

Commercial Air Wars: Strategies That Changed Commercial Aviation

II

A little History:
Wright Brothers to Turbo-Props

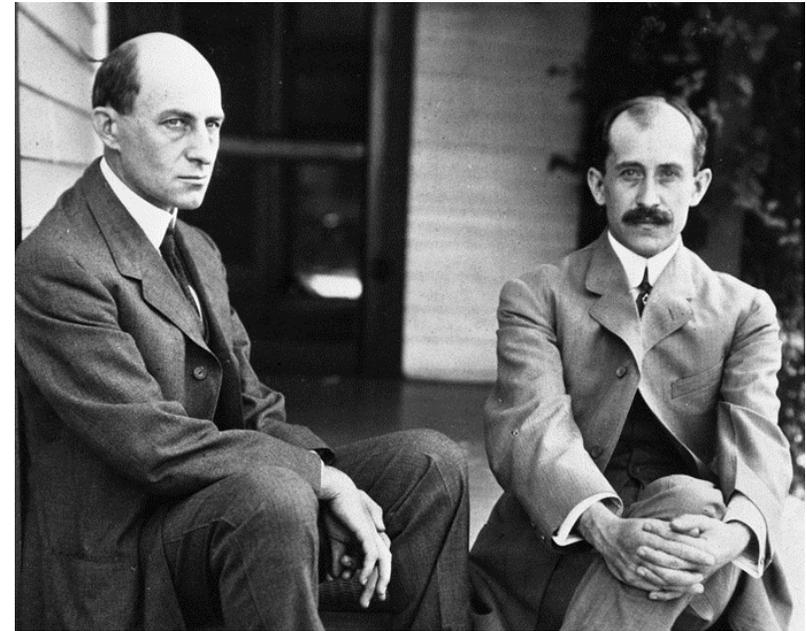
Jim Rauf

Commercial Air Wars: Strategies That Changed Commercial Aviation

To understand the present “battle” between **Boeing** and **Airbus** , a bit of the history of large commercial aircraft manufactures and some of their aircraft , especially jet powered aircraft , will be useful

A Bit of History

December 17, 1903 - Orville Wright makes the first heavier than air manned flight at Kitty Hawk, NC
The plane, made of wood, wire, and cloth, traveled 120 feet and flew for 12 seconds
It was powered by a water cooled 12 hp four cylinder engine

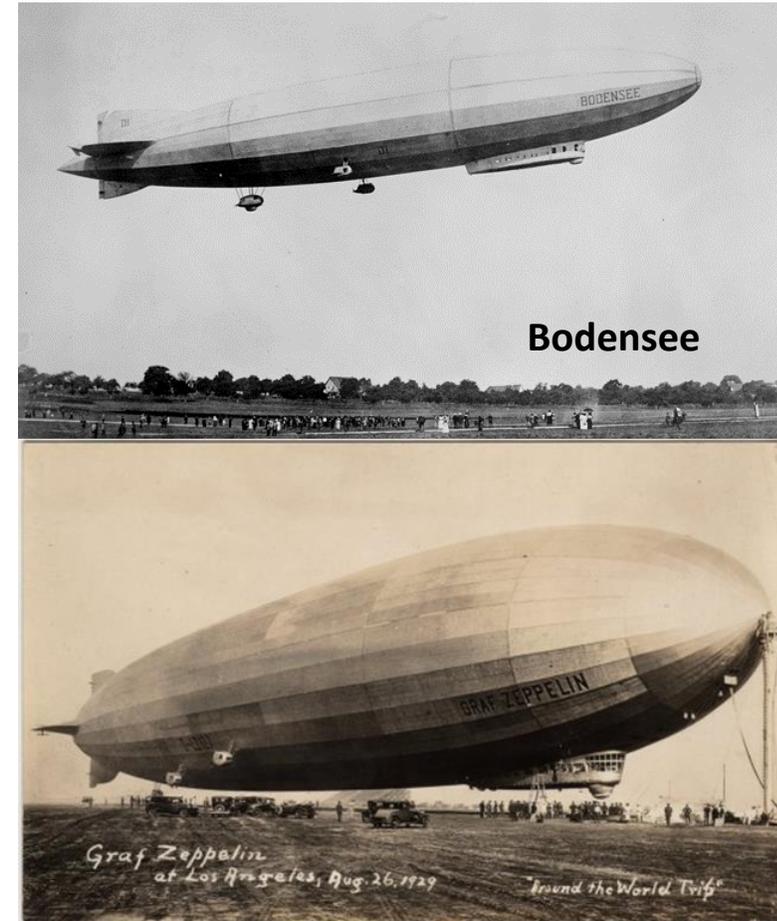


Wilbur and Orville Wright

A Bit of History

World's first passenger airline

- November 16, 1909 **DELAG** (*Deutsche Luftschiffahrts-Aktiengesellschaft*, or German Airship Transportation Corporation Ltd) was established, as an offshoot of the Zeppelin Company
- DELAG airship **Bodensee** began scheduled service between Berlin and southern Germany in 1919
 - The flight from Berlin to Friedrichshafen took 4-9 hours, compared to 18-24 hours by rail
- DELAG offered the world's first transatlantic passenger service, using **LZ-127 Graf Zeppelin** to make scheduled flights between Germany and South America beginning in 1931



Graf Zeppelin crossed the South Atlantic 136 times before being retired after the **Hindenburg** disaster in 1937

A Bit of History

- **St. Petersburg-Tampa Airboat Line**
- January 1, 1914, ten years after Orville and Wilbur Wright made their first flights at Kitty Hawk, N.C., a two seat flying boat built by Thomas Benoist and piloted by Antony H. Jannus flew the 18 mile trip from St. Petersburg to Tampa, Florida carrying its first passenger, former St. Petersburg Mayor Abe Pheil
- Though rarely exceeding an altitude of 5 feet above the water, the flying boat reduced the time of the otherwise 2 hour boat trip to 23 minutes
- The **St. Petersburg-Tampa Airboat Line** would go on to fly two flights per day for the next four months
- The company would go out of business after four months of operation



A Bit of History

- **KLM** (Koninklijke Luchtvaart Maatschappij) is generally recognized as the oldest airline still in service, under its original name
- It was established in October 1919 by a group of investors and its first director **Albert Plesman**
- The first flights began in May 1920, with a **DeHavilland DH-16** aircraft between Croydon, London, and Amsterdam
- The flight was flown using a **De Haviland DH-16**
- **It** carried two British journalists and some newspapers
- In 1920, KLM carried 440 passengers and 22 tons of freight
- In 1921, KLM started scheduled services



- **De Havilland DH-16**
- Crew: One
- Capacity: Four passengers
- Length: 31 ft 9 in
- Wingspan: 46 ft 5+7/8 in
- Height: 11 ft 4 in
- Empty weight: 3,155 lb
- Max takeoff weight: 4,750 lb
- Powerplant: 1 × Napier Lion 450hp
12-cylinder water-cooled piston engine
- Maximum speed: 136 mph
- Cruise speed: 100 mph
- Range: 425 mi
- Service ceiling: 21,000 ft

A Bit of History

- The **Junkers F 13** was the world's first *all-metal transport* aircraft
- It was developed in Germany at the end of World War I
- It was an advanced cantilever-wing monoplane, with enclosed accommodation for four passengers
- 322 were manufactured over 13 years and were operated all over the globe
- It was in commercial service for more than 30 years

Junkers F13



Specification 1919

Type:	open cockpit, enclosed cabin airliner
Dimensions:	(early aircraft) wing span 14.47m (47ft 5¾in), length 9.59m (31ft 5in), height 3.50m (11ft 5¾in)
Loaded weight:	1640kg (3620lb)
Powerplant:	one 185hp BMW IIIa six-cylinder inline piston engine
Maximum speed:	173km/h (107mph)
Range:	1400km (870 miles)
Service ceiling:	5000m (16,400ft)
Crew:	2
Passengers:	4

A Bit of History

- The **Fokker F.VII**, also known as the **Fokker Trimotor**, was produced from 1925 -1932 by the **Dutch** aircraft manufacturer **Fokker**, it's American subsidiary **Atlantic Aircraft Corporation**, and other companies under license
- It was operated by **SABENA** , KLM , and **LOT** airlines



1925

Specification (F.VII-3m)

Type:	trimotor airliner
Dimensions:	wing span 21.71m (71ft 3in), length 14.57m (47ft 7in), height 3.90m (12ft 10in)
Loaded weight:	5300kg (11,684lb)
Powerplant:	three 300hp Wright J-6 Whirlwind nine-cylinder radial piston engines
Cruising speed:	178km/h (111mph)
Range:	1200km (746 miles) with additional fuel
Service ceiling:	4400m (14,435ft)
Crew:	2
Passengers:	8 to 10

A Bit of History

- The **Ford Trimotor** was three-engine civil transport aircraft
- It was produced by Ford from 1925 through
- 199 Ford Trimotors were built
- It was operated by many American and foreign airlines over the years



1925

Specification (Model 5-AT-C)

Type:	all-metal trimotor airliner
Dimensions:	wing span 23.72m (77ft 3in), length 15.32m (30ft 3in), height 3.66m (12ft)
Maximum take-off weight:	6124kg (13,500lb)
Powerplant:	three 420hp seven-cylinder Pratt & Whitney Wasp radial piston engines
Maximum speed:	246km/h (153mph)
Range:	901km (560 miles)
Service ceiling:	5639m (18,500ft)
Crew:	2
Passengers:	13 to 15

A Bit of History

- The **Ju 52** was in production between 1931 and 1952 in Germany, France and Spain
- Total production was 4,845
- It was operated by 12 airlines including **Swissair** and **Lufthansa** as both passenger and freight haulers
- It was also used as a military transport for the Nazi regime



1931



Specification (Ju 52/3m ge)

Type:	all-metal trimotor airliner
Dimensions:	wing span 29.25m (95ft 11in), length 18.90m (62ft), height 6.10m (20ft)
Loaded weight:	9200kg (20,282lb)
Powerplant:	three 600hp BMW 132A-1 radial piston engines
Maximum speed:	290km/h (180mph)
Range:	915km (568 miles)
Service ceiling:	5200m (17,000ft)
Crew:	2
Passengers:	17

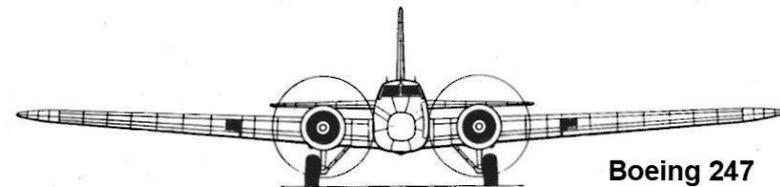
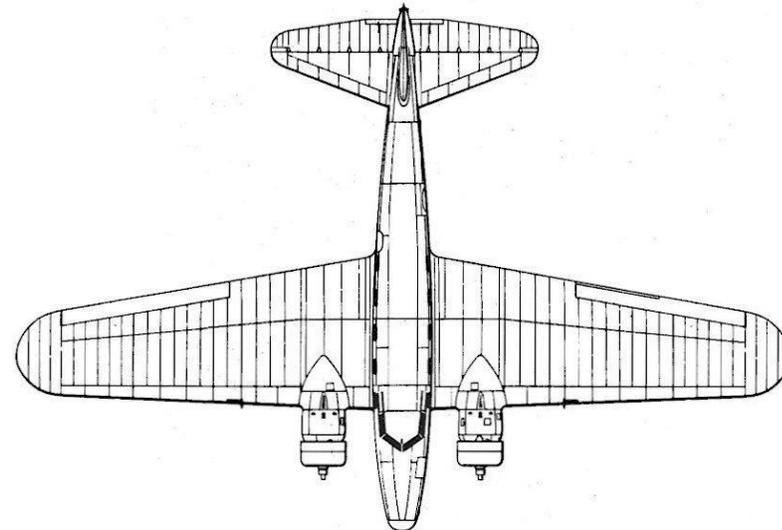
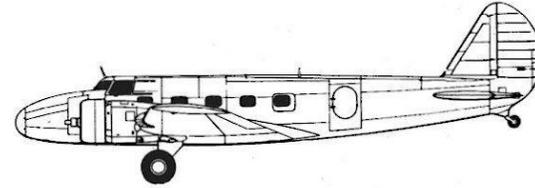
A Bit of History

- 1933 **Boeing Model 247**- *first modern passenger airliner*
- Twin engine, all metal, cantilever wing
- A gyro panel for instrument flying, autopilot, pneumatic de-icing equipment, variable-pitch propeller retractable landing gear



A Bit of History Boeing 247

- **Crew:** three
- **Capacity:** 10 passengers
- **Length:** 51 ft 5 in
- **Wingspan:** 74 ft 1 in
- **Height:** 12 ft 5 in
- **Empty weight:** 8,921 lb
- **Max. takeoff weight:** 13,650 lb
- **Engines:** 2 × Pratt & Whitney S1H1-G Wasp radial engine, 550 hp each
- **Maximum speed:** 200 mph
- **Cruise speed:** 188 mph
- **Range:** 745 miles
- **Service ceiling:** 25,400 ft



Boeing 247

A Bit of History Boeing 247

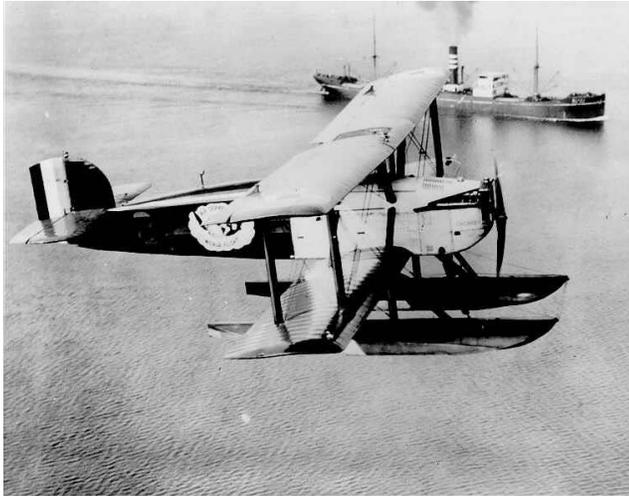
- It took 20 hours with seven stops, for the **Model 247** to fly between New York and Los Angeles.
- Because the 247 flew at 188 mph, its trip was seven and a half hours shorter than that made by any previous airliners
- 75 were built—
Boeing Air Transport flew 60
United Aircraft Corp. flew 10
Deutsche Lufthansa flew 4
- The **Boeing 247** was displaced by the **Douglas DC-1** and later variants



Boeing 247 Passenger Cabin
Capacity : 10 passengers

Douglas Aircraft Company

- The **Douglas Aircraft Company** was founded in 1921 by **Donald Wills Douglas Sr**
- The first circumnavigation of the world by air was in the **Douglas World Cruiser**, modified **Douglas DT** airplanes in 1924



- It later merged with **McDonnell Aircraft** in 1967 to form **McDonnell Douglas**
- It then operated as a division of **McDonnell Douglas**
- **McDonnell Douglas** merged with **Boeing** in 1997

- **Before WW II Douglas Aircraft** designed and built a wide variety of aircraft for the U.S. military, (Navy, Army Air Forces, Marine Corps, Air Force, and Coast Guard)

Douglas Aircraft Company

Douglas Aircraft Company

A Bit of History Douglas DC-3

1934



Specification (DC-3)

Type:	all-metal twin-engined airliner
Dimensions:	wing span 28.96m (95ft), length 19.65m (64ft 6in), height 5.16m (16ft 11in)
Maximum take-off weight:	12,701kg (28,000lb)
Powerplant:	two 1050hp Pratt & Whitney R-1830-S1C3G radial piston engines
Maximum cruising speed:	274km/h (170mph)
Range:	1650km (1025 miles)
Service ceiling:	7070m (23,200ft)
Crew:	2
Passengers:	24



A Bit of History

Douglas DC-2

- The introduction of the **DC-1** (*Douglas Commercial Model One*) in 1933 marked the beginning of 64 years of continuous production of passenger planes by the **Douglas Aircraft Co**
- The airplane was designed as a series prototype for **TWA** to compete against the revolutionary **Boeing Model 247** ordered by **Boeing** subsidiary **United Air Lines**
- The **DC-1** exceeded all but one of the tough specifications set by its buyer — **TWA** wanted three engines
- The **DC-1** had two engines
- The **DC-1** was very advanced for its day
- Its fuselage was streamlined, as were its wings and engine cowlings
- It featured all-metal construction and retractable landing gear
- Variable-pitch propellers gave the plane remarkable takeoff and landing characteristics
- With plush seats, a kitchen and a comfortable restroom, the **DC-1** set a new standard for passenger comfort



A Bit of History

- Great efforts were made to insulate the passenger compartment from the noise of the plane's engines
- The plane's passenger seats were mounted on rubber supports, while the cabin was lined with noise-absorbing fabric
- Carpet covered the cabin floor, and even the engines were mounted on rubber insulators
- The **DC-1** carried 12 passengers (two more than the **Model 247**) and could fly as fast as 180 mph
- In April 1935, it set a transcontinental speed record, covering the distance from Los Angeles, Calif., to New York in 11 hours, five minutes
- Pleased with its new plane, **TWA** placed an order for 25 larger aircraft designated the **DC-2**
- Enlarged once more, the **DC-2's** basic design evolved into the **DC-3**
- Only one **DC-1** was built!



A Bit of History

- The **DC-2** was introduced less than a year after the **DC-1's** first flight
- The new plane was similar in shape to the DC-1 but had more powerful engines, was faster and was capable of longer flights
- It was 2 feet longer and could carry two more passengers — 14 instead of 12
- The **DC-2** was an instant hit
- In its first six months of service, the **DC-2** established 19 American speed and distance records
- In 1934, **Transcontinental & Western Air** put DC-2s on overnight flights from New York to Los Angeles
- Called "*The Sky Chief*," the flight left New York at 4 p.m. and, after stops in Chicago, Kansas City, Missouri, and Albuquerque, New Mexico, arrived in Los Angeles at 7 a.m.
- For the first time, the air traveler could fly from coast to coast without losing the business day.



A Bit of History

- The **DC-2** was the first **Douglas** airliner to enter service with an airline outside the United States
- In October 1934, **KLM Royal Dutch Airlines** entered one of its **DC-2s** in the London-to-Melbourne, Australia, air race
- It made every scheduled passenger stop on **KLM's** regular 9,000-mile route (1,000 miles longer than the official race route), carried mail and even turned back once to pick up a stranded passenger
- Even so, the **DC-2** finished in second place behind a racing plane built especially for the competition
- After that, the **DC-2's** reputation was ensured, and it became the airplane of choice for many of the world's largest airlines
- In 1935, the **DC-2** became the first Douglas aircraft to receive the prestigious **Collier Trophy** for outstanding achievements in flight
- Between 1934 and 1937, **Douglas** built 156 **DC-2s** at its Santa Monica, California, plant

A Bit of History

- The **Douglas DC-3**, which made air travel popular and airline profits possible, is universally recognized as the greatest airplane of its time
- Some would argue that it is the greatest of all time
- Design work began in 1934 at the insistence of **C.R. Smith**, president of **American Airlines**
- **Smith** wanted two new planes — a longer **DC-2** that would carry more day passengers and another with railroad-type sleeping berths, to carry overnight passengers
- The first **DC-3** built was the **Douglas Sleeper Transport** — also known as *Skysleepers* by airline customers — and it was the height of luxury
- Fourteen plush seats in four main compartments could be folded in pairs to form seven berths, while seven more folded down from the cabin ceiling
- The plane could accommodate 14 overnight passengers or 28 for shorter daytime flights



- First flight Dec. 17, 1935
- Model number DC-3
- Wingspan 95 feet
- Length 64 feet 5.5 inches
- Height 16 feet 3.6 inches
- Ceiling 20,800 feet
- Range 1,495 miles
- Weight 30,000 pounds
- Power plant Two 1,200-horsepower Wright Cyclone radial engines
- Speed 192 mph
- Accommodation 3 crew and 14 sleeper passengers, or 21 to 28 day passengers, or 3,725 to 4,500 pounds freight

A Bit of History Douglas DC-3

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- The plane could accommodate 14 overnight passengers or 28 for shorter daytime flights
- The first was delivered to **American Airlines** in June 1936, followed two months later by the first standard 21-passenger **DC-3**
- In November 1936, **United Airlines**, which had been a subsidiary of **Boeing** until 1934, became the second **DC-3** customer
- Initial orders from American and United were soon followed by orders from more than 30 other airlines in the next two years.
- The **DC-3** was not only comfortable and reliable, it also made air transportation profitable
- **American's C.R. Smith** said the **DC-3** was the first airplane that could make money just by hauling passengers, without relying on government subsidies
- By 1939, more than 90 percent of the nation's airline passengers were flying on **DC-2s** and **DC-3s**
- In addition to the 455 **DC-3** commercial transports built for the airlines, 10,174 were produced as **C-47** military transports during World War II

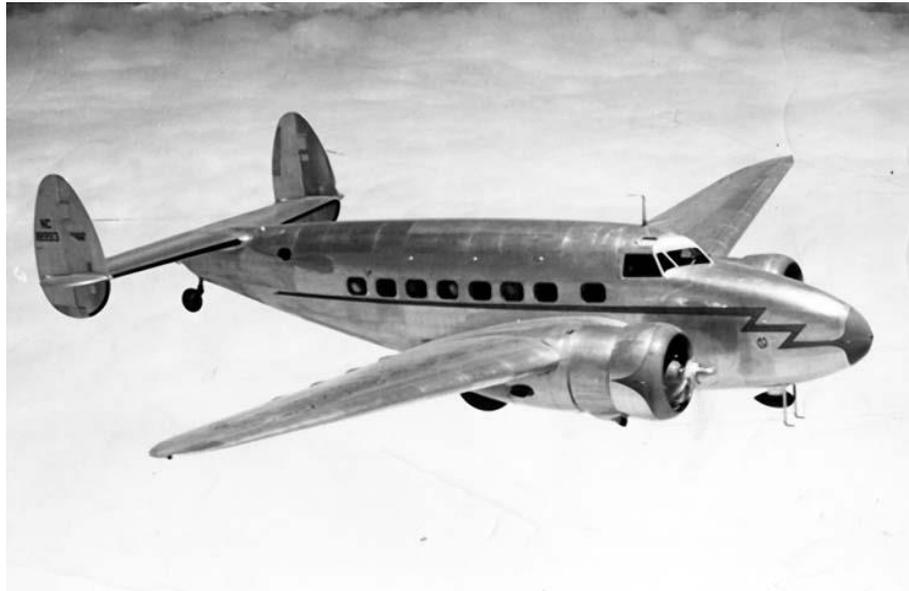
A bit of History

- The first was delivered to **American Airlines** in June 1936, followed two months later by the first standard 21-passenger **DC-3**
- In November 1936, **United Airlines**, which had been a subsidiary of Boeing until 1934, became the second **DC-3** customer
- The **DC-2** had proved more economical than the **Boeing Model 247**, and **United** assumed the **DC-3** would continue that lead
- Initial orders from **American** and **United** were soon followed by orders from more than 30 other airlines in the next two years
- The **DC-3** was not only comfortable and reliable, it also made air transportation profitable
- **American's C.R. Smith** said the **DC-3** was the first airplane that could make money just by hauling passengers, without relying on government subsidies
- As a result, by 1939, more than 90 percent of the nation's airline passengers were flying on **DC-2s** and **DC-3s**

A bit of History Lockheed

- During World War II, Lockheed, in cooperation with TWA, had developed the **L-049 Constellation**, a radical new airliner capable of flying 43 passengers between New York and London at a speed of 300 mph in 13 hours
- Once the Constellation (nicknamed *Connie*) went into production, the military received the first production models; after the war, the airlines received their original orders, giving Lockheed more than a year's head-start over other aircraft manufacturers in what was easily foreseen as the post-war modernization of civilian air travel
- The Constellations' performance set new standards which transformed the civilian transportation market
- Its signature tri-tail was the result of many initial customers not having hangars tall enough for a conventional tail
- During the 1960s, Lockheed began development for two large aircraft: the **C-5 Galaxy** military transport and the **L-1011 TriStar wide-body** civil airliner
- Both projects encountered delays and cost overruns
- The **C-5** was built to vague initial requirements and suffered from structural weaknesses, which Lockheed was forced to correct at its own expense
- The **TriStar** competed for the same market as the **McDonnell Douglas DC-10**; delays in **Rolls-Royce** engine development caused the **TriStar** to fall behind the **DC-10**
- The **C-5** and **L-1011** projects, the canceled U.S. Army AH-56 Cheyenne helicopter program, and embroiled shipbuilding contracts caused Lockheed to lose large sums of money during the 1970s
- 1971 Lockheed asked the US government for a loan guarantee, to avoid insolvency
- May 13, 1971 the **Richard Nixon** administration sent a bill titled "The Emergency Loan Guarantee Act" to Congress requesting a \$250 million loan guarantee for Lockheed and its L-1011 Tristar **airbus** program

A Bit of History Lockheed Super Electra

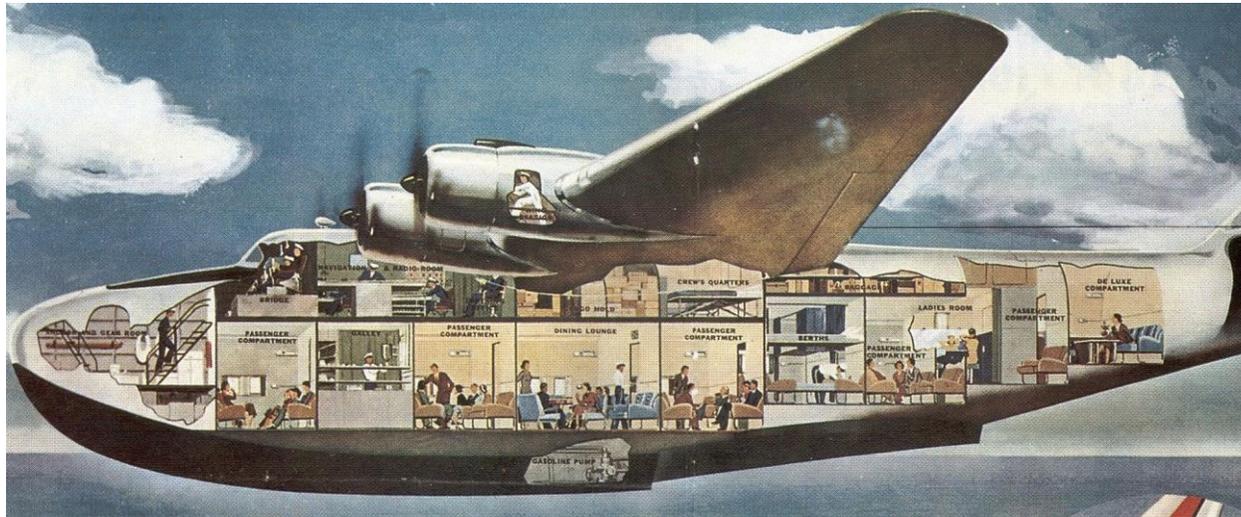


1937

Specification (Model 18)

Type:	Lodestar 18-seat airliner
Dimensions:	wing span 19.96m (65ft 6in), length 15.19m (49ft 10in), height 3.60m (11ft 10in)
Loaded weight:	7938kg (17,500lb)
Powerplant:	two 875hp Pratt & Whitney S1E2-G Hornet radial piston engines
Maximum speed:	428km/h (266mph)
Range:	4025km (2500 miles)
Service ceiling:	7740m (25,400ft)
Crew:	2
Passengers:	18

A Bit of History Boeing 314 Clipper



1938

Specification (Model 314A Clipper)

Type:	transoceanic flying-boat airliner
Dimensions:	wing span 32.85m (152ft), length 32.30m (106ft), height 8.40m (27ft 7in)
Gross weight:	38,000kg (84,000lb)
Powerplant:	four 1600hp Wright GR-2600 Twin Cyclone 14-cylinder radial piston engines
Cruising speed:	296km/h (184mph)
Range:	8369km (5200 miles)
Service ceiling:	4085m (13,400ft)
Flight crew:	5
Passengers:	74

A Bit of History Boeing 307 Stratoliner



1938

Specification (SA-307B Stratoliner)

Type:	long-range pressurized airliner
Dimensions:	wing span 32.70m (107ft 3in), length 22.70m (74ft 4in), height 6.30m (20ft 9in)
Gross weight:	19,050kg (42,000lb)
Powerplant:	four 1000hp Wright GR-1820 Cyclone radial piston engines
Maximum speed:	396km/h (246mph)
Range:	3846km (2390 miles)
Service ceiling:	7985m (26,200ft)
Flight crew:	3
Passengers:	33 (later 38)



A Bit of History Douglas DC-4 , DC-6 , DC-7



1938

Specification (DC-7C)

Type:	long-range airliner
Dimensions:	wing span 38.86m (127ft 6in), length 34.21m (112ft 3in), height 9.70m (31ft 10in)
Maximum take-off weight:	64,864kg (143,000lb)
Powerplant:	four 3400hp Wright R-3350-18EA-1 turbo-compound radial piston engines
Maximum speed:	653km/h (405mph)
Range:	7411km (4605 miles)
Service ceiling:	6615m (21,700ft)
Flight crew:	3
Passengers:	105



DC-6 and DC-7 were pressurized

A Bit of History Lockheed Constellation , Super Constellation

1943



Specification (L-1049C)

Type:	Constellation (unless otherwise stated) long-range airline
Dimensions:	wing span 37.49m (123ft), length (with radar nose) 35.42m (116ft 2in), height 7.56m (24ft 9in)
Maximum take-off weight:	60,329kg (133,000lb)
Powerplant:	four 3250hp Wright R-3350-972TC18DA-1 18-cylinder turbo-compound radial piston engines
Maximum speed:	602km/h (374mph)
Operational range:	6470km (4020 miles)
Service ceiling:	7071m (23,200ft)
Flight crew:	3 to 5

Capacity: 47 to 107 passengers



A Bit of History Boeing 377 Stratocruiser

1947



Specification

Type:	long-range airliner
Dimensions:	wing span 43m (141ft 3in), length 33.65m (110ft 4in), height 11.66m (38ft 3in)
Normal take-off weight:	76,195kg (145,800lb)
Powerplant:	four 3500hp Pratt & Whitney R-4360 Wasp Major 28-cylinder, four-row turbo-supercharged radial piston engines
Maximum speed:	603km/h (375mph)
Range:	7360km (4600 miles)
Service ceiling:	more than 9760m (32,000ft)
Flight crew:	5
Passengers:	typically 67 passengers on the upper deck and 14 below



A Bit of History Vickers Viscount



1948

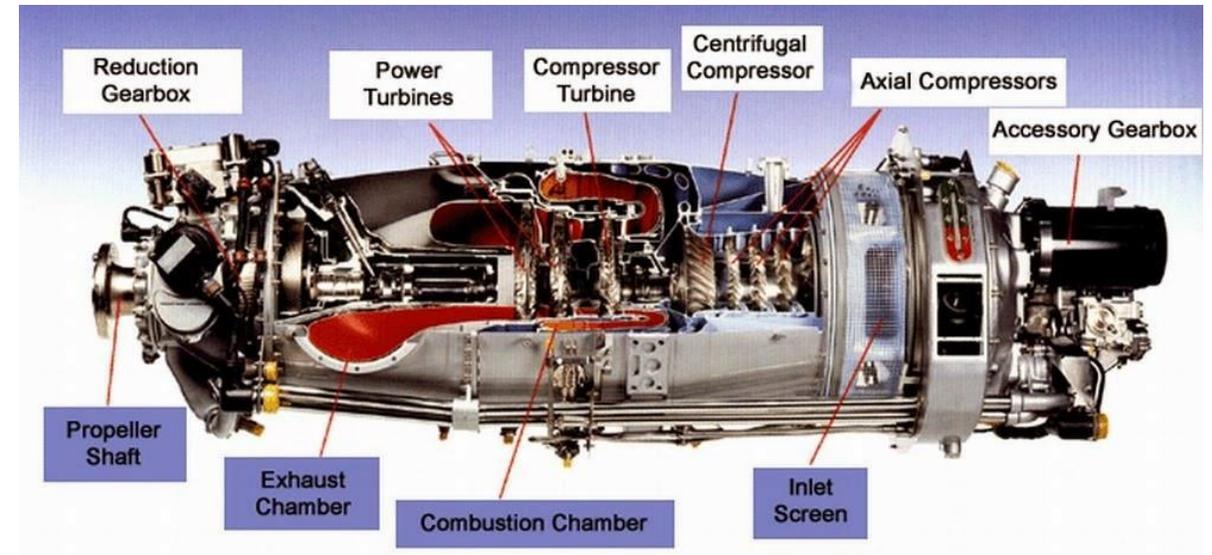
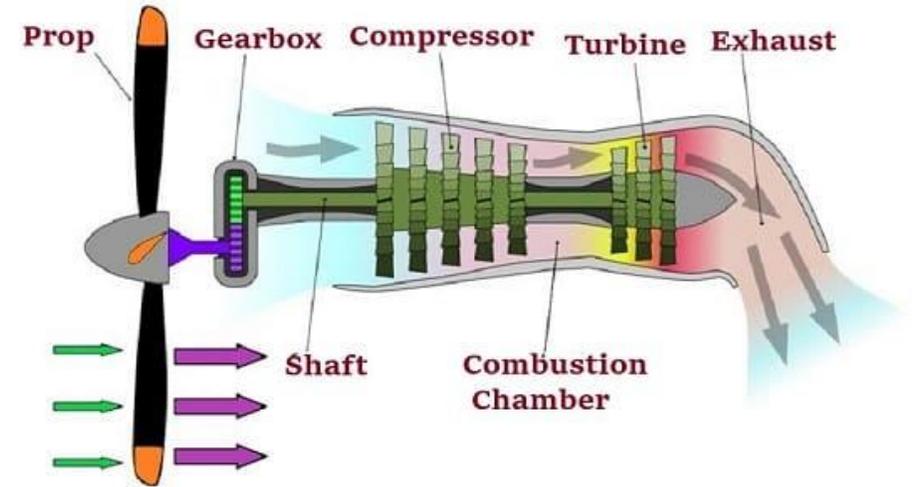
Specification (V.810 Viscount)

Type:	short/medium-range airliner
Dimensions:	wing span 28.56m (93ft 8½in), length 26.11m (85ft 8in), height 8.15m (26ft 9in)
Loaded weight:	32,885kg (72,500lb)
Powerplant:	four 1990ehp Rolls-Royce Dart RDa.7 turboprops
Continuous cruising speed:	565km/h (351mph)
Range:	2832km (1760 miles)
Service ceiling:	7620m (25,000ft)
Flight crew:	2
Passengers:	75



Turboprop Engine

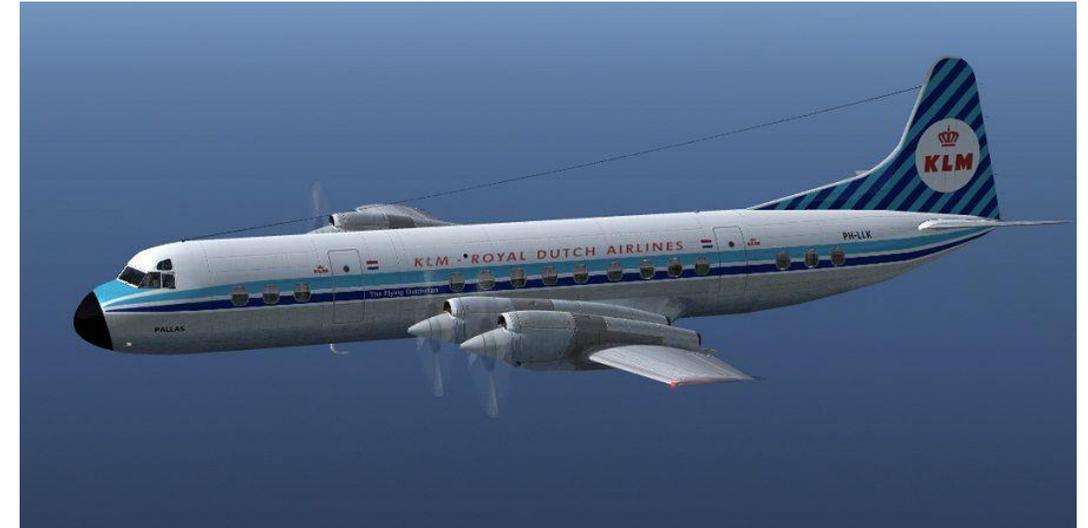
- A **turboprop** engine is a gas turbine engine that drives an aircraft propeller
- The propeller is driven thru a gearbox that reduces the turbine RPM from ~



A bit of History Lockheed L-188 Electra

- The **Lockheed L-188 Electra** first flown in 1957, it was the first large turboprop airliner built in the United States
- Initial sales were good, but after two fatal crashes that led to expensive modifications to fix a design defect, no more were ordered
- Total production 170 aircraft
- **Allison 501-D13** 3750 hp turboprops
- With its unique high power-to-weight ratio, huge propellers the airplane had airfield performance capabilities unmatched by many jet transport aircraft—particularly on short runways and high field elevations

1957



A bit of History Lockheed L-188 Electra

- Lockheed chose to stick with a turboprop driven plane even after Boeing has decided to offer its turbojet powered 707
- Lockheed was counting on the reluctance of the airlines to adopt jet powered aircraft
- This decision as well as the L-188 Electra's disastrous accident proved to be a major error in Lockheed's strategy
- The Lockheed L-188 Electra was developed to meet a 1954 American Airlines requirement for a domestic short to medium range 75 to 100 seat airliner
- In June 1955 American awarded Lockheed an order for 35 such aircraft
- Lockheed's design, the L-188, was a low wing, four turboprop powered aircraft.
- Many other airlines shared American's interest in the L-188, and by the time the first prototype flew on December 6 1957, the order book stood at 144
- Service entry was with Eastern Airlines (due to a pilot's strike at American) on January 12 1959
- However, any optimism Lockheed felt about a strong sales future would have been short lived, as a number of crashes in 1959 and 1960 (two of which where the aircraft broke up in flight) contributed to a number of order cancellations
- As an interim measure following the crashes, speed restrictions were imposed on Electras. Investigations uncovered a design defect with the engine mountings where the wing would shake and eventually break up
- Lockheed undertook a significant modification program where the nacelles, nacelle mountings and wing structure were strengthened, and the speed restrictions were eventually lifted in 1961
- After that the Electra proved reliable and popular in service, but the damage had been done and production wound up in 1961 after 170 had been built
- Lockheed built two basic versions of the Electra. The L-188A was the basic production aircraft, and accounted for most Electra sales. The L-188C entered service with KLM in 1959 and had greater fuel capacity and higher weights, and thus improved payload range performance

A Bit of History

Viscount



Cambrian Airways Vickers Viscount

Role	Turboprop airliner
National origin	United Kingdom
Manufacturer	Vickers-Armstrongs
First flight	16 July 1948
Introduction	18 April 1953 with British European Airways
Retired	January 2009
Status	Retired
Primary users	British European Airways Capital Airlines Trans-Canada Air Lines Air Canada
Produced	1948–1963
Number built	445
Developed into	Vickers Vanguard

L-188 Electra

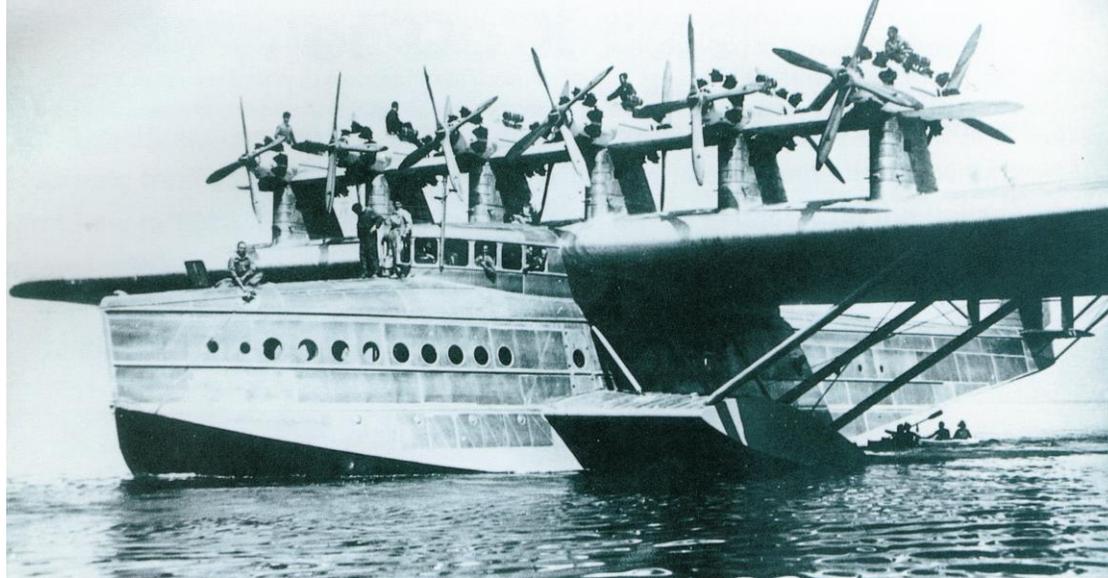


The L-188 is a low wing airliner powered by four turboprops

Role	Turboprop airliner
National origin	United States
Manufacturer	Lockheed Corporation
First flight	December 6, 1957
Introduction	January 12, 1959, with Eastern Air Lines
Status	In service ^[1]
Primary users	Buffalo Airways Air Spray Eastern Air Lines (Retired) American Airlines (Retired) National Airlines (Retired) Varig (Retired)
Produced	1957–1961
Number built	170
Variants	Lockheed P-3 Orion

A Bit of History

Dornier Do X



1929

Specification

Type:	long-range flying-boat airliner
Dimensions:	wing span 48m (157ft 5¾in), length 40m (131ft 4in), height 10.10m (33ft 1½in)
Maximum take-off weight:	56,000kg (123,459lb)
Powerplant:	six 600hp Curtiss Conqueror V-12 inline piston engines
Maximum speed:	210km/h (130mph)
Range:	2200km (1367 miles)
Service ceiling:	1200m (4100ft)
Flight crew:	5
Passengers:	maximum 150, but planned for 100 on transatlantic services