Commercial Air Wars:
Strategies That Changed Commercial Aviation

Boeing MDC Merger
Narrow Body Battles

Jim Rauf
The Boeing Company: The First 100 Years

1916 Boeing
1926 Stearman
1928 Pichairn
1930 North American Aviation
1934 Berliner
1934 Atlantic Fokker
1941 North American Aviation
1941 Paseki/Vertol
1941 Rockwell International
1953 McDonnell Douglas
1967 McDonnell
1967 Hughes Aircraft Company
1984 Hughes Tool Company Aircraft Division

OLLI Fall 2016
Boeing MDC Merger

• In 1996, **Boeing** acquired **Rockwell** for around $3 billion

• Now, it had its sights on **McDonnell Douglas**

• **Phil Condit  Boeing CEO** (1996 to 2003), dramatically reshaped the company:
  • Beginning an ambitious program of cost-cutting, outsourcing, and digitalization
  • Relocating **Boeing** headquarters from Seattle to Chicago
  • The **Boeing McDonnell Douglas** merger

• For **Boeing**, the merger was an opportunity to pick up **McDonnell Douglas’** valuable military expertise and diversify its own offerings

• **Condit** resigned to take symbolic responsibility for a military procurement scandal, although he was not accused of any ethical breaches

• None of the managers implicated in the scandals was a longtime **Boeing** employee. They came from **McDonnell Douglas** after the merger or were recruited by a former **McDonnell Douglas** employee

• **Mike Sears**, the fired **CFO**, was a protege of Stonecipher's at **MDC**
Boeing MDC Merger

- Regulators on both sides of the Atlantic considered their options
- **Airbus** and **Boeing** were already one another’s only significant competitor
- **McDonnell Douglas**’ very existence served a certain purpose—it appears to have made the market more competitive, in helping to drive down prices—but it remained in the doldrums
- Regulators noted **McDonnell Douglas** “no longer [constituted] a meaningful competitive force in the commercial aircraft market,” and that, without a full line of large and small jets, it had no real plan to stave off the “grim prospect” of collapse
- Without a takeover, there is every indication that the company might have failed all by itself
- Regulators approved the match in August of 1997

- **Boeing** bought the **McDonnell Douglas** for $14 billion
- Shares of both enjoyed a slight bump
- **Boeing**’s new acquisition allowed **Condit** to move forward on his other key project:
  - Diversifying **Boeing**’s revenue streams
  - With the lucrative government contracts it picked up with **McDonnell Douglas** and **Rockwell**, **Boeing**’s comparatively fledgling space and defense operations could flourish
Boeing MDC Merger

- **Harry Stonecipher** president of MDC, was elected president and chief operating officer (COO) of Boeing in August 1997

- Many MDC executives were given senior positions following the acquisition

- **Harry Stonecipher** initially appointed chief operating officer and holding more than twice the number of shares in the company as Condit, who remained CEO

- Stonecipher and John McDonnell, formerly the chairman of MDCs’ board, were now the two largest individual shareholders of the merged companies

- Stonecipher eventually became Boeing CEO in 2003 after Condit resigned

- Stonecipher was pushed out in 2005, after an internal investigation revealed a consensual, but extramarital relationship with a fellow Boeing executive

- Many Boeing employees thought that MDC executives seemed to do disproportionately well
Boeing MDC Merger

• Many observers have written that Boeing had been less a business and more, “an association of engineers devoted to building amazing flying machines”

• Boeing’s managers - engineers first and managers second

• Employees enjoyed watertight contracts, thanks to an assertive, family-like union, and an attitude to aviation that put design and quality above all else
  • The 747 “Incredibles”
  • The original 737-100, first ordered in 1964, after Lufthansa CEO requested a 100 passenger short range aircraft for European inter city flights

• HCS: "When people say I changed the culture of Boeing, that was the intent, so that it's run like a business rather than a great engineering firm," he said

• "It is a great engineering firm, but people invest in a company because they want to make money."

• Larry Clarkson, a retired Boeing corporate officer: "In the old Boeing there was a lot of open discussion," After the merger, "Harry had his point of view, and he shut off anybody who tried to come up with a different point of view or raise a question about it."
Boeing MDC Merger

- At a meeting with then-GE CEO Jack Welch in the early 1980s, Stonecipher got a lesson that colors his views of Boeing’s competition with Airbus. He boasted that his GE team had 65 percent of the orders in the large-engine industry.

  Welch's reply? "Tell me what you're [profit] margins would be if you had 45 percent,"

- The lesson: *Market share is worthwhile only if it's profitable*

- In 1998, the year after the merger, Stonecipher warned employees they needed to “quit behaving like a family and become more like a team. If you don’t perform, you don’t stay on the team.”

- Even the company’s ethos seemed to have changed: “There was a kind of inherent ethic about how you went about designing and manufacturing and flying planes that carried passengers, as opposed to flying military planes.”

- “Many of the engineers happened to be the guys who pioneered the 707, and so took the company into the jet age and there was a kind of esprit de corps among them and an integrity of purpose among them,” “And they had a collective sense of what the company was meant to do and what its responsibilities were.” Now, a passion for great planes was replaced with “a passion for affordability.”

- In a 2007 interview, Ron Woodard, the former president of Boeing’s Commercial Airplane Group, stated:
  - “We thought that we’d kill McDonnell Douglas and we had it on the ropes,”
  - “I still believe that Harry outsmarted Phil and his gang bought Boeing with Boeing’s money
  - He added, the company had “paid way, way too much money for MDC and we’re still paying for it
  - We wrote off so many tens of billions of dollars for that whole mess.”
Boeing MDC Merger

- Prior to offering the 7E7/787, Boeing was proposing its Sonic Cruiser, a plane that cruised near the speed of sound.
- This would reduce travel times for longer distance routes but would burn more fuel than slower cruise speed aircraft.
- Airlines preferred more efficient airplanes to faster less efficient airplanes.
- December 2003, authority to offer the 7E7 was given.
- Stonecipher had become CEO and launched the 7E7, later renamed the 787.
- Stonecipher and the MDC-dominated Board demanded a global production system to lower the financial risk to Boeing.
- Today Boeing says the global outsourcing was necessary for strategic reasons and win sales.
- Reports indicated that the MDC-dominated Board wanted Boeing to spend no more than $5 billion on development of the 787.
Boeing MDC Merger

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• Boeing’s composite structure 787 forced Airbus to drop the A330 derivative A350 and offer a composite structure A350XWB.
Boeing MDC Merger

- The multiple manufacturing problems with the **787** had a tremendous effect on **Boeing’s** product strategy.
- The total development cost has been estimated at over $32 billion!
Boeing MDC Merger

• **Boeing** originally planned to introduce a “new small airplane” in 2012, on the assumption the **787** entered service in May 2008 as scheduled
  • The **787 EIS** was October 2011
• A **CFM** power point document from 2006 obtained by **AirInsight** had the timeline,
• The plan was to do the **787**
• Follow with the **737** replacement
• Then to a **777** replacement
• This would have been a timeline **Airbus** would have been unlikely to match and would have sealed **Boeing’s** dominance in commercial aviation for decades to come

• But, having insisted on global outsourcing to spread the financial risk, and then fouling up the **787** program so badly, **Boeing’s** entire product development program of leadership has been reduced to being driven by **Airbus’ A320neo** family
• This is the legacy of **McBoeing** and **Harry Stonecipher**
• **Boeing** was reduced to a me-too response to the **Airbus A320NEO**
• A derivative **737** with new engines the **737MAX**
Narrow Body Single Aisle Aircraft

- The most popular commercial aircraft are the single aisle twins
- **Airbus A320** family and **Boeing 737** family
- There are about 20,000 A320 and 737 aircraft in airline service around the world
- **Boeing** projects over 14,000 Single Aisle aircraft deliveries from 2021 thru 2030
A320 Family of Narrow Body Twin Aircraft

- The **A320** was launched in March 1984
- Its first flight was February 22, 1987
- **EIS at Air France** was April 1988
- The **A320** was followed by the longer **A321** launched in November 1988
- Its first flight was in March 1993
- **EIS at Lufthansa** was in 1994
- The shorter **A319** was launched in March 1984
- **EIS at Swissair** was in 1996
- The even shorter **A318** was launched in the Spring 1999
- Its first flight was in January 2002
- **EIS at Frontier** was in 2002
A320 Family of Narrow Body Twin Aircraft

- Flight deck includes a full glass cockpit
- The **A320**'s flight deck is equipped with Electronic Flight Instrument System (EFIS) with *side-stick* controllers
- The **A320** features an Electronic Centralized Aircraft Monitor (ECAM) which gives the flight crew information about all the systems of the aircraft
- Since 2003, the A320 has featured liquid crystal display (LCD) units in its flight deck instead of the original cathode ray tube (CRT) displays
- **Airbus** offers avionics upgrade for older **A320** aircraft
- **A320** is the world's first airliner with digital fly-by-wire (FBW) flight control system:
  - Input commands through the *side-stick* are interpreted by flight control computers and transmitted to flight control surfaces within the flight envelope protection
    - Fly-by-wire and flight envelope protection was a new experience for many pilots
A320 Family of Narrow Body Twin Aircraft

• Final assembly plants:
  • Toulouse, France
  • Hamburg, Germany
  • Tianjin in China
  • Mobile, Alabama

• Major components manufacturing plants:
  • Aerospatiale
  • Deutsche Airbus
  • British Aerospace
  • CASA
  • Belairbus

• Engines and other components sourced from global sources
A320neo

- Airbus reengined the A320 family with new P&W Geared Fan Engines and CFMI LEAP-1A direct drive fan engines
- They were called “new engine option” or neo
- Additional upgrades to the basic A320 ceo(current engine option) were incorporated
- The neo’s promised improved fuel burn characteristics over the ceo’s as well as the competing Boeing 737 NG
- A320neo was launched December 1, 2010
- Its first flight was September 25, 2014 made its first flight on 25 September 2014
- EIS at Lufthansa was January 25, 2016
## A320 Family Specs

<table>
<thead>
<tr>
<th>Type</th>
<th>A318</th>
<th>A319</th>
<th>A320</th>
<th>A321</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>5,750 KM (3,100 NM)</td>
<td>6,950 KM (3,750 NM)</td>
<td>6,100 KM (3,300 NM)</td>
<td>5,950 KM (3,200 NM)</td>
</tr>
<tr>
<td><strong>Seating (Typical)</strong></td>
<td>(No NEO Version)</td>
<td>(NEO 6,950 KM (3,750 NM))</td>
<td>(NEO 6,500 KM (3,500 NM))</td>
<td>(NEO 7,400 KM (4,000 NM))</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>31.44 Metres (103ft 2in)</td>
<td>33.84 Metres (111ft 0in)</td>
<td>37.57 Metres (123ft 3in)</td>
<td>44.51 Metres (146ft 0in)</td>
</tr>
<tr>
<td><strong>Cabin Width</strong></td>
<td>3.70 Metres (12 ft 2 in)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>A318</td>
<td>A319</td>
<td>A320</td>
<td>A321</td>
</tr>
<tr>
<td><strong>Freight Capacity</strong></td>
<td>(749 cu ft)</td>
<td>(975 cu ft)</td>
<td>(1,321 cu ft)</td>
<td>(1,827 cu ft)</td>
</tr>
<tr>
<td><strong>Cruising Speed</strong></td>
<td>Mach 0.78 (828KPH / 511 MPH at 11,000 Metres / 36,000 feet)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Altitude</strong></td>
<td>39,100–41,000 feet (11,900–12,500 metres)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Fuel</strong></td>
<td>24,210 Lt (6,400 US Gal)</td>
<td>30,190 Lt (7,980 US Gal)</td>
<td>27,200 Lt (7,190 US Gal)</td>
<td>30,030 Lt (7,930 US Gal)</td>
</tr>
<tr>
<td><strong>Maximum Take-off Weight (MTOW)</strong></td>
<td>68,000 kg (150,000 lb)</td>
<td>75,500 kg (166,000 lb)</td>
<td>78,000 kg (172,000 lb)</td>
<td>93,500 kg (206,000 lb)</td>
</tr>
<tr>
<td><strong>TO SL distance ft</strong></td>
<td>1,828 Metres (5,997 Feet)</td>
<td>2,164 Metres (7,100 Feet)</td>
<td>2,090 Metres (6,860 Feet)</td>
<td>2,560 Metres (8,400 Feet)</td>
</tr>
<tr>
<td><strong>Engines (CFM)</strong></td>
<td>CFM International CFM56-5 series</td>
<td>CFM International CFM56-5 series</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Engines (PW)</strong></td>
<td>Pratt &amp; Whitney PW6000 series</td>
<td>IAE V2500 series</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thrust x 2</strong></td>
<td>96 to 106 kN (22,000 to 24,000 lbf)</td>
<td>98 to 120 kN (22,000 to 27,000 lbf)</td>
<td>111 to 120 kN (25,000 to 27,000 lbf)</td>
<td>133 to 147 kN (30,000 to 33,000 lbf)</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>A318</td>
<td>A319</td>
<td>A320</td>
<td>A321</td>
</tr>
</tbody>
</table>
Boeing 737 Family

Evolution of the Boeing 737

P&W JT8D Turbofan Engines

CFM56-3 HBP Fan Engines

CFM56-7B HBP Fan Engines

CFMI LEAP-1B HBP Fan Engines

Response to A320neo
Boeing 737

- In 1967, the smaller, short-range 737 twinjet was the logical airplane to complement the 707 and the 727
- There was increasing demand for transports in its category, but the 737 faced heavy competition from the Douglas DC-9 and the British Aircraft Corp. BAC 1-11
- To save production time, and get the plane on the market as soon as possible, Boeing gave the 737 the same upper lobe fuselage as the 707 and 727 so that the same upper deck cargo pallets could be used for all three jets
- The 737 later adopted the 727's cargo convertible features, which allowed the interior to be changed from passenger to cargo use in the 737-200 series
- The 737 had six-abreast seating (the DC-9 seated five abreast)
- The number of seats in the 737 also was increased by mounting the engines under the wing
- This engine made it easier to maintain the airplane at ground level
- The 737 could operate self-sufficiently at small airports and on remote fields

- Dec. 27, 1967, Lufthansa took delivery of the first production 737-100 model, in a ceremony at Boeing Field
- Dec 28, United took delivery of the first 737-200
- The last 737-200 was delivered in August 1988
Boeing 737

- By 1987, the **737** was the most ordered plane in commercial history
- In January 1991, 2,887 **737s** were on order, and Models **737-300**, **-400** and **-500** were in production
- By 1993, customers had ordered 3,100 **737s**, and the company was developing the **Next-Generation 737s** — the **-600**, **-700**, **-800** and **-900**
- **Boeing** certified and delivered the first three **Next-Generation** models in less than one year
- August 30, 2011 **Boeing** launched its latest derivative of the **737**
- The **737MAX** expecting a 4% lower fuel burn than the **A320neo**
- Four versions; **737MAX7, 737MAX8, 737MAX9** and **737MAX10** to compete with **A320 neo** variants

- **737MAX** used **CFMI LEAP-1B** HBP Turbofan engines
- The airframe featured new “split tip” winglets
Boeing 737 MAX Assembly  Put Together Quickly


https://www.wired.com/2016/09/boeing-builds-737-just-nine-days/
What is new on Boeing’s 737 MAX

**Winglets**
Dual-feather winglet reduces fuel consumption by up to 1.8% compared with existing winglets.

**Strengthening**
Wings, fuselage and main landing gear strengthened at strategic locations to carry heavier engines.

**Quieter aircraft**
737 Max has a 40% smaller noise footprint than existing single-aisle airplanes.

**Nose landing gear**
Raised to lift the wing slightly and allow the relocation of the engines on the wing.

**Tail cone**
Streamlined for better air flow.

**Propulsion installation**
New strut, fairing, nacelle, fan and primary duct chevrons.

**New engines**
CFM LEAP-1B has superior fuel efficiency which reduces carbon emissions.

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**MAX FAMILY:**

**737-MAX 7**
- Wingspan: 117 feet, 10 inches
- Length: 116 feet, 8 inches
- Passengers: 172 (maximum seating)

**737-MAX 8**
- 117 ft., 10 in.
- 129 ft., 8 in.
- 189 (maximum seating)

**737-MAX 9**
- 117 ft., 10 in.
- 138 ft., 4 in.
- 220 (maximum seating)

Source: Boeing

MARK NOWLIN / THE SEATTLE TIMES
Boeing’s 737 MAX 10

First flight: Expected in 2019

Wingspan: 117 ft., 10 in.
Length: 143 ft., 8 in.
Passengers: 230 (Single-class seating)

Mid exit door
- 4 inches wider
- Variable exit-limit rating

Wing
- Low-speed drag reduction
- Modified for revised landing gear

Fuselage
- 66 inches longer

Gear
- Levered main landing gear
- Larger brakes

New engines
CFM LEAP-1B is more fuel-efficient, reducing carbon emissions.

THE 737 MAX FAMILY:

**737 MAX 7**
First flight: Unscheduled
Wingspan: 117 feet, 10 inches
Length: 116 feet, 8 inches
Passengers: 172 (maximum seating)
Source: Boeing

**737 MAX 8**
First flight: Feb. 2, 2016
117 ft., 10 in.
129 ft., 8 in.
186 (single-class seating)

**737 MAX 9**
First flight: April 13, 2017
117 ft., 10 in.
138 ft., 2 in.
218 (single-class seating)

MARK NOWLIN / THE SEATTLE TIMES
## 737MAX Specs

<table>
<thead>
<tr>
<th>Variant</th>
<th>737 MAX 7</th>
<th>737 MAX 8 / MAX 200</th>
<th>737 MAX 9</th>
<th>737 MAX 10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seating</strong></td>
<td>153 (8J + 145Y) to 172 max</td>
<td>178 (12J + 166Y) to 210 max[226]</td>
<td>193 (16J + 177Y) to 220 max</td>
<td>204 (16J + 188Y) to 230 max</td>
</tr>
<tr>
<td><strong>Seat pitch</strong></td>
<td>28–29 in (71–74 cm) in high density, 29–30 in (74–76 cm) in economy, 36 in (91 cm) in business</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cargo capacity</strong></td>
<td>1,139 cu.ft / 32.3 m³</td>
<td>1,540 cu.ft / 43.6 m³</td>
<td>1,811 cu.ft / 51.3 m³</td>
<td>1,961 cu.ft / 55.5 m³</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>116 ft 8 in / 35.56 m</td>
<td>129 ft 6 in / 39.47 m</td>
<td>138 ft 4 in / 42.16 m</td>
<td>143 ft 8 in / 43.8 m</td>
</tr>
<tr>
<td><strong>Wing</strong></td>
<td>117 ft 10 in / 35.92 m span, 1,370 sq ft (127 m²) area[47]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Overall height</strong>[227]</td>
<td>40 ft 4 in / 12.3 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MTOW</strong></td>
<td>177,000 lb / 80,286 kg</td>
<td>182,200 lb / 82,644 kg</td>
<td>194,700 lb / 88,314 kg</td>
<td>197,900 lb / 89,765 kg</td>
</tr>
<tr>
<td><strong>Maximum Payload</strong></td>
<td>46,040 lb / 20,882 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OEW</strong>[228]</td>
<td>99,360 lb / 45,070 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fuel capacity</strong></td>
<td>6,820 USgal / 25,816 L – 45,694 lb / 20,730 kg (no ACT)[8]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Engine (× 2)</strong></td>
<td>CFM International LEAP-1B, 69.4 in (176 cm) Fan diameter,[229] 26,786–29,317 lbf (119–130 kN)[47]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cruising speed</strong></td>
<td>Mach 0.79 (453 km; 839 km/h)[230]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong>[231]</td>
<td>3,850 nmi / 7,130 km</td>
<td>3,550 nmi / 6,570 km[6]</td>
<td>3,550 nmi / 6,570 km[c]</td>
<td>3,300 nmi / 6,110 km[c]</td>
</tr>
<tr>
<td><strong>Ceiling</strong></td>
<td>41,000 ft (12,000 m)[47]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Takeoff (ISA, SL, MTOW)</strong></td>
<td>7,000 ft (2,100 m)</td>
<td>8,300 ft (2,500 m)</td>
<td>8,500 ft (2,600 m)</td>
<td></td>
</tr>
<tr>
<td><strong>Landing (SL, MLW, dry)</strong></td>
<td>5,000 ft (1,500 m)</td>
<td>5,000 ft (1,500 m)</td>
<td>5,500 ft (1,700 m)</td>
<td></td>
</tr>
<tr>
<td><strong>ICAO Type</strong>[233]</td>
<td>B37M</td>
<td>B38M</td>
<td>B39M</td>
<td>B3XM</td>
</tr>
</tbody>
</table>

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[226]: lightweight configuration
[227]: http://example.com/overall_height
[228]: http://example.com/oew
[229]: http://example.com/leap_engine
[230]: http://example.com/cruising_speed
[231]: http://example.com/range
[232]: http://example.com/ceiling
[233]: http://example.com/icao_type
Boeing 737 MAX

- **Lion Air** Flight 610 took off from Jakarta, Indonesia on Monday, October 29th, 2018, at 6:20AM local time
- Its destination was Pangkal Pinang, the largest city of Indonesia’s Bangka Belitung Islands
- Twelve minutes after takeoff, the plane crashed into the Java Sea, killing all 189 passengers and crew

- **Ethiopian Airlines** Flight 302 took off from Addis Ababa, Ethiopia on Sunday, March 10th, 2019, at 8:38AM local time
- Its destination was Nairobi, Kenya
- Six minutes after takeoff, the plane crashed near the town of Bishoftu, Ethiopia, killing all 157 people aboard

- In 2019, the Boeing 737 MAX was grounded worldwide after a malfunctioning flight control system caused two new aircraft to crash in Indonesia (Lion Air Flight 610) and Ethiopia (Ethiopian Airlines Flight 302), killing all 346 people on board
- During the twenty month grounding, Boeing redesigned the computer architecture that supported the MCAS
- Investigations faulted aircraft design and certification lapses
- Boeing faced severe financial consequences
- No MAX deliveries could be made and airlines canceled numerous orders
- Boeing found foreign object debris in the fuel tanks of 35 of 50 grounded 737 MAX aircraft that were inspected, they had to check the remainder of the 400 undelivered planes
- The FAA curtailed Boeing’s delegated authority and invited global aviation stakeholders to comment on pending changes to the aircraft and to pilot training
- The FAA lifted its grounding order in 2020
- All aircraft must be repaired to comply with various airworthiness directives
Maneuvering Characteristics Augmentation System (MCAS)

How the MCAS system works

1. Sensors in nose measure angle of flight
2. Horizontal stabiliser trim adjusts to correct angle if too high
3. Nose pushed down to reduce risk of a stall
4. But if the sensor reading is wrong, MCAS may activate and push the nose down anyway
5. Pilots can temporarily switch off MCAS and pull up.

+10 degrees: risk of a stall

But system restarts if false readings continue, creating a tug of war between the aircraft and its crew.
A321neo and 737MAX 10

**Airbus A321neo**
- Seats: 244 max
- Length: 44.51m / 146.0 ft
- Wingspan: 35.80m / 117 ft 5 in
- Height: 11.76 m / 38.6 ft
- MTOW: 213,800 lbs / 97 t
- Cruise speed: Mach 0.78 / 450 kn

**Boeing 737 Max10**
- Seats: 230 max
- Length: 43.8 m / 143 ft 8 in
- Wingspan: 35.92 m / 117 ft 10 in
- Height: 12.3 m / 40 ft 4 in
- MTOW: 197,900 lbs / 89,765 kg
- Cruise speed: Mach 0.79 / 453 kn

**Primary Users**
- @gironiair
- @swissair
- @southwestair
- @airberlinairlines
- @flydubai

**Potential Users**
- @koreanair
- @united
- @delta
- @blackjet
- @airfrance
- @konairgroup

*Source: Wrapped A321neo, Boeing*
The 737 MAX Offers Greatest Range Capability

- **737-7**
  - 80,300-kg (177,000-lb) MTCW

- **737-8**
  - 82,200-kg (181,200-lb) MTCW

- **737-9**
  - 88,300-kg (194,700-lb) MTCW

- **737-10**
  - 89,800-kg (197,900-lb) MTCW

Standard rules
Airways and traffic allowances included
85% annual winds
Two-class seating
Boeing 737 MAX and Airbus A320

As of June 2021:
- 9,315 Boeing 737s were in service
- 9,353 Airbus A320 family were in service

Airbus A320 Deliveries 10,322
Airbus A320neo’s 2,222

Boeing 737 Deliveries 10,840
Boeing 737 MAX Deliveries 768

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Books

• Air Wars The Global Combat Between Airbus and Boeing
  • Scott Hamilton 2021
• The World’s Greatest Civil Aircraft An Illustrated History
  • Paul E. Eden 2015
• Evolution of the Airliner
  • Ray Whitford 2007
• Boeing the First Century and Beyond
  • Eugene E. Bower 2008
• The Sporty Game
  • John Newhouse 1982
• Barons Of The Sky
  • Wayne Biddle 1991
• Higher 100 Years of Boeing
  • Russ Banham 2015
• Twenty First Century Jet The Making and Marketing of the Boeing 777
  • Karl Sabbagh 1996
• From Props to Jets Commercial Aviation’s Transition to the Jet Age 1952-1962
  • Jon Proctor, Mike Machat and Craig Kodera 2010
• McDonnell Douglas DC-10
  • Terry Waddington 2000
• Lockheed L1011 Tristar
  • Phillip Birtles 1998
• Turbulent Skies The History of Commercial Aviation
  • T.A. Heppenheimer 1995
• Boeing 787 Dreamliner
  • Guy Norris and Mark Wagner 2009
• The Boeing 787 Dreamliner
  • Claude G. Luisada and Steven D. Kimmell 2014
• Flying Blind: The 737 Max Tragedy and the Fall of Boeing
  • Peter Robison 2021
Next Session

• Airbus versus Boeing
  Current and Future