

# Examination of the A380 Design



Presented by  
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## Sources:

- 1) Jackson, Paul ed. Jane's All The World's Aircraft 2000-01, Jane's Information Group, Inc., Alexandria 2000
- 2) Aviation Week & Space Technology, January 1, 2001
- 3) Interavia: Business & Technology, October 2000
- 4) [www.boeing.com](http://www.boeing.com)
- 5) [www.airbus.com](http://www.airbus.com)
- 6) [www.themag-fs-news.com](http://www.themag-fs-news.com)

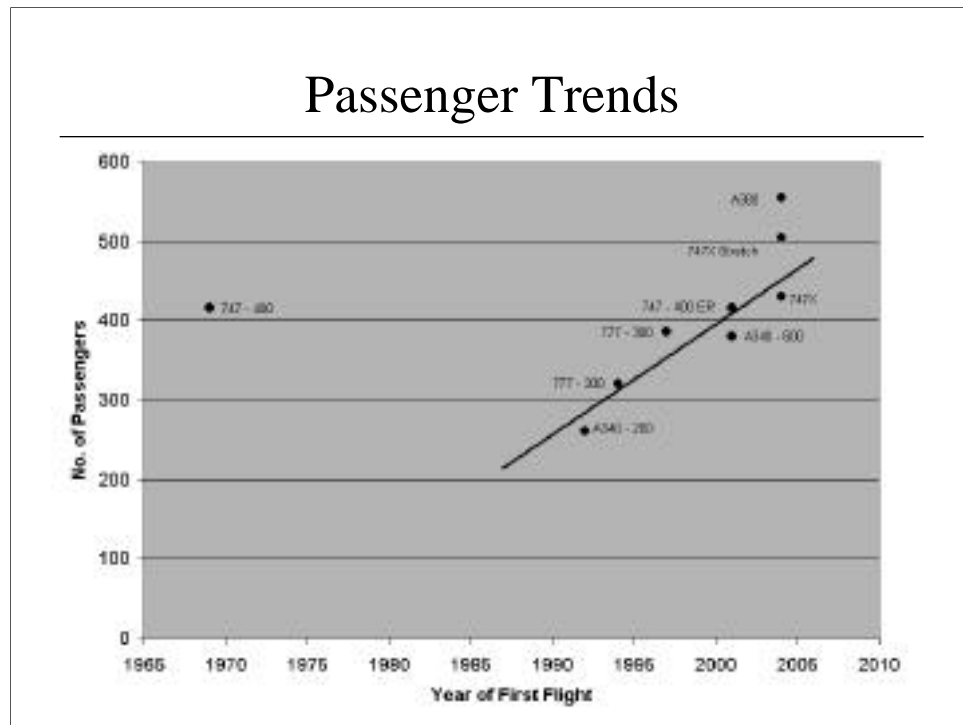
## Presentation Outline

- » Comparison to other designs
  - Boeing
    - 747 - 400 and 747 - 400ER
    - 777 - 200 and 777 - 300
    - 747X and 747X Stretch
  - Airbus
    - A340 - 200 and A340 - 600
- » Characteristics of the design
  - Properties
  - Effect of 80 m Gate-box restriction
- » Closing Remarks

Data was compiled into the following two tables and is presented graphically throughout the presentation.

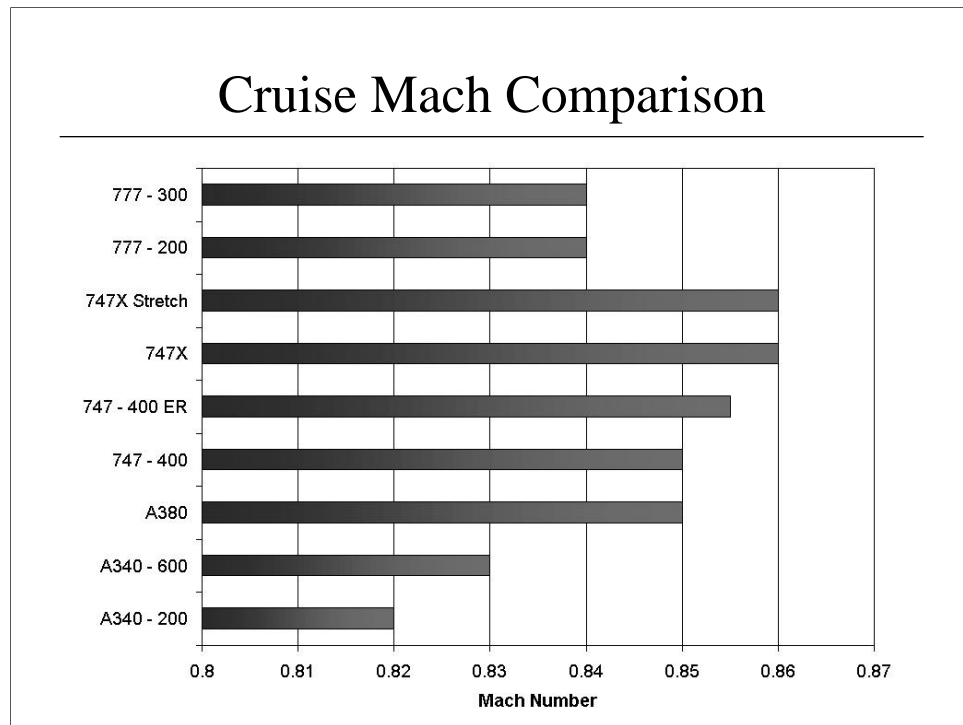
Company	Aircraft	First Launch	# passengers 3 class	max # of passengers	Cruise Mach #	Range (nm)	Max TOGW (lb)	Total Thrust (lb)
Boeing	747 - 400	1969	416	524	0.85	7,320	875,000	253,200
Airbus	A340 - 200	1992	261	300	0.82	8,000	606,300	136,000
Boeing	777 - 200	1994	320	440	0.84	5,150	545,000	154,400
Boeing	777 - 300	1997	386	550	0.84	5,960	660,000	196,000
Airbus	A340 - 600	2001	380	419	0.83	7,500	804,700	224,000
Boeing	747 - 400 ER	2001	416	568	0.855	7,690	910,000	253,200
Airbus	A380	2004	555	No Data	0.85	8,150	1,235,000	280,000
Boeing	747X	2004	430	No Data	0.86	8,975	1,043,000	272,000
Boeing	747X Stretch	2004	504	No Data	0.86	7,800	1,043,000	272,000

Company	Aircraft	Wing Area (ft <sup>2</sup> )	AR	Span (ft)	LE Sweep,	Taper Ratio,	t/c	T/W	W/S	W/b
Airbus	A340 - 200	3892	10.06	197.9	59	0.29	0.11	0.22	155.8	3064.1
Airbus	A340 - 600	4729	9.16	208.1	59	0.29	0.11	0.28	170.2	3866.4
Airbus	A380	9100	7.53	261.8	54	0.26	0.08	0.23	135.7	4717.9
Boeing	747 - 400	5825	7.7	211.8	47	0.24	0.08	0.29	150.2	4131.6
Boeing	747 - 400 ER	5825	7.7	211.8	47	0.24	0.08	0.28	156.2	4296.8
Boeing	747X	6815	7.68	228.8	47	0.22	0.08	0.26	153.0	4559.0
Boeing	747X Stretch	6815	7.68	228.8	47	0.22	0.08	0.26	153.0	4559.0
Boeing	777 - 200	4605	8.7	200.2	55	0.16	0.08	0.28	118.3	2722.8
Boeing	777 - 300	4605	8.7	200.2	55	0.16	0.08	0.30	143.3	3297.4



This chart examines the trend in number of passengers versus the year the first flight of the aircraft was made. The trendline here does not account for the 747-400 or the future aircraft because these points would throw off the general trend. What we see here is a general increase in the number of passengers per flight as the years move forward. This reflects the increase in the number of travelers per year and therefore the number of seats necessary to accommodate them. However this chart does not take into account increased number of flights and more aircraft available.





This chart depicts a simple Cruise Mach number comparison between all of the aircraft in the long range category. The differences are small but do affect the mission performance greatly. Boeing appears to have a slight edge over Airbus in their ability to achieve very high cruise Mach numbers. However, it can be seen in the successive Airbus aircraft the Mach number is approaching that of Boeing's capabilities.

## A380 Properties



- Overall
  - Max TOGW = 1,235,000 lbs
  - Wingspan = 261.8 ft
  - Length = 239.5 ft
  - Height = 79.1 ft
- Planform
  - Wing Area = 9,100 ft<sup>2</sup>
  - AR = 7.53
  - LE Sweep = 54
  - Taper Ratio = 0.26
  - t/c = 0.08

Properties from Jane's All the World's Aircraft 2000-1 ed.

This data was compiled from various sources and is here to obtain a feel for what the Airbus A380 looks like and its size. Some of the data was obtain by estimating and measuring points on a 3-view drawing. Since the drawing was small the t/c was very sensitive to the values chosen. A slight change leads to a very different number. Taper ratio was a little more stable but still exhibited large fluctuations depending on what was measured.

## 747X Stretch Properties



- Overall
  - Max TOGW = 1,043,000 lbs
  - Wingspan = 228.8 ft
  - Length = 264.3 ft
  - Height = 65.2 ft
- Planform
  - Wing Area = 6,820 ft<sup>2</sup>
  - AR = 7.68
  - LE Sweep = 47
  - Taper Ratio = 0.22
  - t/c = 0.08

Properties from Aviation Week & Space Technology Jan 1, 2001

As mentioned with the previous slide, estimation is also present here and the same variation of results occurred. However, I was able to obtain a much larger picture from Boeing and therefore, the resulting measurements are a little more sound. One thing to note here is that Boeing does not have nearly the wing area of the A380 and also does not infringe upon the 80 m gate box limit.

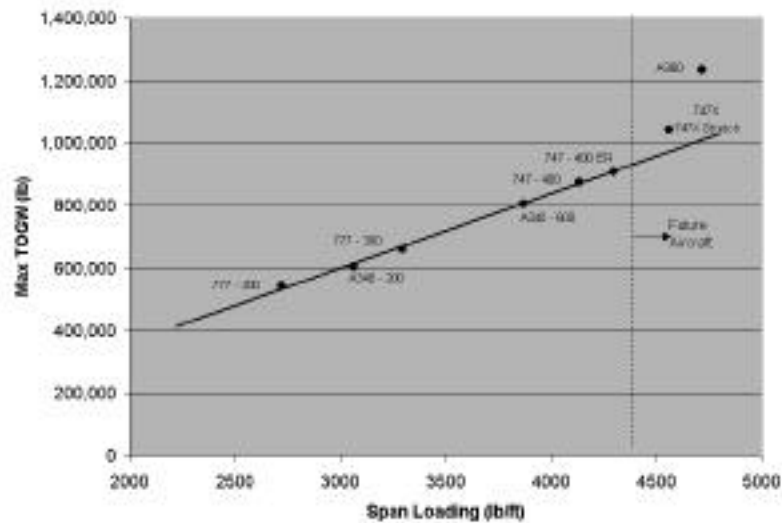
## High Lift Systems

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- Conventional Devices
- Probably Similar to A340
  - Full span leading edge slats
  - Double slotted flaps
- Typical Lift Dumping
  - Spoilers
  - Speed Brakes

So far, what I have read does not indicate that Airbus is planning to do anything unusual with its high lift system. It appears that they plan to just use conventional methods, which I'm guessing will be very similar to the A340's high lift system. However, the lifting surface is much larger than that of the A340, so it would not be surprising if the A380 employs more spoilers in its design to dump lift upon landing.

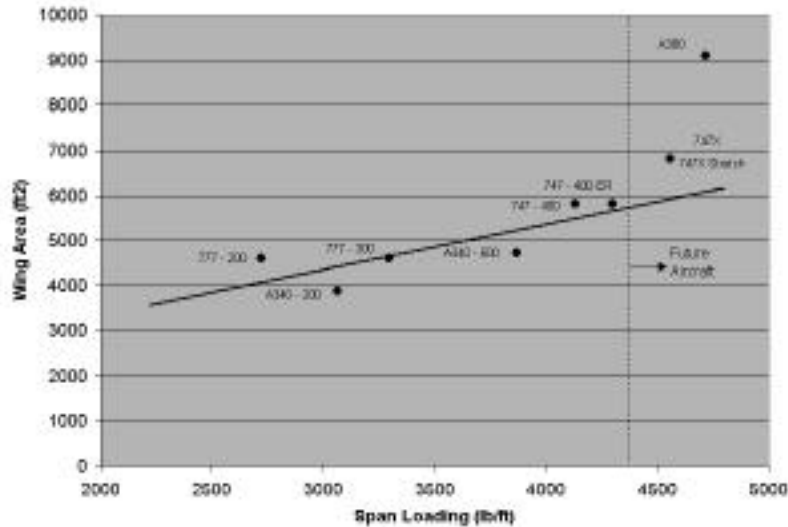
## 80 Meter Gate Box Effects



One of the most important aspects of the A380 design is the 80 m gate box limit. This aircraft was designed to just meet this requirement. The question is how this affects the overall design. In this plot the effect is very clear. When comparing Max TOGW with the Span Loading a nearly perfect linear correlation is found among the current aircraft. This implies that for every increase in span a corresponding increase in TOGW occurs.

In the design of the A380 we see a large increase in span to the 80 m limit, but a disproportionate increase in TOGW is seen. To achieve this difference some type of new technology must be employed. In this particular case the structural technology must be increased to accommodate the excessive increase in TOGW. The 747X also shows a disproportionate increase; however, this increase is small and doesn't involve as much technological improvement as the A380.

## 80 Meter Gate Box Effects



Like the previous graph, a large deviation from the general trend is seen in the A380 design. Here the wing area is compared to the span loading. Once again an increase in the structural technology is required to obtain this increase from the norm. Here we see that a large wing area is desired, but the proper span to accommodate this area can not be provided due to the 80 m limit. This implies that the 80 m gate box did have serious implications on the design of the A380. This is probably a large contributor to the 10 billion dollar development program for this aircraft. The only way to achieve their goal was to increase the technology factor of the A380, which in turn carried with it an expensive price tag.

## Closing Remarks

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- » Ambitious, but feasible
  - Requires more advanced structures
  - Large, but conventional
- » Limit of conventional design
  - Advanced concepts required
- » Prediction

Overall the A380 project seems very risky. I think Boeing approached the problem of a larger/longer range aircraft safely. Airbus stands to lose a lot if this idea does not pan out. They predict that the market will be for 1,000 aircraft and that they must sell 250 to break even. If Boeing takes a large chunk of that one thousand aircraft, Airbus could face large problems. Despite the ambitiousness of this project, I think it is definitely feasible. The technology level will have to be increased to achieve their goal, which in turn will affect the airline industry in sale price of these aircraft. The question will end up coming down to whether the extra technology investment is worth the increased cost. The A380 in my opinion will probably achieve the limits of what is possible with conventional aircraft. More advanced concepts will probably be required, like the blended wing body, to stay within the 80 meters, but still manage to increase the overall payload capabilities.