passenger-Miles Flown[b] (Millions)	Revenue Passenger Load Factor (Percent)	Average Passenger Revenue per Passenger Mile (Cents)	Average Length of Trip (Miles)
1929	11.5	N.A.	N.A.	N.A.	N.A.	N.A.
1930	33.0	N.A.	18.6	N.A.	N.A.	464
1931	59.2	N.A.	14.2	N.A.	N.A.	238
1932	71.5	N.A.	20.8	N.A.	N.A.	289
1933	74.4	N.A.	25.0	N.A.	N.A.	315
1934	96.8	N.A.	36.8	N.A.	N.A.	351
1935	111.3	N.A.	46.0	N.A.	N.A.	381
1936	87.7	N.A.	41.8	N.A.	N.A.	414
1937	112.3	N.A.	53.7	N.A.	N.A.	416
1938	N.A.	116.1	53.2	45.83	8.33	487
1939	136.1	134.4	71.8	53.46	8.57	557
1940	170.2	175.5	99.8	56.88	8.83	614
1941	235.8	248.3	162.8	65.57	8.61	713
1942	276.2	313.1	237.0	75.68	8.85	880
1943	292.9	307.5	244.2	79.42	7.92	874
1944	356.7	391.3	310.6	79.37	7.82	910
1945	493.5	583.4	448.0	76.78	8.67	942
1946	1,066.4	1,553.7	1,100.7	70.85	8.31	1,057
1947	1,359.7	2,924.3	1,810.0	61.90	7.77	1,332
1948	1,372.9	3,292.3	1,889.0	57.38	8.01	1,376
1949	1,520.1	3,624.7	2,054.0	56.67	7.72	1,351
1950	1,675.5	3,695.4	2,206.4	59.71	7.28	1,316
1951	2,041.8	4,327.7	2,599.8	60.08	7.10	1,273
1952	2,365.5	4,850.9	3,021.0	62.28	7.04	1,277
1953	2,700.4	5,472.5	3,385.6	61.87	6.87	1,254
1954	2,848.0	6,284.9	3,743.3	59.56	N.A.	N.A.

N.A.—Not available.
[a] 1929-1946: Total passengers; 1947 to date: Revenue passengers only.
[b] 1930-1937: Total passenger-miles; 1938 to date: Revenue passenger-miles.

Sources: 32, 38.

As might be expected, the average length of trip in international service is much greater than in domestic. U.S. international airlines in 1954, flew nearly 3 million passengers without a single fatality.

DOMESTIC SCHEDULED AIRLINES—OPERATORS, EQUIPMENT, AND SPEED
1926 TO DATE

As of December 31	Operators	Aircraft in Service	Average Available Seats	Route Mileage Operated	Average Speed, M.P.H.
1926	13	N.A.	N.A.	N.A.	N.A.
1927	18	N.A.	N.A.	N.A.	N.A.
1928	34	268	N.A.	N.A.	N.A.
1929	38	442	N.A.	N.A.	N.A.
1930	43	497	N.A.	30,293	N.A.
1931	39	490	N.A.	30,857	N.A.
1932	32	456	6.61	28,956	N.A.
1933	25	418	7.59	28,283	N.A.
1934	24	423	8.86	28,609	N.A.
1935	26	363	10.33	29,190	N.A.
1936	24	280	10.67	29,797	N.A.
1937	22	291	12.52	32,006	N.A.
1938	16	260	13.91	34,879	N.A.
1939	18	276	14.66	36,654	N.A.
1940	19	369	16.54	42,757	N.A.
1941	19	370	17.54	45,163	N.A.
1942	19	186	17.91	41,596	N.A.
1943	19	204	18.34	42,537	N.A.
1944	19	288	19.05	47,384	155.6
1945	20	421	19.68	48,516	155.4
1946	24	674	25.25	53,981	160.2
1947	28	810	29.93	62,215	168.2
1948	31	878	32.37	67,702	171.9
1949	37	913	35.03	72,667	179.0
1950	38	960	37.47	77,440	181.2
1951	38	981	39.55	78,913	184.6
1952	35	1,078	42.71	77,894	190.8
1953	32	1,139	46.07	78,384	197.8
1954	32	1,175	50.22	77,070	N.A.

N.A.—Not available.

Sources: 32, 38.

In 1932, the domestic airlines had only 2,000 seats available; by 1941 these had grown to 6,500, by 1946 to 24,000. Today there are 60,000. The increase in average speed makes this growth of carrying capacity even more impressive.

U. S. International Scheduled Airlines—Operators, Equipment, Speed, 1928 to Date

As of December 31	Operators	Aircraft in Service	Average Available Seats	Route Miles Operated (thousands)	Average Speed M.P.H.
1928	1	57	N.A.	N.A.	N.A.
1929	4	83	N.A.	N.A.	N.A.
1930	3	103	N.A.	19.2	N.A.
1931	3	100	N.A.	19.5	N.A.
1932	3	108	N.A.	19.6	N.A.
1933	3	86	N.A.	19.4	N.A.
1934	2	99	N.A.	22.2	N.A.
1935	2	101	N.A.	31.3	N.A.
1936	2	94	N.A.	32.0	N.A.
1937	2	92	N.A.	32.0	N.A.
1938	2	73	16.9	35.0	N.A.
1939	2	84	17.7	43.5	N.A.
1940	3	68	18.3	52.3	N.A.
1941	3	83	18.0	N.A.	N.A.
1942	3	68	17.7	N.A.	N.A.
1943	3	70	17.5	27.2	N.A.
1944	3	70	18.5	29.7	149.2
1945	4	97	18.9	38.9	150.7
1946	9	147	27.2	66.4	166.3
1947	12	154	35.2	95.5	191.1
1948	13	175	35.1	105.9	198.5
1949	13	177	36.6	109.0	207.1
1950	12	160	41.0	106.4	218.4
1951	12	140	46.4	108.8	223.5
1952	13	148	49.1	110.5	226.8
1953	14	161	52.3	111.8	229.9
1954	15	161	56.9	112.3	N.A.

N.A.—Not available.

Sources: 32, 38.

U.S. flag carriers have about 9,200 seats available. Because these lines use principally the newer, four-engine equipment, their average speed is nearly thirty miles faster than that of domestic airlines.

DOMESTIC AIRMAIL RATES, SINCE 1918

Effective Date	Rate	Note
1918, May 15....	24¢ per ounce or fraction	10¢ of this for special delivery
July 15.....	16¢ for first ounce or fraction	10¢ of this for special delivery
Dec. 15....	6¢ per ounce or fraction	
1919, July 18.....	2¢ per ounce	
1924, July 1.....	8¢ per ounce or fraction per zone	3 zones established
1925, July 1.....	10¢ per ounce or fraction	Overnight airmail New York-Chicago
1926, Jan. 19.....	10¢ per ounce for fraction up to 1,000 miles	More for greater distances
Sep. 4-11...	Special rates for special services	Varying from 8 to 32¢
1927, Feb. 1.....	10¢ per half ounce or fraction	Zoning abandoned
1928, Aug. 1.....	5¢ for first ounce or fraction	
1932, July 6.....	8¢ for first ounce or fraction	
1934, July 1.....	6¢ per ounce or fraction	
1944, Mar. 26....	8¢ per ounce or fraction	Overseas mail to servicemen 6¢ per half ounce
1946, Oct. 1.....	5¢ per ounce or fraction	
1949, Jan. 1.....	6¢ per ounce or fraction 4¢ per postal card or post card	

Sources: 63, 88.

Although airmail carried by U.S. airlines is increasing rapidly, it provides a much smaller share of airline income today than it did in the earlier days of airline operation. Even conventional first class mail now often goes by plane.

PERSONNEL, U. S. SCHEDULED AIRLINES

As of Dec. 31	Total		Domestic		International	
	All Personnel	Pilots and Copilots	Total	Pilots and Copilots	Total	Pilots and Copilots
1929	2,345	562	1,958	514	387	48
1939	15,914	1,699	10,639	1,412	5,275	287
1949	80,994	6,843	59,886	5,257	21,108	1,586
1952	104,072	8,790	79,687	7,209	24,385	1,581
1953	109,392	9,437	84,651	7,726	24,741	1,711
1954[a]	108,718	9,558	83,691	7,805	25,027	1,753

[a] As of September 30.

Sources: 32, 38.

The domestic airlines of the United States employ nearly seven pilots and co-pilots per plane, and about nine other employees for every flying officer—a total of 71 employees per plane. U.S. international airlines employ nearly 11 pilots and co-pilots per plane and 155 employees per plane.

DEVELOPMENT OF WORLD CIVIL AIR TRANSPORT—1919 TO DATE
(Scheduled Services—International and Domestic, Excluding China and USSR)
1919 TO DATE

Year	Miles Flown (millions)	Passengers Carried (millions)	Passenger-Miles (millions)	Cargo Ton-Miles (millions)	Mail Ton-Miles (millions)	Average No. of Passengers Per Aircraft	Average Miles Flown Per Passenger
1919	1	N.A.	N.A.	N.A	N.A.	N.A.	N.A.
1929	57	N.A.	132	N.A.	N.A.	2.3	N.A.
1934	101	N.A.	405	N.A.	N.A.	4.0	N.A.
1939	185	N.A.	1,262	N.A.	N.A.	6.8	N.A.
1944	257	N.A.	3,412	N.A.	N.A.	13.3	N.A.
1949	836	26.5	14,478	390	128	17.3	546
1954	1,206	57.8	32,000	716	217	26.5	554

N.A.—Not available.

Sources: 55, 59, 60.

AIRCRAFT IN SERVICE ON WORLD AIRLINES
(Members of International Air Transport Association—Dec. 31, 1953)

GRAND TOTAL	2441		100.0%
U.S.-made aircraft:		2065	84.6%
DC-3		750	
DC-4		252	
DC-6 and -7		309	
Constellation and Super Constellation		231	
Convair 240		140	
Convair 340		107	
Stratoliner and Stratocruiser		59	
Martin 4-0-4 and 2-0-2		118	
All other		99	
British-made aircraft:		273	11.6%
Viking		62	
Viscount		22	
Bristol 170		30	
DH Dragon Rapide		30	
DH Dove		33	
All other		96	
Canadian-made aircraft:	58		2.4%
Aircraft made in other countries	45		1.8%

Source: 58.

GENERAL UTILITY AVIATION

Air transportation is not confined just to the airlines. Private aircraft are playing an ever-growing role and are being extensively used in various fields of business, industry and agriculture.

Civil aviation divides generally into two segments, more popularly called Airline and General or Utility Aviation.

The airlines utilize the larger multi-engine aircraft along with helicopters and a few single engined aircraft for specialized local service activities in carrier aviation. General aviation utilizes all types, but principally light transports, some helicopters, and large numbers of single engined aircraft.

There are four principal types of utility aircraft:

1. One- to two-place, having a gross weight of 1,500 pounds or less. Powered with 65 to 150 horsepower engines, they have speeds from 70 to 125 miles an hour. In this group are found the sort of aircraft most often used for instruction, for light agricultural use, and for sport flying.

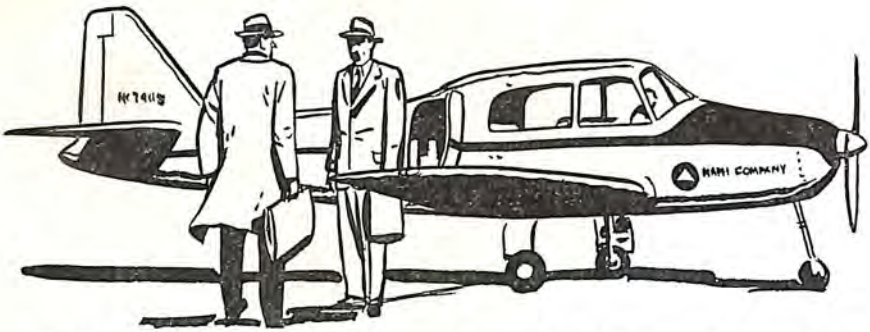
2. Three- to four-place, weighing from 2,200 to 2,700 pounds and powered with engines from 125 to 225 horsepower. These are good "cross-country" aircraft, able to maintain cruising speeds of 125-175 miles per hour, and have endurance of three to four hours without refueling.

3. Four- to five-place, having a gross weight of from 2,200 to 4,600 pounds and powered with engines from 175 to 300 horsepower. These planes can cruise 140 to 225 miles per hour and are generally referred to as executive aircraft. They are well equipped with radio and instruments, and capable of cross-country flight under instrument conditions.

4. Four- to ten-place, twin-engine light transport, with 175 to 500 horsepower engines. These aircraft, in demand by corporate users, have a cross-country speed of from 150 to 225 miles per hour; four to seven hours endurance, and extensive instrumentation and radio enable these aircraft to operate in marginal weather—much as do the scheduled airliners.

In addition to these four principal aircraft types, there is an active fleet of several hundred larger multi-engined aircraft, identical to planes

HOW UTILITY AIRCRAFT ARE USED



BUSINESS uses aircraft as the best means of rapid, safe, and economical transportation of executives. Often these planes are owned and operated by businessmen themselves. Fleets are frequently maintained by corporations who retain professional pilots to operate these aircraft. 35,070 utility aircraft are operated by the nation's businesses, corporations and partnerships. Of these, 18,220 are company owned.

AGRICULTURAL applications of utility aircraft are increasing. Today, one of every 12 acres under cultivation in the United States is either sprayed or dusted by aircraft.

AIR TAXI service continues to increase. Today, there are 5,010 planes maintained by base operators for charter or rent, much as a car, either with or without a pilot.

INDUSTRY, always conscious of time and cost, has developed the airplane into one of its prime tools. From uranium prospecting to the fast delivery of heavy equipment, 2,520 aircraft are hard at work for industry.

PERSONAL aircraft to air traveling America, has taken on characteristics of the "private automobile". There are 29,260 utility aircraft of all sizes and types used today for both business and pleasure transportation.

used by the airlines, in use by corporations for business purposes, principally executive transportation.

The use of aircraft in business has shown steady acceleration in recent years. Civil Aeronautics Administration statistical data emphasize this fact. According to CAA, business uses of aircraft accounted for 2.6 million hours in 1949. The CAA estimate for 1954 credits business aircraft use with 3.9 million hours, a 50 per cent increase over 1949.

During 1954 the airlines of the nation, based on an analysis of Air Transport Association data, flew an estimated 3.1 million revenue hours, 810,000 less hours than in business aviation. The business fleet now includes more than 20,000 active aircraft, the scheduled airline fleet is less than 1500.

CIVIL AIRCRAFT BY YEAR OF MANUFACTURE
AS OF JANUARY 1, 1953

Year of Manufacture	Number	Percent of Total
	89,313	100.0
1941	6,567	7.3
1942	4,741	5.3
1943	6,254	7.0
1944	1,591	1.8
1945	1,940	2.2
1946	27,521	30.8
1947	11,325	12.7
1948	5,569	6.2
1949	2,767	3.1
1950	2,973	3.3
1951	1,930	2.2
1952	2,847	3.2
Other years	13,288	14.9

Source: 33.

This table shows that only about 10 per cent of all utility planes are less than four years old. About half of all passenger automobiles are in that recent age group.

Development of General Aviation

There was little flying during the '20s and '30s which could be called utility or general aviation in today's use of those terms. Commercial and business aviation in that period was related to the early growth of the airlines and to servicing the small fleet of privately owned aircraft.

In 1940, just before the start of the second World War, there were

several thousand light aircraft of a type which could be used for corporate and other utility purposes. But, by and large, such flying as privately done was mostly for personal pleasure or sport.

Prior to the second World War the Federal government established the Civilian Pilot Training Program (CPTP). It was designed to increase the knowledge of aviation and to build a reserve of trained pilots

ESTIMATED COST OF OPERATING A TYPICAL 125 HORSEPOWER UTILITY AIRCRAFT SEATING FOUR PEOPLE

Direct Costs per Hour	
Gas and oil	$2.70
Inspection and maintenance	.65
Engine overhaul	.82
Hourly direct operating cost	$4.17
Indirect Costs per Year	
Hangar	$ 240.00
Insurance	474.99
Depreciation	1,548.75
Annual Fixed Cost	$2,263.74

	300 Hours	*500 Hours*	*1000 Hours*
Total cost per hour	$11.72	$8.70	$6.43
Cost per passenger seat mile	2.33¢	1.73¢	1.27¢
Cost per mile at 125 mph	9.3 ¢	6.9 ¢	5.1 ¢

Source: 87.

Operating costs of small executive planes approach the operating cost of automobiles, provided the plane is used an average of one hour a day or more.

TOTAL CIVIL AIRCRAFT, 1927 TO DATE

As of January 1	TOTAL	Active	Inactive
1928	2,740	N.A.	N.A.
1932	10,680	N.A.	N.A.
1935	8,322	N.A.	N.A.
1941	26,013	N.A.	N.A.
1951	92,809	60,921	31,888
1952	88,549	54,039	34,506
1955[E]	91,800	56,500	35,300

N.A.—Not available.
E Estimate.

Sources: 32, 35.

Since 1952, the number of active aircraft has been increasing. Many surplus and training planes of the 1940's are still in existence but inactive.

for the military. The demand for small trainers caused by this program resulted in a pre-war manufacturing spurt.

The start of World War II, however, forced a shutdown in the manufacture of light civil aircraft. The CPTP program was halted and replaced with one designed more specifically for wartime needs, known as the War Training Service (WTS). From this developed the wartime contract training of military aviation personnel conducted so successfully during the war years.

Though civil manufacture was halted, almost every type of light aircraft then being produced found some wartime use. Also, about 2,000 light aircraft were taken over by the military for instrument and other training purposes, and for use as light utility cargo and personnel transports.

The Army subsequently acquired and used many thousands of light aircraft for liaison purposes. Used first as artillery spotters, they soon demonstrated a multiplicity of uses. Their versatility is best described by the term then so frequently applied to these small aircraft—"flying jeeps." These military uses of light liaison aircraft dramatically demonstrated the everyday utility available in typical light aircraft.

There was a steady decline in numbers of light aircraft produced since 1946 when nearly 35,000 were produced in comparison to 1951 when only about 2,300 were delivered. However, aircraft produced in the early post-war years were light trainer types, unsuited for business or even for personal use. This resulted from the G. I. Bill of Rights which caused a great post-war training boom with many thousands of veterans taking flight training. As a result, the base operators who did the G. I. training, were the industry's biggest customer, not the individual aircraft owner or user.

It wasn't until 1947 that a sound and steady growth in the acceptance of general utility airplanes in business began. Since 1947, there has been a steady growth in the utility aircraft industry. Three principal factors account for this: 1. Demonstration of worth of the utility airplane as a profitable business tool; 2. the great improvement in the aircraft itself; and 3. the user's ability to obtain greater utilization out of the airplane.

Mobilization of General Aviation for Civil Defense

There are plans in existence today which, under conditions of military emergency, would make several hundred transport aircraft quickly available for purposes of military air-lift. These plans have been jointly worked out by the Commerce Department's Defense Air Transportation Administration, Department of Defense, and the nation's airlines. An

emergency would invoke the activation of these plans and would also intensify the need for civil air transportation generally, for essential business, industry, agriculture, and for civil defense.

The CAA estimates that, among the general aviation fleet, there are more than 20,000 aircraft which are considered to be in daily use for business purposes. Of these, at least 15,000 are four-place aircraft of a type especially suitable for executive transportation. This group of

CIVIL AIRCRAFT BY STATES, JANUARY 1, 1954

State	Total	Active	Inactive	State	Total	Active	Inactive
TOTAL	91,102	55,505	35,597				
Alabama	747	423	324	Nebraska	1,763	1,208	555
Arizona	1,262	691	571	Nevada	471	258	213
Arkansas	1,093	647	446	New Hampshire	215	126	89
California	10,369	5,782	4,587	New Jersey	1,931	1,080	851
Colorado	1,256	781	475	New Mexico	772	461	311
Connecticut	629	315	314	New York	4,497	2,785	1,712
Delaware	210	133	77	North Carolina	1,600	962	638
District of Columbia	567	391	176	North Dakota	1,148	577	571
Florida	2,686	1,224	1,462	Ohio	4,309	2,568	1,741
Georgia	1,242	694	548	Oklahoma	1,996	1,297	699
Idaho	870	611	259	Oregon	1,760	1,112	648
Illinois	5,030	3,291	1,739	Pennsylvania	3,910	2,452	1,458
Indiana	2,757	1,664	1,093	Rhode Island	197	106	91
Iowa	2,064	1,542	522	South Carolina	592	334	258
Kansas	2,503	1,653	850	South Dakota	1,130	745	385
Kentucky	704	411	293	Tennessee	923	537	386
Louisiana	1,284	749	535	Texas	6,740	4,256	2,484
Maine	527	318	209	Utah	481	282	199
Maryland	864	501	363	Vermont	158	105	53
Massachusetts	1,431	876	555	Virginia	1,237	676	561
Michigan	3,899	2,286	1,613	Washington	2,260	1,494	766
Minnesota	2,164	1,412	752	West Virginia	602	349	253
Mississippi	868	518	350	Wisconsin	1,967	1,282	685
Missouri	2,050	1,441	609	Wyoming	506	352	154
Montana	1,179	803	376	Territories and Foreign	1,682	944	738

Source: 32.

While there is about one motor vehicle for every three people in this country, there is only one active airplane for about every 3,000 persons. On a per capita basis, plane ownership is highest West of the Mississippi.

aircraft is capable of providing as many as 10,000,000 seat miles of transportation an hour. There are, of course, many thousands of other aircraft in daily use, including approximately 2500 multi-engined aircraft, more than are operated by the airline industry.

Apart from the daily use of the general aviation fleet in routine business, industry, and agriculture, this fleet of thousands of light aircraft provides a reserve of transportation which could be vital. Under the conditions which would result from atom bombing, it is reasonable to assume that the usual surface transportation would be either at a standstill or badly disrupted for many hours following such an attack. But the air-lanes would still be open. Light aircraft capable of landing in small areas under emergency conditions could become the chief link between life and death, bringing the supplies and providing the communications necessary to re-establish devastated areas.

CIVIL AIRPLANE PRODUCTION

1937–1945, by Number of Engines and Places

Year	TOTAL PRODUCTION	By Number of Engines		Landplanes, by Place		
		Single	Multi	1–2	3–5	Over 5
1937	2,289[a]	2,171	118	1,668	460	105
1938	1,823	1,770	53	1,487	258	42
1940	6,785	6,562	167	5,527	1,031	140
1945	2,047	1,946	101	1,929	17	73

1946–1952, by Type of Use and Number of Places

Year	TOTAL PRODUCTION	By Type of Use		By Place		
		General	Transports	1–2	3–5	Over 5
1946	35,001	34,568	433	30,766	3,802	433
1948	7,302	7,039	263	3,302	3,737	263
1950	3,520	3,391	129	1,029	2,362	129
1951	2,477	2,279	198	614	1,661	202
1952	3,509	3,057	452	3,056		453
1953	4,134	3,825	309	3,822		312
1954	3,389	3,098	291	2,982		407

N.A.—Not available.

[a] Civil airplane production shown here differs from that on pp 8 & 9. Recent CAA revision of total civil airplane production not yet carried through all breakdowns.

Sources: 23, 32.

Civil aircraft production has recovered from the low of 1951. Production now is mostly of larger multi-engine executive type planes as compared with the predominantly 1-2 seat single-engine type production immediately following the end of the war.

CERTIFICATED CIVIL PILOTS AND STUDENT PILOTS, 1927 TO DATE

As of December 31	Certificated Airplane Pilots				Student Pilot Approvals During Year	Glider Pilots
	TOTAL PILOTS	Airline Transport	Commercial	Private		
1927	1,572	[a]	N.A.	N.A.	545	—
1928	4,887	[a]	N.A.	N.A.	9,717	—
1929	10,287	[a]	6,053	4,162	20,400	—
1930	15,280	[a]	7,847	7,433	18,398	178
1931	17,739	[a]	8,513	9,226	16,061	267
1932	18,594	330	7,967	10,297	11,325	209
1933	13,960	554	7,635	5,771	12,752	149
1934	13,949	676	7,484	5,789	11,994	109
1935	14,805	736	7,362	6,707	14,572	145
1936	15,952	842	7,288	7,822	17,675	138
1937	17,681	1,064	6,411	10,206	21,770	161
1938	22,983	1,159	7,839	13,985	15,556	172
1939	33,706	1,197	11,677	20,832	29,839	170
1940	69,829	1,431	18,791	49,607	110,938	138
1941	129,947	1,587	34,578	93,782	93,366	160
1942	166,626	2,177	55,760	108,689	93,777	211
1943	173,206	2,315	63,940	106,951	36,802	1,435
1944	183,383	3,046	68,449	111,888	51,276	2,412
1945	296,895	5,815	162,873	128,207	77,188	2,438
1946	400,061	7,654	203,251	189,156	173,432	N.A.
1947	433,241[b]	7,059[b]	181,912[b]	244,270[b]	192,924	2,995[b]
1948	491,306[c]	7,762[c]	176,845[c]	306,699[c]	117,725	3,143[c]
1949	525,174	9,025	187,769	328,380	49,575	3,291
1950	[d]	[d]	[d]	[d]	44,591	[d]
1951	580,574	10,813	197,900	371,861	45,003	3,300
1952	581,218	11,357	193,575	376,286	30,537	3,365
1953	585,974	12,757	195,363	377,854	37,397	3,402
1954[e]	596,128	13,137	197,995	384,996	39,150[f]	3,511[E]

E Estimate.
N.A.—Not available.
[a] Airline Transport Rating became effective May 5, 1932.
[b] As of April 1, 1948.
[c] As of May 1, 1949.
[d] No survey made.
[e] As of July 1, 1954.
[f] July 1, 1953-June 30, 1950.

Sources: 2, 32, 35.

Pilot certificates, once issued, remain in force permanently. However, to hold an active "ticket," periodic physical examinations are required. A survey of active pilots on January 1, 1954, showed 11,419 active transport pilots, 67,809 active commercial pilots and 153,426 active private pilots, or a total of only 232,654 instead of the 585,974 shown for the same period who "hold" certificates.

AIDS TO AIR NAVIGATION, 1926 TO DATE

Year	Civil Airways Mileage		Radio Range Stations		Non-directional Radio Beacons	Federally Operated Traffic Control Facilities		Interstate Airways Communication Stations
	Controlled Airways	Direct VOR Airways	Low and Medium Frequency	Very High Frequency		Airport Towers	Airway Centers	
1926	2,041	—	—	—	—	—	—	—
1931	17,152	—	47	—	46	—	—	
1936	22,245	—	146	—	57	—	—	203
1941	36,062	—	323	8	48	—	14	415
1946	44,145	—	364	50	74	115	29	397
1951	74,424	—	375	385	152	157	31	427
1953	72,097	54,490	368	392	181	115	31	395
1954	69,359	64,995	346	403	170	104	31	376

Sources: 32, 35.

LANDING AIDS TO AIR NAVIGATION, 1941 TO DATE

Calendar Year	Instrument Landing Systems	Precision Approach Radar	Airport Surveillance Radar
1941	1	—	—
1946	31	—	—
1951	97	10	10
1952	120	10	10
1953	143	10	17
1954	153	10	28

Sources: 32, 35.

Federal airways are "highways in the air" ten miles wide and divided into several traffic levels a thousand feet above each other. Traffic is guided and controlled by radio signals, beacon lights, weather reports, instrument approach systems, radar facilities, traffic control centers and towers. The tables show the growth of this system.

PUBLIC AIRPORTS BY LENGTH OF RUNWAY AND REGION, MARCH 1, 1954

Region	Total	Airports by Length of Runway (in feet)						
		0-2,999	3,000-3,499	3,500-4,199	4,200-4,999	5,000-5,899	5,900-6,999	7,000- & over
TOTAL	2,903	1,354	368	408	207	336	96	134
New England	127	70	4	23	11	11	2	6
Middle Atlantic	322	216	40	26	12	19	3	6
East North Central	588	350	95	78	18	31	5	11
West North Central	445	233	65	65	23	29	9	21
South Atlantic	323	128	31	38	36	68	7	15
East South Central	113	39	14	25	13	16	2	4
West South Central	359	136	48	58	40	43	18	16
Mountain	297	48	33	50	30	71	31	34
Pacific	329	134	38	45	24	48	19	21

Source: 32.

The airports shown in this table receive scheduled air carrier service or offer minimum public service of full-time attendant and fuel sale. In addition to these public airports there were 3,857 "limited" airports making a total of 6,760 airports. More than 1,000 fields were lighted for night flying.

ESTIMATED INVESTMENT IN CIVIL AIRPORTS, 1926–1954
(Millions of Dollars)

Year	Amount of Investment
1926	$ 42
1939	326
1941	419
1945	1,027
1954	4,000[a]

[a] Estimated acquisition cost.

Sources: 32, 50, 89.

HOURS FLOWN BY UTILITY AIRCRAFT, 1931–1953

Calendar Year	Total (Thousands of Hours)	Instructional		Commercial[a]		Business[b]		Pleasure, etc.	
		Hours 000's	Percent	Hours 000's	Percent	Hours 000's	Percent	Hours 000's	Percent
1931	1,083	307	28.3	281	25.9	152	14.1	343	31.7
1941	4,460	2,816	63.1	511	11.5	250	5.6	883	19.8
1951	8,451	1,902	22.5	1,584	18.8	2,950	34.9	2,015	23.8
1952	8,186	1,503	18.4	1,727	21.1	3,124[c]	38.2	1,832	22.3
1953	8,527	1,248	15.0	1,649	19.0	3,626	42.0	2,004	24.0

[a] Includes contract, industrial, and commercial agricultural flying.
[b] Includes flying for corporate or executive purposes as well as flying on personal business.
[c] Company Business 2.1 million hours; Individual Business 1.0 million hours.
Source: 31.

HELICOPTERS

Five hundred years ago, Leonard da Vinci sketched plans for an aerial screw design for vertical flight. The helicopter,* as we know it today, derives lift from an overhead rotor, or rotors (the large screw-thread on a vertical shaft theory of da Vinci).

Since da Vinci's time more than 100 different helicopters were designed and built for attempted flight, but it was not until the advent of the gasoline engine that much progress was achieved.

In 1907, Louis Breguet in France flew a helicopter that weighed half a ton and was driven by four rotors. In the '20's, Juan de la Cierva in Spain experimented with rotary wing flight (non-powered autogiro rotor principle.) His development of the hinged rotor blades, rather than the rigid type, proved an impotrant contribution to the design of practical helicopters. The first real distance flight by helicopter was made by Dr. Heinrich Focke from Bremen to Berlin in 1937.

In 1939, the first successful helicopter flight in the Western hemisphere was made by Dr. Igor Sikorsky at Bridgeport, Connecticut.

During World War II, the Army, Navy and Coast Guard began limited use of helicopters in military combat operations. In this period, however, their use was restricted almost completely to light emergency transport and rescue.

Introduction of atomic weaponry by the close of World War II, as with other military tactics, forced a radical change in techniques of assault landings. The helicopter offered the third dimension—vertical landings—to the aspect of amphibious and air-head assault.

Prior to, and during, the late global war, development and production of the helicopter was, for the most part, experimental and limited. It wasn't until March 8, 1946, that the first commercial helicopter was certificated by the Civil Aeronautics Administration.

---

*Pronunciation of the name *helicopter* is derived from the Greek—*helix*—meaning "spiral" and *pteron*—meaning "wing"—the accepted pronunciation is *hell*-i-copter.

Early in 1947, the Marine Corps formed the first experimental helicopter squadron to test proposed combat techniques. The Coast Guard had already pioneered in proving utility of the helicopter as a rescue vehicle and a year later it became an integral unit in air rescue operations of the Air Force.

Today, less than 10 years later, helicopter manufacturing employment has risen to approximately 15,000. The industry as of December 31, 1954, had an estimated backlog of 550 million dollars. Sales in 1954 totaled more than 155 million dollars.

The Korean war brought into sharp focus the unique utility of the helicopter in military operations and the great potential of the helicopter

HELICOPTERS IN PRODUCTION
April 1, 1955

Producer	Number of Places	H.P.	Commercial Desgn.	Military Designations			
				USAF	USA	USMC	USN
Bell	3	200	47G	—	H13G	—	HTL-6
	3	200	47H	—	—	—	—
	16	1900	—	—	—	—	HSL-1
Cessna	2–4	260	CH-1	—	—	—	—
Hiller	3	200	12-B	—	H23B	—	—
	2	92	HJ-1	—	H32	—	HOE-1
Kaman	4	600	K-3	—	—	—	HOK-1
Piasecki	16	1150	—	H21A	—	—	—
	22	1425	—	—	H21C	—	—
Sikorsky	10–12	600-700	S-55	H19B	H19D	HRS-3	HO4S-3
	N.A.	1550	S-58	—	H34	—	HSS

Source: 2.

to civil aviation. Aside from its capability as a rescue vehicle, the 'copter proved outstanding for aerial survey, flying food, medicine and ammunition over difficult terrain to supply front line posts and for quick transport of personnel to strategic points. The helicopter also was credited with the rescue and evacuation of more than 23,000 United Nations personnel including pilots who were shot down behind enemy lines, as well as evacuation of front line casualties. Many of these missions were performed at night in inclement weather.

In 1947, the world's first scheduled helicopter mail route was established to serve a 50-mile radius of Los Angeles. Two years later, the Civil Aeronautics Administration authorized similar service for the Chicago area and in 1952 in the New York area.

In July 1953, the first scheduled helicopter passenger, mail and cargo service was established in New York and another now is authorized in

Los Angeles. Today, helicopter service is also available between airports and airports and city in Pittsburgh and Cleveland, and this year will be inaugurated in Indianapolis. In 1953, two U.S. scheduled airlines inaugurated helicopter passenger service. In Europe, Belgium inaugurated the first international helicopter passenger service in 1953 between Belgium, the Netherlands, France and Germany.

The New York Police and The Port of New York Authority use the helicopter in solution of official transportation problems. Operating off waterfront, roof-top and airport heliports, the police use small helicopters for quick transport of key personnel over traffic-congested Manhattan.

U. S. Exports of Civil Rotary-Wing Aircraft
1948–1954

Year	Number	Value in Thousands
1948	47	$1,933
1949	31	1,181
1950	38	984
1951	28	899
1952	37	1,411
1953	98	4,873
1954	74	4,044

Source: 23.

In agricultural operations the helicopter has established an enviable record: crop dusting, spraying, aerial and geological survey, mapping, power line patrol, off-shore drilling service, uranium prospecting, and frost control are only a few of the services offered by some 25-30 commercial fleet helicopter operators. Large ranchers find the helicopter invaluable in ranch activities. For example, the huge Waggoner Ranch, covering more than 500,000 acres in Texas, find the helicopter equal to 15-20 cowboys in rounding up cattle and in the patrol of 2,700 miles of fence lines.

The short-haul travel market—up to 300 miles—is a comparatively untapped potential helicopter air travel market. Present day ground travel time from the airport to the city business district is often as long as the air trip itself.

Full utilization of the helicopter as a short-haul, city-center to city-center transport is only limited by the lack of "downtown" heliports. In this connection, the Helicopter Council of the Aircraft Industries Association has recently completed a survey of the nation's state aviation

laws. In most cases, according to this analysis, the helicopter is handicapped by being classed in the general "aircraft" category, without recognition of its operational capabilities. The Council, working with the National Association of State Aviation Officials, will seek a remedy for this unsatisfactory situation.

Today, nine major helicopter manufacturers are producing or are engaged in experimental development projects for the military. These rotary winged craft include: small 2-3 place models for training, rescue and observation; light transport models seating 10-16 passengers, and larger types which will seat from 40-50 passengers.

There are 11 models in production, 14 in prototype and 9 models in the design-development stage, including very large versions to serve as "flying cranes"—for the military, in transporting mortars and bridge sections over rivers and mountains and in civil use, for construction companies—by moving heavy equipment and machinery to and from building sites anywhere.

SALES AND OPERATIONS, 1952–1954
(Seven Helicopter Manufacturers)

	1952	1953	1954
Estimated Sales (Millions of Dollars)	$165.0	$190.0	$155.0
Estimated Backlog (Millions of Dollars)[a]	$355.0	$450.0	$550.0
Number of models[a]			
In production	13	14	11
In prototype stage	3	10	14
In design stage	9	8	9
Plant Area[a]			
(Thousands of Square Feet)	1,792.8	1,887.7	2,161.5
Number of employees	13,776	14,977	14,460
Payroll (Millions of Dollars)	$51.4	$66.4	$71.6

[a] As of December 31.

Source: 2.

AIRCRAFT EXPORTS

American businessmen go almost everywhere in the free world to sell American products and, because of the speed and economy of air travel, export business has become almost as routine as the pursuit of domestic sales.

The greatest problem in doing export business, however, has not progressed so rapidly. The world is faced with exchange restrictions, quotas, tariffs, and other limitations which still make it much more difficult to do export business than domestic.

Although the airplane is responsible for easy access to world markets, products of the aircraft industry suffer the same handicap as all other merchandise when it comes to changes in national ownership. While the attitude of those behind the iron curtain is largely responsible for the restrictions existing even between friendly countries, the tremendous improvement and growth of military, as well as civilian, aircraft products is largely due to military protective incentive and cooperative agreement of the free world.

Aircraft production in the United States exceeds that in all the rest of the world with the exception of Russia. Russian production, of course, is a matter of speculation. Some quarters feel that Russia is producing more than the United States, and others, that she produces considerably less.

Because of the restive international situation, however, public information regarding the manufacture and export of aircraft, engines and components has been so restricted that detailed statistics cannot be compiled. Overall U.S. dollar exports increased annually following World War II from 1946 to 1954 with reversals only in 1948 and 1954. The overall aircraft industry product export for the past three years has been as follows:

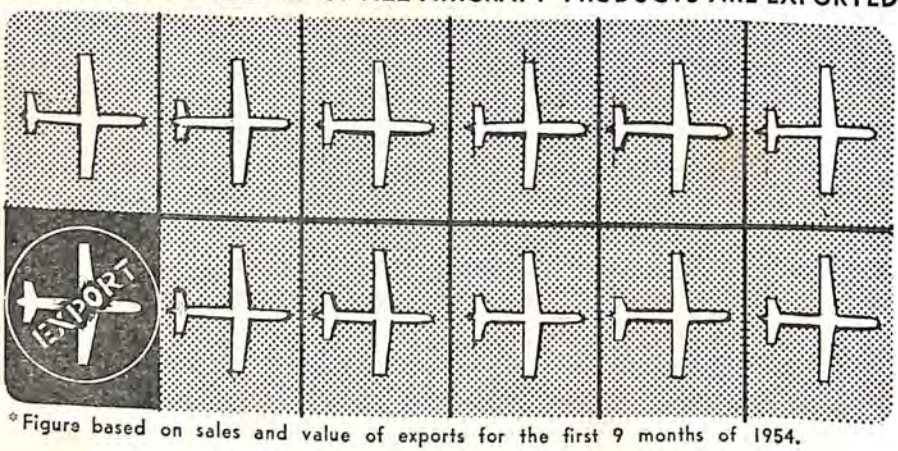
1952	$603,000,000
1953	880,000,000
1954	619,000,000

No details of U.S. exports have been available since 1949 with respect to military aircraft types, quantity, or destination. A considerable

part of the more important civilian items of complete aircraft and parts have similarly been restricted.

The destruction of the German and Japanese aviation industry was complete in World War II. During the last year both nations have been accepted as "members in good standing" by the free world. Both, in pre-war years, were formidable competitors in world export markets. Both, with assistance of the United States, are making rapid progress in the restoration of their aircraft industry. Neither, however, will be able for some years to offer competition to the United States in world exports.

Much of the aircraft industry of France, the Netherlands, Belgium and Italy was destroyed during World War II. The United States



through several aid plans—the foremost being the Mutual Defense Assistance Program—has done much to refurbish the industry of those nations, including substantial "off-shore" procurement of military aircraft, engines, electronics, etc., for use by the free world.

While off-shore procurement has done much to restore the industry of those nations and has greatly strengthened the military posture of allied air forces quantitatively, none has been able to match the qualitative definition "Made-in-America," as applied to the aviation product.

Great Britain

Since World War II, Great Britain, Canada, and France have all made great strides in the export of aviation products—particularly in military items. Great Britain, in addition to making considerable progress in the export of military aviation end items, has also placed heavy emphasis on the export of civil aviation products.

While ill fate has followed the production of the British jet-powered DeHavilland *Comet*, nevertheless the British have made substantial progress in the redevelopment and production of this aircraft. The turboprop Vickers *Viscount*, medium transport type, has, on the other hand, distinguished itself and is becoming a substantial import into the United States. Their larger turbo-prop aircraft, the Bristol *Britannia*, shows promise but is not a substantial production item as yet. However, it remains to be seen whether the largest jet type transport aircraft still will not be supplied primarily from the United States. Turboprop development in the United States is moving rapidly.

Utility Aircraft

The United States has always excelled in the number and quality of utility aircraft supplied both at home and for export. In recent years 15-20% of all such production in the United States has been exported. While Great Britain and France have supplied much of their demands at home, they have done very little exporting of this type of aircraft.

Canada

Canada has worked in close cooperation with both Great Britain and the United States in her production of a very substantial volume of aircraft. She has combined the airframes of the United States with power plants from Great Britain and vice versa. In addition, she has designed and produced numerous airframes and power plants in her own companies. She has supplied substantial quantities of trainers, fighters and bombers for Europe and elsewhere, and has sold some of her liaison type aircraft in the United States, despite domestic competition.

UNITED KINGDOM: AERONAUTIC EXPORTS

Annual Average	Million Dollars	Annual	Million Dollars
1924–1928	$ 5.6	1949	$125.2
1929–1933	7.1	1950	95.2
1934–1938	16.3	1951	116.5
1939–1943	33.9	1952	121.6
1944–1948	57.7	1953	182.0
		1954[E]	156.9

E Estimate.

Sources: 11, 56.

Exports have been much more important to the British aircraft industry than to the American. About one quarter of total British production is exported—compared to about 10 per cent of U.S. production.

UNITED KINGDOM: EMPLOYMENT AND PRODUCTION IN THE AIRCRAFT MANUFACTURING INDUSTRY

Year	Employment	Value of Production (Million Dollars)
1918	347,112	N.A.
1935	35,890	69.1
1939	355,000	N.A.
1944	1,821,000	N.A.
1948	134,219	455.2
1950	153,600	423.1
1954	239,780[a]	624.0[E]

N.A.—Not available.
E Estimate by official British sources.
[a] May 1954 employment.

Sources: 56, 57.

Employment in the British aircraft industry in the years immediately following the war stayed remarkably high—at 57 per cent of American employment. Today American employment is more than three times as high as in Great Britain because the increase in employment in the UK has been slower than here.

UNITED KINGDOM: ORDERS FOR GAS TURBINE AIRLINERS UP TO SEPTEMBER 16, 1954

Name of Airliner	Total	For British Use		For Export	
		Number	Value (Million Dollars)	Number	Value (Million Dollars)
Comet I & IA .... (all delivered)	19	10	$12.6	9	$11.3
Comet II.....	33	12	17.1	21	30.3
Comet III.....	10	5	10.5	5	10.5
Viscount	153	44	30.8	109	76.3
Britannia.....	39	33	50.8	6	9.3
Total	254	104	$121.8	150	$137.7

Source: 56.

Britain was the first nation to produce turbo-jet and turbo-prop airliners. This table shows the latest available official status of orders for these airliners.

MUTUAL SECURITY PROGRAM, AUTHORIZATION AND SHIPMENTS OF CIVIL AIRCRAFT, ENGINES, AND PARTS, 1948 TO JUNE 30, 1954 (Millions of Dollars)

Program	Procurement Authorizations	Paid Shipments		
		Total	U. S.	Other
European	$111.4	$109.0	$108.9	.1
Greece & Turkey	2.6	1.0	N.A.	N.A.
Asia	2.5	.4	.4	—

N.A.—Not available.

Source: 52.

CANADA: AIRCRAFT AND PARTS INDUSTRY, 1935-1953

Year	Number of Plants	Average Number of Employees	Gross Selling Value of Products (Millions of U. S. Dollars)
1935	7	294	$ .9
1936	7	416	1.3
1937	8	606	1.7
1938	13	1,617	6.9
1939	13	3,596	12.6
1940	19	10,348	24.2
1941	24	26,661	74.0
1942	42	44,886	137.8
1943	45	69,529	223.7
1944	45	79,572	388.2
1945	38	37,812	253.3
1946	16	11,405	36.2
1947	12	9,374	44.3
1948	11	8,049	45.6
1949	14	10,695	59.7
1950	15	10,549	50.2
1951	23	19,198	111.3
1953	43	38,048	398.7

Sources: 10, 48.

Canada's aircraft industry follows the pattern of ups and downs of the U.S. industry more than that of Britain. Since the post-war low, employment has grown nearly five fold, production eleven fold.

U. S. EXPORT OF AIRCRAFT ENGINES[a] FOR CIVILIAN AIRCRAFT, 1948 TO DATE

Year	Number	Value (Thousands of dollars)
1948[b]	660	$326
1949[b]	107	112
1950	247	285
1951	304	509
1952	551	941
1953	347	708
1954	728	1,516

[a] Under 400 h.p.; data for exports of engines of 400 h.p. and over withheld for "security reasons."

[b] Under 250 hp.

Source: 23.

MUTUAL SECURITY PROGRAM, SHIPMENTS OF MILITARY AIRCRAFT
OCTOBER 6, 1949—DECEMBER 31, 1954

Period	Total Aircraft Shipped	Air Force Aircraft	Navy Aircraft
TOTAL	6,416[a]	5,236[a]	1,180[a]
October 6, 1949—March 31, 1950	28	818[b]	283[b]
April 1, 1950—September 30, 1950	223		
October 1, 1950—March 31, 1951	474		
April 1, 1951—September 30, 1951	376		
October 1, 1951—March 31, 1952	656	512	144
April 1, 1952—September 30, 1952	661	612	49
October 1, 1952—March 31, 1953	1,366	1,202	164
April 1, 1953—September 30, 1953	1,323	1,072	251
October 1, 1953—March 31, 1954	641	478	163
April 1, 1954—September 30, 1954	529	445	84
October 1, 1954—December 31, 1954	246	197	49

[a] Revised. Since revision of previously reported monthly shipments is not available "Total" does not agree with total shipments reported above.

[b] Total shipments October 6, 1949 to September 30, 1951.

Sources: 44, 45.

Air power plays a major role in our government's program of giving military, economic, and technical assistance to allied countries of the free world. The military mutual security program aims at 278 air squadrons and 182 shore-based maritime naval aircraft groups.

U. S. TOTAL EXPORTS AND EXPORTS OF AERONAUTIC PRODUCTS
1912 TO DATE
(Millions of Dollars)

Year	Total United States Merchandise	Total Aeronautic Products	Percent of total
1912	$ 2,170.3	$ .1	[a]
1915–1918	22,176.7	31.5	.14
1921	4,378.9	.5	[a]
1929	5,157.1	9.1	.18
1939	3,123.3	117.8	3.8
1946	9,500.2	115.3	1.2
1952	15,025.7	603.2	4.0
1953	15,649.0	880.6	5.6
1954	14,948.1	618.9	4.1

[a] Less than .05 percent.

Sources: 26, 27, 28, 29, 30.

The U.S. is the world's largest exporter of aeronautical products. American aviation equipment flies in all parts of the free world. Yet aviation products represent only about 5 per cent of total U.S. exports and less than 10 per cent of total aeronautical production.

Exports of Civil Aircraft, 1948 to Date

New Passenger Transports

Year	Total		3,000–14,999 lbs airframe weight		15,000–29,999 lbs airframe weight		30,000 lbs & over airframe weight	
	Number	Value (Millions)	Number	Value (Millions)	Number	Value (Millions)	Number	Value (Millions)
1948	91	$37.4	34	$2.4	14	$4.2	43	$30.8
1949	51	22.2	16	1.3	25	7.6	10	13.4
1950	48	40.4	4	.4	15	6.6	29	33.4
1951	26	13.2	13	1.1	1	[a]	12	12.1
1952	25	18.2	9	.6	1	.6	15	17.0
1953	87	79.2	17	1.3	13	7.5	57	70.4
1954	110	93.0	29	2.0	7	4.0	74	87.0

New Utility, Personal and Liaison Planes

Year	Total		3-Places or less		4-Places and over	
	Number	Value (Millions)	Number	Value (Millions)	Number	Value (Millions)
1948	935	$4.2	552	$1.5	383	$2.7
1949	510	2.8	235	.7	275	2.1
1950	408	2.2	173	.5	235	1.7
1951	540	3.7	237	1.0	303	2.7
1952	815	5.6	551	3.1	264	2.5
1953	776	5.4	370	1.5	406	3.9
1954	529	4.5	223	1.1	306	3.4

Other

Year	Rotary Wing Aircraft		Used Aircraft	
	Number	Value (Millions)	Number	Value (Millions)
1948	47	$1.9	202	$ .7
1949	31	1.2	252	.6
1950	38	.9	262	.9
1951	28	.9	300	.9
1952	37	1.4	303	1.5
1953	98	4.9	416	1.5
1954	74	4.0	340	1.2

[a] Less than $500,000.

Source: 23.

Exports of large air transports in 1954 have reached an all-time high both in number and in dollar value. This indicates that the United States will maintain its leadership as the major supplier of planes for the world's airlines.

TRAINING

In the final analysis the quality of the U.S. aviation product, whether aircraft, engines, components, electronic devices, etc., is determined by the men and women that design, build or fly.

U.S. aviation leadership is the product of thousands of men and women who push back the frontiers of knowledge, and who apply what has been learned to the design and production of more advanced aircraft for civil use, and planes, guided missiles and electronic devices for the military.

There are engineers, draftsmen and production line workers. There are skilled technicians who maintain and direct air traffic. There are highly skilled crews who fly the nation's commercial and military aircraft. There are managers in the aircraft and air transport industries, in the military, and in the civil services of government who plan and guide America's gigantic aviation effort.

The lowest common denominator of American aerial supremacy is training and education—in manufacturing, in maintenance, in the military and in civil aviation.

Examination of any big city newspaper will disclose great numbers of opportunities in all aspects of the aircraft industry for pilots, for engineers, for research specialists, electronic experts, and for production workers.

The aircraft manufacturing industry, which has been repeatedly faced with shortages of skilled personnel, undertakes apprentice and in-plant training programs. Some of the larger companies offer advanced courses in various technical aspects of aviation research, development, and production. These companies, hard pressed for qualified technical personnel in most cases, will take qualified engineers in any field and train them to their aeronautical need.

The nation's airlines operate flight and ground schools for the orientation and training of new employees, and for maintaining a high level of personnel efficiency.

The high schools and colleges of the nation, more and more, are

increasing their curricula to cover many fields of aviation. Colleges are, in many cases, offering pre-flight aviation training, and some offer flight training. Texas A & M College, for example, with the assistance of the Civil Aeronautics Administration is establishing a special six-weeks flight training school to train pilots in "aerial applicator" flight. This particular adjunct of agriculture is assuming tremendous proportions as America strives to increase her productivity to meet domestic and international food needs.

During World War II, more than 160 civilian aviation schools were under Army Air Force contract to train flying and technical personnel. To a lesser degree, the Air Force employed this system of contracting with civilian schools during the early days of the Korean War.

The Air Force has since discontinued its use of civilian schools for other than primary flying instruction, and as a result most training schools have been faced with serious economic problems during the last eighteen months. The picture is brightening generally, however, as the

ESTIMATED NUMBER OF ENGINEERING GRADUATES IN THE UNITED STATES AND THE SOVIET UNION
1940 TO DATE

Year	United States	Soviet Union
1940	14,000	30,000
1941	13,000	26,500
1942	N.A.	14,000
1943	14,000	9,000
1944	14,000	9,000
1945	4,000	10,000
1946	7,000	11,500
1947	19,000	17,000
1948	31,000	20,000
1949	47,000	25,000
1950	52,000	28,500
1951	42,000	29,500
1952	30,000	30,000
1953	24,000	32,000
1954	19,000	35,000
1955	23,000	40,000

N.A.—Not available.

Sources: 53, 80.

The number of engineers entering industry in 1954 has been less than one-half the number required. Reliable sources indicate that Russian engineer output is even higher than shown here.

CIVIL FLYING SCHOOLS, STUDENTS AND CERTIFICATED PILOTS
1927 TO DATE

Year	Certified Civil Flying Schools	Student Pilot Certificates Issued As of December 31
1927	—	545
1928	—	9,717
1929	24	20,400
1930	39	18,398
1931	29	16,061
1932	21	11,325
1933	19	12,752
1934	21	11,994
1935	24	14,572
1936	27	17,675
1937	30	21,770
1938	24	15,556
1939	46	29,839
1940	749	110,938
1941	1,054	93,366
1942	843	93,777
1943	693	36,802
1944	N.A.	51,618
1945	964	77,188
1946	1,557	173,432
1947	3,078	192,924
1948	3,058	117,725
1949	2,430	49,575
1950	2,086	44,591
1951	1,625	45,003
1952	1,280	30,537
1953	1,093	37,397
1954	N.A.	39,150[a]

N.A.—Not available.
[a] July 1, 1953-June 30, 1954.

Sources: 32, 35.

The attrition in numbers of flying schools is continuing. However, student pilot licenses have reversed their long downward trend and beginning to increase. The military services train their own pilots—the USAF about 7,800—Navy about 2,000 aviation cadets per year.

significance of the civil aviation industry to the nation's economy in peacetime emerges.

In 1950, pilots were being trained for the Air Force at an annual rate of 3,000. With the advent of the Korean War, this rate was increased to 4,000 per year, then to 7,200 per year. Pilot output during 1951 through 1953 remained at approximately 7,200 per year. In 1954, however, Air Force pilot output once again began to drop. In fiscal 1955 (July 1954-July 1955) pilot output is pegged at approximately 6,000 annually.

CIVIL PILOT AND OTHER RATINGS CERTIFICATES ISSUED
Selected Periods 1952-1954

Type of Certificate	Jan-June 1952	Jan-June 1953	Jan-June 1954
Pilot Ratings			
Student	13,384	16,521	18,274
Private	7,518	5,256	6,858
Commercial	2,219	1,343	4,490
Air Transport	449	354	1,287
Flight Instructor	618	476	371
Instrument	1,497	1,046	942
Other Ratings			
Mechanic	2,376	3,061	3,424
Navigator	90	26	55
Radio Operator	84	6	2

Sources: 32, 35.

The number of new pilot licenses issued annually in the U.S. is reversing the past decline and is now increasing in all categories.

RESEARCH AND DEVELOPMENT

The military aerial weapons user is never satisfied. If he were, he would soon be outdone by his adversary. Yet, aircraft industry production lines require stability if the nation is to have air forces and air power "in being."

At the same time, however, of prime concern to the nation is the maintenance of an air power second to none whether the weapons be piloted aircraft or unmanned guided missiles. As a result, the balance of dollars and effort between production and inventory on the one hand and research and development on the other is difficult to determine for both industry and government.

Following World War II, research and development conducted by the aircraft industry was virtually smothered in a landslide of cancelled contracts and heavy slashes in the defense budget.

As a result, the Korean War found this nation with practically no jet bombers and relatively few jet fighters. The thousands of aircraft built for the Air Force and Navy, during and after the Korean build-up, were far more expensive than they needed to be for the industry was not prepared to build them under emergency schedules and its research and development nucleus was just beginning to gather personnel in strength.

Today, with the nation's air power goal in sight in terms of numbers, an increasingly heavy emphasis is becoming evident in the research and development of higher performing aircraft, engines and guided missiles and their components. The industry, geared for the "long pull in the age of peril," is able to devote increasing time to aerial weaponry of quality instead of "quantity" as dictated by war emergency.

Research

At the basis of all of our aeronautical accomplishments is what we know about the laws of nature. Even the best equipped engineer can do

no more than apply the knowledge provided him by the scientist. Fundamental, or pure, research then sets the pace of technical progress.

Research has to do primarily with the discovery of new facts about nature and with finding and developing principles. Its aim is the ad-

WHERE THE FEDERAL GOVERNMENT'S RESEARCH AND DEVELOPMENT WORK IS PERFORMED

In government-owned installations	25 percent
Work sponsored at non-profit institutions	15 percent
Work sponsored at business organizations	60 percent
TOTAL	100 percent

Source: 81.

Only about one fourth of the government's research and development work is being done in government owned installations. Far more than half is being done by private industry.

TOTAL AND RESEARCH AND DEVELOPMENT EXPENDITURES OF THE FEDERAL GOVERNMENT
1940 TO DATE
(Millions of Dollars)

Fiscal Year	TOTAL FEDERAL EXPENDITURES	Expenditures for Research and Development				
		TOTAL	Air Force	National Advisory Committee for Aeronautics	Atomic Energy	Other
1940	$ 9,183	$ 97	$ 8.7	$ 2.2	—	$ 86.1
1945	98,703	1,606	136.0	24.1	859	586.9
1950	39,606	1,143	218.4	54.5	221	649.1
1951	44,058	1,342	297.9	61.6	243	739.5
1952	65,410	1,839	523.0	67.4	250	998.6
1953	74,274	2,108	618.4	78.6	261.8	1,149.2
1954	67,772	2,095	598.0	89.5	274.3	1,133.2
1955[E]	63,504	2,071	604.0	72.0	288.7	1,106.3

E Estimate.

Sources: 49, 81.

It is estimated that the 2 billion dollar expenditures of the Federal government for research and development represent approximately half the total expenditures of the nation—industry spending another $2 billions for this purpose. Eighty-five per cent of the Federal total goes to Defense and Atomic Energy.

vancement of the frontiers of knowledge and the collection of basic information.

Development

Development is the intricate process by which new knowledge is used by engineering and industry.

Application of the results of research to the design, development, and production of improved aircraft is a function of the aircraft industry. The industry's task is the design and production of aircraft with

COST OF RESEARCH AS A PERCENTAGE OF SALES, BY INDUSTRY
1951

Industry	Percent
ALL INDUSTRIES	2.0
Manufacturing	2.0
Aircraft and Parts	12.7
Electrical Machinery	6.4
Chemical and Allied Products	2.5
Non-Manufacturing	1.8

Source: 73.

Because of the rapid rate of aeronautical progress an unusually large percentage of the sales dollar of the aircraft industry goes into research. One out of every eight aircraft dollars is so expended.

INDUSTRIAL RESEARCH: COST AND SOURCE OF FINANCING, 1951
(Cost in Millions of Dollars)

Industries	Cost	Percent Federally Financed
ALL INDUSTRIES	$1,804.5	46.8
Manufacturing	1624.7	46.4
Aircraft and Parts	410.8	85.1
Electrical Machinery	432.3	57.0
Chemicals and Allied Products	204.2	7.1
All Other Manufacturing	577.4	21.9
Non-Manufacturing	179.8	50.6

Source: 73.

a specified performance—so fast, so high, so far, so much capacity—based on military or civil requirements.

Measuring the Research and Development Effort

At the beginning of the Second World War the annual outlay for all research and development in the United States was well below one billion dollars.

In 1952, it had risen to more than 3.5 billion dollars. About one half of this money came from the Federal Government.

Only about one-fourth of the government's research and development work was performed in government-owned installations. The rest went to industry, universities, research institutions, etc.

Research and development expenditures by the aircraft industry alone in 1951 (the only year for which information is available) totaled more than 400 million dollars. About six of every seven dollars spent on aircraft research and development in that year came from Federal funds.

In January, 1952, the aircraft industry employed more than 20,000 of the 90,000 professional research engineers and scientists, and 50,000 of the 220,000 total research personnel employed by American industry.

RESEARCH PERSONNEL IN INDUSTRY
January 1952

Industry	Research Engineers and Scientists	Total Research Employees
ALL INDUSTRIES	91,585	220,157
Manufacturing	80,306	196,517
Aircraft and Parts	20,235	49,915
Electrical Machinery	17,274	51,172
Chemicals and Allied Products	13,201	23,211
All Other Manufacturing	29,596	72,219
Non-Manufacturing	11,279	23,640

Sources: 72, 73.

The unusual concentration of the aircraft industry on research and development is also apparent in its employment of research personnel. While the industry employs only five percent of all employees in manufacturing industries, it employs 25 percent of all research engineers and scientists.

SOURCES:

1 "Aero Digest" (Monthly)

2 Aircraft Industries Association

3 Aircraft Industries Association, "Aircraft Year Book" (1919-1954)

4 Aircraft Industries Association "Aviation Facts & Figures" (1945 & 1953)

5 Aircraft Industries Association: Compilations from Aircraft Manufacturing Companies' Annual Financial Statements

6 Aircraft Industries Association: Compilations from Moody's Industrial Manuals

7 Aircraft Resources Control Office, "Model Designations of Military Aircraft. Revised. December 1944"

8 Department of the Air Force, Directorate of Statistical Services

9 Department of the Air Force, Office of Public Information

10 Air Industries & Transport Association of Canada, Annual Reports

11 "American Aviation Daily"; "American Aviation Magazine" (Bi-weekly)

12 Army Air Forces Statistical Control Division

13 U. S. Army, Office of the Chief of Engineers

14 "Aviation Week" (Weekly)

15 U. S. Chamber of Commerce, "Transport Review & Outlook 1954-1955"

16 Civilian Production Administration, Industrial Statistics Division, "Wartime Manufacturing Plant Expansion, Privately Financed, 1940-1945"

17 Department of Commerce, "Air Commerce Buletin" (Volume 1, Number 5)

18 Department of Commerce, "Survey of Current Business—National Income"

19 Department of Commerce, Bureau of the Census, "Biennial Census of Manufactures" (1921, 1937)

20 Department of Commerce, Bureau of the Census, "Census of the United States—Manufactures" (1919, 1929, 1939)

21 Department of Commerce, Bureau of the Census, "Census of Manufactures, 1947"

22 Department of Commerce, Bureau of the Census, "Annual Survey of Manufactures" (1949, 1950, 1951, 1952)

23 Department of Commerce, Bureau of the Census, "Facts for Industry," Series M42A, (Monthly)

24 Department of Commerce, Bureau of the Census, "Facts for Industry," Series M42C, (Monthly)

25 Department of Commerce, Bureau of the Census, "Facts for Industry," Series M42D, (Quarterly)

26 Department of Commerce, Bureau of the Census, Foreign Trade Division

27 Department of Commerce, Bureau of the Census, "Foreign Trade Statistics Notes"

28 Department of Commerce, Bureau of the Census, "U. S. Exports of Domestic & Foreign Merchandise," (Report FT-410)

29 Department of Commerce, Bureau of the Census, "Historical Statistics of the United States, 1789-1945"

30 Department of Commerce, Bureau of the Census, "Statistical Abstract of the United States," (Annual)

31 Department of Commerce, Civil Aeronautics Administration, "The Airplane at Work for Business & Industry"

32 Department of Commerce, Civil Aeronautics Administration, "CAA Statistical Handbook of Civil Aviation"

33 Department of Commerce, Civil Aeronautics Administration, "Statistical Study of U. S. Civil Aircraft," January 1, 1953

34 Department of Commerce, Civil Aeronautics Administration, "U. S. Military Aircraft Acceptances, 1940-1945"

35 Department of Commerce, Civil Aeronautics Administration, Office of Aviation Information

36 Department of Commerce, Civil Aeronautics Administration, "Report No. ACA-503"

37 Department of Commerce, Civil Aeronautics Board, "Annual Report of the Civil Aeronautics Board"

38 Department of Commerce, Civil Aeronautics Board, Statistical Section

39 Department of Commerce, Bureau of Public Roads

40 Department of Defense, "Monthly Report on the Status of Funds by Budget Category," EISED 250

41 Department of Defense, "Annual Report on the Status of Funds by Budget Category," EISED 224

42 Department of Defense, "Estimated Expenditures by Budget Category," EISED 265

43 Department of Defense, Office of Public Information

44 Department of Defense, Managerial Statistics Division, Office of International Security Affairs

45 Department of Defense, Office of Military Assistance, "Department of Defense Key MDAP Statistics" (Monthly)

46 Department of Defense, "Releasable Information on U. S. Air Force Aircraft"

47 "Disposal of Surplus Aircraft and Major Components Thereof," Senate Subcommittee Print No. 6, June 26, 1944

48 Dominion Bureau of Statistics, Ottawa, Ontario, Canada

49 Executive Office of the President, Bureau of the Budget, Estimates Division, "Budget of the U. S. Government" (Annual)

50 Federal Coordinator of Transportation, "Public Aids to Transportation," (Volume 1)

51 First National City Bank, Monthly Letter, "Business and Economic Conditions"

52 Foreign Operations Administration, "Monthly Operations Report"

53 Department of Health, Education and Welfare, Office of Education

54 House Subcommittee Hearings, "Appropriations for the Department of the Air Force" (1954)

55 H. M. Stationery Office, London, "The Civil Aviation and Technical Review, 1938"

56 H. M. Central Office of Information, London

57 H. M. Stationery Office, London, "Ministry of Labour Gazette" (Monthly)

58 International Air Transport Association, "Bulletin #19"

59 International Air Transport Association, ICAO News Release, 30 December, 1954, "Air Traffic Increases in 1954"

60 International Civil Aviation Organization, "Scheduled Airline Operations Digest of Statistics, No. 36," Series T, No. 9

61 Interstate Commerce Commission, Bureau of Transport Economics and Statistics

62 Interstate Commerce Commission, "Monthly Comment on Transportation Statistics"

63 Interstate Commerce Commission, "Some Aspects of Postwar Air & Surface Transportation," January 1945

64 Interstate Commerce Commission, Bureau of Transport Economics and Statistics, "Statistics of Oil Pipe Line Companies"

65 Department of Justice, Immigration and Naturalization Service, Administrative Division, Statistics Branch, "Report of Travel between U. S. and Foreign Countries." (Monthly)

66 Department of Labor, Bureau of Employment Security

67 Department of Labor, Bureau of Labor Statistics, Division of Wages and Industrial Relations

68 Department of Labor, Bureau of Labor Statistics, Industrial Hazards Branch

69 Department of Labor, Bureau of Labor Statistics, "Employment and Earnings" (Monthly) (Formerly "Employment and Payrolls")

70 Department of Labor, Bureau of Labor Statistics, "Revised Series—Employment"

71 Department of Labor, Bureau of Labor Statistics, "Wartime Development of the Aircraft Industry," Bulletin #800

72 Department of Labor, Bureau of Labor Statistics, "Industrial Research and Development. A Preliminary Report." (January 1953)

73 Department of Labor, Bureau of Labor Statistics, Bulletin 1148—"Scientific Research and Development in American Industry," June 25, 1953

74 Department of Labor, Bureau of Labor Statistics, "Work Injuries in the U. S." (Annual)

75 Munitions Board

76 Munitions Board, Office of Aircraft Programs

77 National Association of Bus Operators

78 National Production Authority, Aircraft Division

79 National Safety Council, "Accident Facts," (Annual)

80 National Science Foundation, Annual Reports

81 National Science Foundation, "Federal Funds for Science: II The Federal Research and Development Budget, 1952, 1953"

82 Department of the Navy, Bureau of Aeronautics

83 Department of the Navy, Office of Information

84 Department of the Navy, Bureau of Naval Personnel, Military Personnel Statistics

85 Department of the Navy, Navy Aviation Desk, News Branch

86 North American Aviation, Inc., "Corporation Summary Commitment Report" (1954)

87 Piper Aircraft Corporation, "Piper Gives Wings to Business" (1953)

88 Post Office Department, Bureau of Transportation, Division of Air Service

89 President's Airport Commission, "The Airport and Its Neighbors"

90 Department of the Treasury, Bureau of Internal Revenue

INDEX

THE AIRCRAFT INDUSTRIES ASSOCIATION

OF AMERICA, INCORPORATED