Commercial Air Wars: Strategies That Changed Commercial Aviation

Douglas and McDonnell Merger and the 747 and Widebodies

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History of U.S. Aircraft Manufacturers

1916 - Boeing
1926 - Stearman
1930 - Atlantic Fokker
1934 - Berliner
1928 - North American Aviation
1925 - Picairn
1941 - North American Aviation
1946 - Rockwell International
1967 - McDonnell Douglas
1939 - McDonnell
1935 - Hughes Aircraft Company
1934 - Hughes Tool Company Aircraft Division
2000 - Boeing
Douglas and McDonnell—The Players

- **Donald W. Douglas Sr.** founded the *Douglas Aircraft Company* on July 22nd, 1921
- He remained company president until 1957, becoming chairman of the board until 1967
- **Donald Douglas Jr.** was also a driving force within the company since 1939, he became president in 1957

- **James Smith McDonnell** incorporated the *McDonnell Aircraft Corporation* on July 6th, 1939
- The firm would go on to become a force in the aviation industry in the following decades, especially when it came to the space race and military efforts
- Mr McDonnell was president until 1962 before becoming chairman and CEO
McDonnell Douglas Company

• It was announced that Douglas Jr. would continue as head of the Douglas branch of the merged entity.

• “Despite management efforts to make the Douglas acquisition fit under the McDonnell umbrella, the two remain very separate entities. Douglas, with production facilities at Long Beach, Calif., was founded and built by Donald Douglas, who began in 1920 by making a biplane of wood, wire and cloth,” The New York Times shared in 1979.

• “The company dominated the commercial aircraft industry virtually without challenge until 1955, when Boeing and Lockheed began to gain ground

• By 1967, when McDonnell took it over, the company had overcommitted itself and faced cash shortages and huge production costs on the DC-9 twin jet transport.”

• Following the merger, the McDonnell Douglas Corporation would find it hard to balance success

• “The McDonnell half of the company, paradoxically as strong in its defense business as ever, was having difficulty making the Douglas half perform as expected

• The DC-10, once the company’s great hope for its commercial business, has been a continuing problem ever since production began eight years ago. The plane has never made money for McDonnell Douglas and was not expected to until at least 1982,” The New York Times added.

• Military contracts would provide a boost for the company

• Sales of the F-4, F-15, and F-18 fighters would help McDonnell Douglas report a record income of $161.1 million in 1978
Douglas Aircraft Company

- The post-war transformation in the market would take its toll on Douglas. Demand was at an all-time high for both civilian and fighter aircraft
  - The DC-8 and DC-9 were receiving a lot of attention from airlines, while the A-4 Skyhawk was increasing in popularity
- Douglas was struggling to increase production output following the rise in demand.
- There were also challenges due to staff shortages during the Vietnam War
- These difficulties were on top of financial troubles that were rocking operations
- As a result, Douglas was open to an offer from McDonnell, and talks began in the early 1960s

- After approximately four years of discussions, in January 1967, the leaders of two Douglas and McDonnell announced their intention of a merger
  - Following this step, Douglas Jr. and Mr McDonnell confirmed that the boards of their two businesses approved a definitive merger agreement on March 1st, 1967
  - The plan was revealed to have Douglas Sr. serve as honorary chairman of the new McDonnell Douglas Corporation (MDC)
  - Meanwhile, Mr McDonnell would serve as chairman and chief executive officer, and David Lewis would be the president.
Douglas Aircraft Company

• In 1963, Douglas had begun designing the short-range DC-9, which was introduced in 1965.
• Hoping to continue to expand its line of commercial airliners, Douglas would begin development of what would become the DC-10.
• On the surface of things, this was a sound business move, with Douglas looking to develop brand new airliners that airlines actually wanted.
• Douglas Aircraft were running out of money.
• Then there was also Douglas’ business practices.
• One of the reasons that they’d been so successful before WWII, was that they only focused on producing a few types of aircraft, thus allowing them to produce a few amazing aircraft, rather than several mediocre aircraft.
• However, Douglas failed to see the shift that took place after WWII.
• Following the war, companies like Boeing, were able to take advantage of producing every type of aircraft, thus giving them better market coverage.
• Douglas on the other hand, were only producing medium-range jet airliners, a few missiles and rockets here and there, and ejector seats.
• Facing mounting development costs, and having no way to pay for them, Douglas Aircraft began to look shaky from a financial standpoint. Indeed, it got so bad that Douglas Aircraft were less than a year away from going bankrupt!
• Seeing this, McDonnell Aircraft CEO James “Mac” McDonnell saw it as his chance to position McDonnell Aircraft as one of the world’s major aircraft manufacturers, entering talks with Donald Douglas about a takeover in early 1967.
• Not long after this, McDonnell would announced formation of McDonnell Douglas (MDC).
• McDonnell would dominate the merger, with McDonnell remaining as the company’s chairman and CEO, with Donald Douglas holding the position of honorary chairman of the company, which he’d hold until his death in 1981.
• Upon announcing this to the world, it was hailed as one of the smartest business moves of the century. After all, the issues that plagued both companies complimented each other nicely.
• While Douglas was struggling to finance its commercial aviation projects, McDonnell was overflowing with money, and was looking to invest it so the money could continue to make the company money.
• On top of this, Douglas was primarily a commercial aircraft manufacturer.
• McDonnell on the other hand, was solely a military aircraft manufacturer, meaning that a merger would compliment both companies nicely.
McDonnell Douglas Company

- Following the McDonnell Douglas merger in 1967, all commercial aircraft then under development at Douglas would be continued by the new McDonnell Douglas, who’d use McDonnell’s money to finance the rest of the jets’ development.

- Upon the introduction of jets like the MD-80 and DC-10 (and later the MD-11), these jets would prove to be cash cows for the new company, just as much as their military aircraft were.

- In September 1994, Harry Stonecipher was elected president and CEO of McDonnell Douglas, holding this post until its merger with Boeing in 1997.

- During this period he became much more of a public figure, and even began hosting the company’s quarterly video report.

- He remained on the board following the Boeing merger, serving as president and COO (chief operating officer).

- In 2001, he was elected vice chairman and retired the next year, while continuing to serve on the board as vice chairman.
Genesis of the Boeing 747

• In 1963, USAF started a series of study projects on a very large strategic transport aircraft

• These studies led to initial requirements for the CX-Heavy Logistics System (CX-HLS) in March 1964

• The desire to keep the number of engines to four required new engine designs with greatly increased power and better fuel economy

• In May 1964, airframe proposals arrived from Boeing, Douglas, General Dynamics, Lockheed, and Martin Marietta

• Engine proposals were submitted by General Electric, Curtiss-Wright, and Pratt & Whitney

• Boeing, Douglas, and Lockheed were given additional study contracts for the airframe, along with General Electric and Pratt & Whitney for the engines

• As the CX-HLS needed to be able to be loaded from the front, a door had to be included where the cockpit usually was

• All of the companies solved this problem by moving the cockpit above the cargo area; Douglas had a small "pod" just forward and above the wing, Lockheed used a long "spine" running the length of the aircraft with the wing spar passing through it, while Boeing blended the two, with a longer pod that ran from just behind the nose to just behind the wing

• In 1965, Lockheed's aircraft design and General Electric's engine design were selected for the new C-5 Galaxy transport, which was the largest military aircraft in the world at the time

• Boeing carried the nose door and raised cockpit concepts over to the design of the 747
Genesis of the Boeing CX-HLS Proposals
Genesis of the Boeing 747

High Bypass Turbofan Engines
Genesis of the Boeing 747

High Bypass Turbofan Engines

- The **Pratt & Whitney JT9D** engine was the first high bypass ratio jet engine to power a wide-body airliner.
- It was **Pratt & Whitney's** first high-bypass-ratio turbofan.

**Fan:** 1 stage  
**Low pressure compressor:** 3 stages  
**High pressure compressor:** 11 stages  
**High pressure turbine:** 2 stages  
**Low pressure compressor:** 4 stages  
**Fan tip diameter:** 93.4 inches  
**Length, flange to flange:** 132.7 inches  
**Weight:** 8,500 lbs

- **Bypass ratio:** 4.8-to-1  
- **Overall pressure ratio:** 26.7  
- **Fan pressure ratio:** 1.67  
- **Takeoff thrust:** 48,000 - 56,000 pounds

**Program launch:** September 1965  
**First engine test:** December 1966  
**FAA certification:** May 1969  
**Entry into service:** January 1970

- Without the High Bypass Turbofan engines large aircraft such the **747** would need 8 turbojet or low bypass turbofan engines.
Genesis of the Boeing 747

- Thanks in part to tourist/economy class, more and more Americans were taking to the skies.
- To take advantage of this rise, Juan Trippe wanted a plane with a larger seating capacity - 2.5 times that of the 707.
- Trippe struck an agreement with Bill Allen, president of Boeing.
- Although Allen casually agreed to the project while on a fishing trip, he would soon realize that it was no casual undertaking.
- *If you build it, I’ll buy it,* Trippe told Allen, who replied: “If you buy it, I’ll build it.”
Genesis of the Boeing 747

- The initial vision came from Juan Trippe, CEO of Pan Am
- Trippe was quick to notice that the new faster jet liners were making airports much more crowded because long trips were now possible and accessible to more people
- He approached Boeing with a request to design a plane capable of carrying more than double the number of passengers than such as Boeing’s 707
- Boeing had an interesting design on its drawing boards, a military project for a heavy cargo carrier
- It had lost the military contract to Lockheed’s C5 Galaxy and had not considered other possibilities for its design
- Then came Trippe’s request to design a super-large passenger plane
- That’s where the persistence came in, in the shape of Boeing engineer Joe Sutter and his team
- Boeing’s President, Bill Allen, took Sutter off his work on the 737 in 1965 to head up this new project
- Sutter worked with Pan Am and other airlines to determine their requirement
Genesis of the Boeing 747

• It was a constant fight on many fronts
• It took the backing of seven banks to finance the project
• Then there was the internal competition for the highly qualified engineering personnel necessary to carry the project through all of its phases, from design to final certification and delivery
• At the time, Boeing was working on the 737, as well as the 2707 SST, a supersonic competitor to the European Concorde
• The Boeing 2707 SST program was cancelled in 1971

• The 2707 design was a large aircraft
• Seating for 250 to 300 passengers
• Cruise speeds of approximately Mach 3
• It was intended to be much larger and faster than the Concorde
Genesis of the Boeing 747

- At one key meeting, **Sutter** was told he was going to have to give up many of his key staff to other programs.

- In front of **Bill Allen**, the President, he said that, in that case, he could not build the **747** and left the meeting, pretty sure he would lose his job as a result of his words and action.

- Instead, **Allen** recognized the courage **Sutter** was displaying in opposing his colleagues and peers and told him the **747** project was still on.

- The **747**’s long-term production would be greatly ensured if it stayed based closely on the original military aircraft that had failed to win the government contract for a large cargo freighter.

- **Sutter** and others thought that, long after the **747** passenger version would become obsolete, it would have an even longer future as a cargo freighter.

- This was possible because the pilots’ control flight deck was positioned high above the nose, enabling a wide nose door.
Genesis of the Boeing 747

- The **747** was the result of the work of some 50,000 **Boeing** people

- Called "**the Incredibles**," these were the construction workers, mechanics, engineers, secretaries and administrators who made aviation history by building the **747** — the largest civilian airplane in the world — in roughly 16 months during the late 1960s

- The incentive for creating the giant **747** came from reductions in airfares, a surge in air-passenger traffic and increasingly crowded skies

- The **747's** final design was offered in three configurations: all passenger, all cargo and a convertible passenger/freighter model

- The design philosophy behind the **747** was to develop a completely new plane, and other than the engines, the designers purposefully avoided using any hardware developed for the C-5

- The massive airplane required construction of the 200 million-cubic-foot **747** assembly plant in Everett, Wash., the world's largest building (by volume)

- The fuselage of the original 747 was 225 feet long

- The tail as tall as a six-story building

- Pressurized, it carried a ton of air

- The cargo hold had room for 3,400 pieces of baggage and could be unloaded in seven minutes

- The total wing area was larger than a basketball court

- The entire global navigation system weighed less than a modern laptop computer
747-100 Assembly Everett Plant
Genesis of the Boeing 747

- In April 1966, Pan Am ordered 25 Boeing 747-100 aircraft for US$525 million (equivalent to $3.3 billion in 2020 dollars)
Genesis of the Boeing 747

• The next version, the **747-200**, holds approximately 440 passengers and has a range of about 5,600 nautical miles.

• In 1990, two **747-200Bs** were modified to serve as **Air Force One**.

• They replaced the **VC-137s (707s)** that served as the presidential airplane for nearly 30 years.

• The **747-300** has an extended upper deck and carries even more passengers than the **-200**.

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- **Model number**: 747-100/-200
- **First flight**: Feb. 9, 1969
- **Wing Span**: 195 feet 8 inches
- **Length**: 231 feet 4 inches
- **Gross weight**: 735,000 pounds
- **Cruising speed**: 640 mph
- **Range**: 6,000 miles
- **Ceiling**: 45,000 feet
- **Engines**: Four P&W JT9D-3 43,000 lb thrust
- **Flight Crew**: 3
- **Accommodation**: 374 to 490 passengers, 33 attendants
Genesis of the Boeing 747

• The experience of taxiing such a large plane was acquired in a contraption called "Waddell's Wagon," named after Jack Waddell, the company's chief test pilot.

• The pilot sat in a mockup of the 747 flight deck built atop three-story-high stilts on a moving truck.

• The pilot learned how to maneuver from such a height by directing the truck driver below him by radio.
Genesis of the Boeing 747
Boeing 747

- The 747-400 rolled out in 1988
- Its wingspan is 212 feet, and it has 6-foot-high "winglets" on the wingtips
- The 747-400 also is produced as a freighter, as a combination freighter and passenger model, and as a special domestic version, without the winglets, for shorter range flights
- Another variant is the Dreamlifter — a specially modified 747-400 — that transports the large composite structures, including huge fuselage sections of the 787 Dreamliner, from partners around the world to Everett, Wash., and Charleston, S.C., for final assembly
- The massive cargo is loaded and unloaded from a hinged rear fuselage
- The fourth Dreamlifter entered service Feb. 16, 2010
- The longer range 747-400 airplanes (also known as 747-400ERs) were launched in late 2000
Boeing 747

• In November 2005, Boeing launched the 747-8 family

• The 747-8 Intercontinental passenger airplane

• The 747-8 Freighter

• These airplanes incorporate technologies from the 787 Dreamliner

• The 747-8 Freighter first flew on Feb. 8, 2010

• The airplane is 250 feet, 2 inches long, which is 18 feet, 4 inches longer than the 747-400 Freighter

• The stretch provides customers with 16 percent more revenue cargo volume compared with its predecessor

• The passenger version, the Boeing 747-8 Intercontinental, serves the 400- to 500-seat market and took its first flight on March 20, 2011

• The cabin’s sculpted ceilings, bigger overhead and side stowbins, a redesigned staircase and dynamic LED lighting all add to an overall more comfortable passenger experience

• With 51 additional seats and 26 percent more revenue cargo volume than the 747-400

• Launch customer Lufthansa took delivery of the first airline 747-8 Intercontinental April 25, 2012

• Total 747 (all versions) production 1,570
Boeing 747
Boeing 747
Wide Body Aircraft

- In the 1960s, **American Airlines** approached **Lockheed** and **Douglas** (later **McDonnell Douglas**) with the need for an airliner smaller than the **747**, but still capable of carrying a large passenger load to distant locations such as London and Latin America from company hubs in New York and Dallas/Ft Worth
- **Lockheed** had been absent from the civilian airline market since the late 1950s following problems with its **L-188 Electra**
- Having experienced difficulties with some of its military programs, **Lockheed** was eager to re-enter the civilian market
- **MDC** was eager to offer an aircraft larger than the **DC-9**
- The **DC-8** was about the same age and capability as the **Boeing 707**
  - Single aisle narrow body aircraft
Wide Body Aircraft

- **Lockheed** was eager to re-enter the civilian market, and its response was the **L-1011 TriStar**
  - 256 passengers
- Twin aisle three engine wide body
- **Rolls Royce RB211** engines
- **L-1011** production 250
Wide Body Aircraft

- **Douglas**, by this time **McDonnell Douglas**, responded with the **DC-10**
  - 260 passengers
- Three engine twin aisle wide body
- **GE CF6-6** engines
- **DC-10** production 386 + 60 **KC-10** tankers
- A stretched version, the **MD-11**, entered service in 1990
  - 298 to 410 passengers
  - Production 200
Wide Body Aircraft

- McDonnell Douglas and Lockheed both introduced three engine wide body or twin aisle aircraft
- 1971-1972 regulations prohibited long over water flights by two engine aircraft
- MDC DC-10 used 3 GE CF6 HBP turbofan engines
- Lockheed L-1011 used 3 Rolls Royce RB211 HBP turbofan engines
- The aircraft were very similar in their capabilities
  - Range
  - Capacity
  - Speed
  - Operating costs, etc
- The L-1011 was delayed by problems with the RR engine’s composite fan blades
  - Led to RR going into receivership
  - A U.S. government loan guarantee for Lockheed
Wide Body Aircraft  Bad Decisions?

• Both MDC and Lockheed studied twin engine wide body aircraft

• Had one company offered a twin and the other a trijet they might have continued in the commercial jet business

• A wide body twin would have made it more difficult for Airbus to get a foothold in the commercial aircraft industry
Next Session

• Airbus Industrie strategy
• Early wide body competition