2014 AirInsight Premium Stories

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Premium #109 - Air India, Boeing and the 787

2/21/2014

We wonder about the rash of 787 problems that make the news. How bad is it really?

According to AeroInside, at this writing, there have been 27 "incidents" with the 787. Of these six are Air India issues. Air India has 12 of the current 121 787s in service. With 10% of the fleet, Air India represents 22% of the incidents.

The 787 is new with a host of new features - one expects the settling in process to see incidents. But Air India is out of the norm - it is the only 787 operator which has had a piece of the aircraft fall off because of poor airline maintenance. (Picture from IndiaToday.in)

We imagine the lip biting in Seattle (and Charleston) when it comes to Air India. The airline has been the most vocal in demanding compensation. Nearly one third of the 787 fleet is based in Japan, and these aircraft have also had glitches, yet the Japanese have been doing their discussions with Boeing quietly. Air India has been offered $23m in compensation of the $46m demanded. Air India continues to use the media as a means to negotiate with Boeing. Norwegian expressed its frustration with very public 787 disruptions, but with none of the heated statements from Air India.

Boeing is in a quandary. It dare not throw the customer under the bus, much as they might deserve it. This would reflect badly on the 787 program. Besides India is buying C-17s. Selling these makes up for some of the 787 compensation. Moreover Air India has been a long standing customer. The longevity of the relationship is perhaps seen as less valuable by Air India.

Looking at other operators of the 787 (Ethiopian comes to mind), none have had the number of issues as Air India. It would seem the problem is less to do with Boeing and its 787 and more to do with Air India. As a financial disaster (and here), Air India management is focused on the short term and securing more public funding. Air India is the poster child for the argument against state owned airlines. The airline has been a drain on Indian tax payers. The reason the airline stays operating is because India's politicians spend other people's money to ensure they get the travel privileges they want.

Now the FAA has asked India to update it's aviation technology. It would seem that Air India is a problem customer. While the 787 has not been a trouble-free aircraft, Air India's mismanagement has probably exacerbated the situation. The question for Boeing may be when a customer turns from an asset into a liability, and whether they are capable of safely operating high technology aircraft.

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Premium #110 - Alaska Airlines vs Delta Air Lines

02/28/2014

Alaska Airlines is something of an airline enigma in the US market. It has been independent since its creation. Yet it has relationships with many airlines. Alaska has been in business for over 80 years.

Alaska is the seventh-largest U.S. airline based on passenger traffic and is the dominant U.S. West Coast air carrier. Its location in Seattle and Alaska have made the airline something of a bright spot for larger airlines focused on the lower 48 states. But Alaska's footprint stretches far beyond its Seattle base. The airline has partnerships with many international airlines.

Delta Air Lines is about 90 years old and is one of the world's mega carriers. The table shows a few key comparative data points.

	Alaska	Delta
Markets	95	322
Fleet	132	722
Enplanements	25.8m	165m
Employees	10,266	80,000

Of particular note is the partnerships Alaska has with Delta and American. Delta has been aggressively growing its own Seattle footprint. This growth is squarely aimed at Alaska. With Delta growing its Seattle operation into a hub for trans-Pacific service, it wants to also control its traffic feed. To support its ambitions in the region, Delta is offering that old marketing trick - double miles.

In response Alaska increased its own services - on February 11 it announced service to New Orleans, Tampa and Detroit (a Delta hub). Though it is much smaller than the big three, Alaska has been a scrappy operation that has survived in the most competitive airline market anywhere.

Using our AirInsight Operational Index model, we demonstrate how Alaska and Delta compete.

A brief explanation of our model is helpful - airlines are in a business where revenues are fixed and costs are variable. If an airline runs late, its costs continue to mount while passenger and cargo revenue does not. An early flight arrival means lower than budgeted costs and therefore a higher than planned profit. An airline's business plan is essentially its schedule. Performing according to schedule should generate planned profits.

Our AirInsight Index is a cocktail of the operational data that equalizes numbers and allow for a comparison between airlines and aircraft. Zero is equivalent to "performing as planned"; a negative number is "better than plan" and a positive number is "worse than plan".

Of course airlines operate a business that is highly susceptible to exogenous factors such as weather, which can throw off a schedule. However, these events are generally short lived.

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Using a number of data sources our model shows that since 2012, Alaska has run a very tight operation. Its flight have arrived on average earlier than scheduled. This has translated into profits as shown in row titled "Est. OpImpact". This is despite a significant number of its flights experiencing delays. Delta experienced equivalent delay levels but saw more average delayed arrivals. As the data shows, Delta consequently saw bigger operational losses.

Note that despite being over five times larger in fleet terms, its average operational cost per minute is only 22% higher than Alaska's.

		Quarter of FlightDate							
		2012 Q1	2012 Q2	2012 Q3	2012 Q4	2013 Q1	2013 Q2	2013 Q3	2013 Q4
Alaska Airlines Inc.	Fleet Size	118	119	119	123	125	127	127	132
	Number Of Flights	34,241	37,867	39,573	35,888	35,613	39,636	41,937	37,557
	Avg. ArrDelay	-1	-3	-3	-1	-3	-1	1	-3
	AvgCostPerMin	$95.33	$89.31	$91.23	$97.19	$93.91	$89.44	$89.52	
	Est. OpImpact	$1.85M	$11.73M	$9.52M	$2.19M	$8.46M	$2.14M	($5.55M)	
	PercentageDelayed	31.1%	26.6%	26.4%	31.4%	31.1%	35.3%	40.8%	29.8%
	AirinsightIndex	-0.01	-0.07	-0.05	-0.02	-0.06	-0.02	0.05	
Delta Air Lines Inc.	Fleet Size	683	700	695	698	691	705	699	708
	Number Of Flights	167,928	183,839	193,711	181,401	173,973	192,605	200,693	187,399
	Avg. ArrDelay	-2	-1	2	-2	-1	4	4	0
	AvgCostPerMin	$113.44	$130.24	$98.49	$114.05	$119.36	$114.60	$99.74	
	Est. OpImpact	$41.02M	$34.50M	($35.54M)	$35.68M	$15.21M	($87.94M)	($78.73M)	
	PercentageDelayed	29.0%	28.1%	30.9%	28.6%	29.4%	34.1%	34.7%	31.5%
	AirinsightIndex	-0.08	-0.06	0.06	-0.06	-0.03	0.18	0.15	

We believe that Alaska may have a fight on its hands with Delta expanding in its traditional markets. On an operational basis, Alaska actually does well enough that it should be able to hold its own as the next table illustrates. Delta, being a much bigger airline and focused on many more markets, plus competing with the other two mega carriers, is likely to suffer more operational hiccups. Performing better to plan, we think Alaska will continue to attract traffic (predictable schedules being a great attraction for passengers) and withstand the competitive blast from Delta.

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Alaska Airlines Inc.		Quarter of FlightDate						
Model-Series		2012 Q1	2012 Q2	2012 Q3	2012 Q4	2013 Q1	2013 Q2	2013 Q3
737-400	Fleet Size	24	24	24	24	24	24	24
	Number Of Flights	7,870	8,933	9,412	8,557	8,436	8,790	9,150
	Avg. Distance	668	696	660	660	643	665	640
	Avg. ArrDelay	2	0	1	4	0	2	5
	PercentageDelayed	33.1%	31.1%	30.6%	37.1%	34.3%	40.3%	44.9%
	AirinsightIndex	0.11	-0.01	0.06	0.26	0.03	0.15	0.37
737-400F	Fleet Size	1	1	1	1	1	1	1
	Number Of Flights	391	624	487	624	476	333	628
	Avg. Distance	470	442	471	447	447	448	467
	Avg. ArrDelay	3	-1	3	0	0	1	4
	PercentageDelayed	29.2%	23.1%	35.9%	29.8%	27.9%	34.2%	40.8%
	AirinsightIndex	0.20	-0.03	0.24	0.02	-0.02	0.10	0.34
737-400M	Fleet Size	4	4	4	4	4	4	4
	Number Of Flights	2,417	2,377	2,045	2,017	2,228	2,474	2,105
	Avg. Distance	445	449	454	457	450	454	463
	Avg. ArrDelay	-1	-3	0	-1	1	2	1
	PercentageDelayed	29.4%	23.4%	30.0%	28.4%	34.7%	39.0%	39.4%
	AirinsightIndex	-0.11	-0.14	-0.01	-0.07	0.10	0.18	0.12
737-700	Fleet Size	17	17	17	17	17	17	17
	Number Of Flights	5,375	6,185	6,334	5,649	5,484	6,256	6,331
	Avg. Distance	911	962	920	885	903	968	962
	Avg. ArrDelay	-3	-7	-5	-2	-6	-1	0
	PercentageDelayed	22.1%	18.0%	20.1%	25.7%	21.9%	31.9%	37.5%
	AirinsightIndex	-0.07	-0.09	-0.09	-0.05	-0.12	-0.02	0.02
737-800	Fleet Size	60	61	61	61	61	61	61
	Number Of Flights	15,213	16,350	17,533	15,481	14,854	15,962	17,519
	Avg. Distance	1,574	1,573	1,586	1,706	1,746	1,619	1,539
	Avg. ArrDelay	-1	-4	-4	-3	-4	-2	0
	PercentageDelayed	32.9%	28.0%	25.0%	30.2%	31.3%	33.9%	39.7%
	AirinsightIndex	-0.02	-0.06	-0.05	-0.04	-0.06	-0.03	-0.00
737-900	Fleet Size	12	12	12	12	12	13	13
	Number Of Flights	2,375	3,398	3,762	3,102	2,833	3,710	4,106
	Avg. Distance	1,210	1,257	1,290	1,252	1,193	1,222	1,281
	Avg. ArrDelay	1	-4	-1	2	-1	-2	2
	PercentageDelayed	34.4%	26.8%	29.5%	33.9%	33.3%	32.6%	42.2%
	AirinsightIndex	0.04	-0.03	-0.03	0.05	-0.03	-0.05	0.05

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Premium #111 - Does the A380 Need Re-engining to Compete with the A350 and 777-X?

3/4/2014

Tim Clark at Emirates has been quite clear that he wants performance improvements for the A380, and as the largest customer by far, these comments carry considerable weight at Airbus. With Emirates also a customer for the 777-9X, it is interesting to compare these two aircraft, and how they will stack-up economically.

Why are we comparing aircraft that are so far apart from a size perspective? Simply because they will be among the alternatives several airlines will consider at as they build route structures over the next decade. What are the factors that would influence the decision to fly an A380 on a route? The answers include traffic, the need for larger premium class configurations, and airport constraints.

Today, for example, Cathay Pacific has two daily flights using 777-300s departing Hong Kong and arriving in London a little over an hour apart. On the surface, it would seem to make sense to consolidate those two operations onto a single larger aircraft, particularly as Heathrow continues to become even more constrained.

Seating configuration also plays a role in the game. If we compare today's Airbus A380 with today's Boeing 777-300ER for a typical long-haul mission, the results show that the A380 has lower seat-mile costs than the Boeing when the 777 is in 9 abreast configuration, but slightly worse when the 777 is in the 10 abreast higher density configuration. If comfort is not an issue, the Boeing wins on pure economics. But when seat width and quality of service factor in, the A380 offers more floor space and flexibility for unique configurations. Of course, as one would expect given the size differential, the A380 has much higher costs per aircraft mile. The following table shows economic performance for a trip from Hong Kong's Chep Lak Kok airport to London's Heathrow, a 5,206 nautical mile mission.

We calculated the comparative economics using the following assumptions:

- ISO Standard conditions, Fuel price $3.25 per US gallon, crew cost at international standards, 80% passenger load factors, maintenance costs using by the hour engine maintenance and life limited part accruals, and a $4 per 1,000 lbs. average rate for landing fees.
- Seating capacities for each aircraft are based on configurations currently used by Emirates for its three-class service, which has 360 seats in its 777-300ERs (10 abreast in economy) and 497 seats in its A380-800s (10 abreast in economy).

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ECONOMIC COMPARISON - 5,206 nm segment			
		B777-300ER	A380-800 RR
Fuel Cost		$ 87,750	$ 139,200
Crew Cost		$ 15,265	$ 18,075
Maintenance Cost		$ 15,100	$ 23,925
Navigation and Landing		$ 10,425	$ 13,350
Total Cost		$ 128,540	$ 194,550
Cost per Aircraft mile *nm)		$ 24.69	$ 37.37
Seats		$ 360	$ 497
Cost per Seat Mile nm)		$ 0.0686	$ 0.0752

The results indicate that the current 777-300ER, in 10 abreast configuration has 8.7% lower seat-mile costs than the A380-800 with 10 abreast configuration, computed using our "apples to apples" comparison.

The A380 can accommodate higher density seating, with 11 abreast that would provide equivalent seat width to the 777. This would increase capacity on the A380 by an additional 40 seats and bring the aircraft into a virtual tie with respect to seat-mile costs. But it would also render Airbus marketing campaign to differentiate on the basis of seat width, 18 inches versus 17 inches, moot.

What New Aircraft Mean to the A380 Competitively

But the world is not standing still, and new aircraft, the A350-1000 and 777-9X, will be introduced that are more efficient than today's models. Using a similar analysis, and the limited data currently available for the 777-X, we examined these aircraft using typical seating configurations proposed by the manufacturers, and calculated their projected economics. The table below compares the A380-800, 777-9X, and A350-1000, again using the same economic assumptions for a Hong Kong-London Heathrow route.

ECONOMIC COMPARISON - 5,206 nm segment				
		A350-1000	A380-800 RR	B777-9
Fuel Cost		$ 73,300	$ 139,200	$ 80,645
Crew Cost		$ 15,825	$ 18,075	$ 16,200
Maintenance Cost		$ 11,745	$ 23,925	$ 13,600
Navigation and Landing		$ 9,800	$ 13,350	$ 10,215
Total Cost		$ 110,670	$ 194,550	$ 120,660
Cost per Aircraft mile *nm)		$ 21.26	$ 37.37	$ 23.18
Seats		$ 330	$ 497	$ 407
Cost per Seat Mile nm)		$ 0.0644	$ 0.0752	$ 0.0569

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Our estimates show that the current A380 does not stack-up as well against the newer models, which will have substantially lower seat-mile costs - nearly 17% lower for the A350-1000 and almost 32% lower for the 777-9X with its high density seating.

This doesn't bode well for the future of the A380 program, except for the limited number of markets in which airports remain capacity constrained. Clearly, to remain competitive, the A380 will need to be utilized in higher density configurations, re-engined, or both.

How would an A380neo change the picture?

Rolls-Royce just announced its plans for geared engine technology, with expectations to be about 10% better than the current TrentXWB. Let's assume a 10% differential in fuel burn as the baseline for an A380neo, with maintenance cost equivalent to today's engines. How does an A380neo stack-up against the 777-9 or even an A350-1000 stretch? The answer, unfortunately, is not as well as Airbus would like.

The A380neo still doesn't match the seat-mile economics of the newer competitors, as shown below:

ECONOMIC COMPARISON - 5,206 nm segment			
	A350-1100	A380neo	B777-9
Fuel Cost	$ 80,500	$ 125,280	$ 80,645
Crew Cost	$ 16,300	$ 18,075	$ 16,200
Maintenance Cost	$ 11,745	$ 23,925	$ 13,600
Navigation and Landing	$ 9,980	$ 13,350	$ 10,215
Total Cost	$ 118,525	$ 180,630	$ 120,660
Cost per Aircraft mile *nm)	$ 22.77	$ 34.70	$ 23.18
Seats	$ 380	$ 497	$ 407
Cost per Seat Mile nm)	$ 0.0599	$ 0.0698	$ 0.0569

At a 10 abreast configuration, A380neo remains behind its smaller A350 and 777-9X rivals in terms of seat-mile costs, and again, pulls nearly even with an 11 abreast configuration. But at 11 abreast, the A380 is less differentiated from its competition.

Unless constrained by airport restrictions, an airline would logically choose the lowest cost aircraft to maximize profitability, using the lowest size aircraft feasible in a market to reduce the risk of flying with empty seats and maximizing profits. While there is a limit to constraining size and turning away customers, an airline can always add an additional flight a few minutes ahead of or behind an existing flight to accommodate growth, and with 787, the capacity addition for an addition flight can be relatively small, in the 200-250 seat range.

The following chart compares seat-mile and aircraft mile costs for the various aircraft, in several seating configurations:

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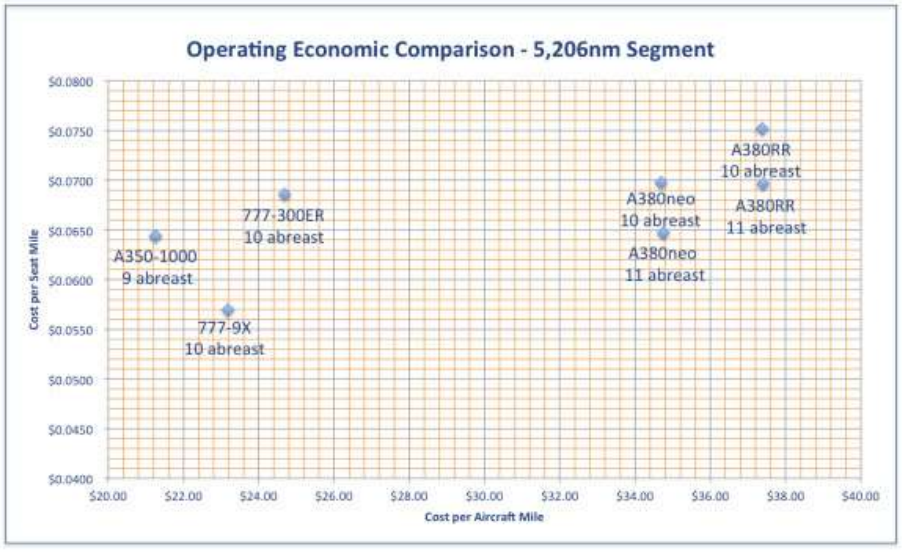

Can Airbus Keep the A380 Competitive?

We conclude that to regain the lead in seat-mile economics, the A380 will need to be stretched, and the engine manufacturers, like they did for A350-500 and -600, may need to cap engine maintenance costs for the four engines to two engine levels. A stretch of another 10 rows would provide significant seat growth and lower seat-mile costs, but at the risk of having an even larger aircraft that will be more difficult to fill.

Consequently we see a limited future market for the A380, even with a neo option, as the economics of the aircraft simply are not competitive with new long-range twins. While the aircraft can be successful for those who differentiate on service, or wish to provide extended premium class service, the fuel burn and maintenance costs of four versus two engines has changed the economic equation, particularly for commodity players. Very large aircraft, like A380 and 747-8, will find an extremely difficult competitive marketplace as more efficient large twins, the A350 and 777-X, enter service.

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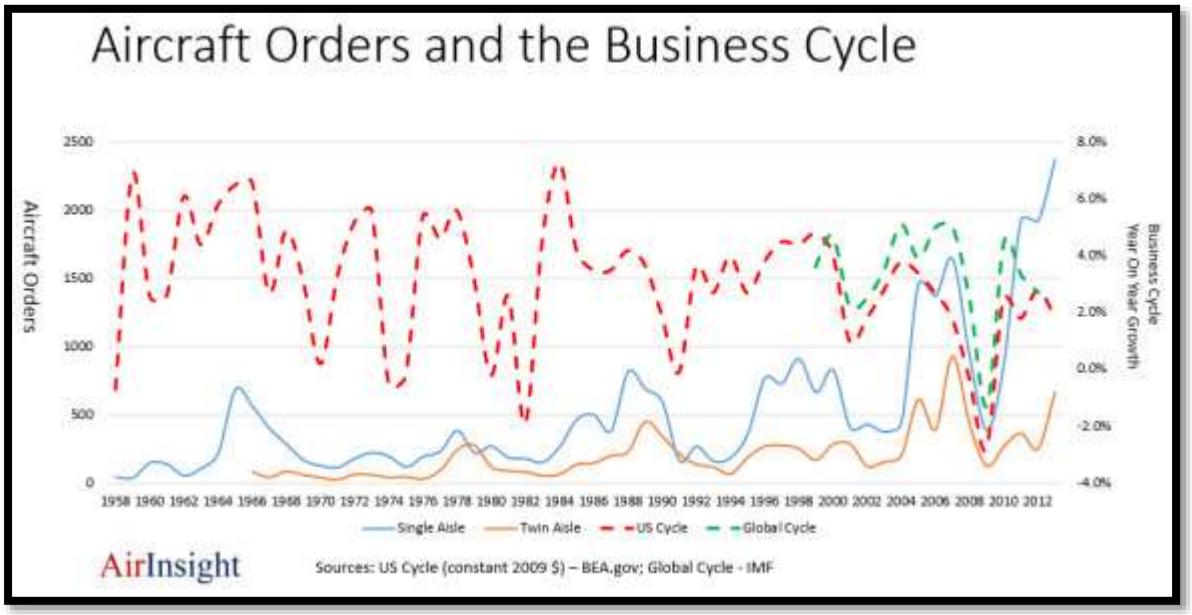
Premium #112 - Business Cycles and Bubbles

3/11/2014

Airbus and Boeing dismiss the talk of a bubble in orders. Even some airline CEOs dismiss this talk. Yet, the talk about a bubble persists. In April 2013, Reuters mentioned this. In October 2013 Avitas' Adam Pilarski also spoke a bubble. Recently at the PNAA conference in Seattle it came up again.

One might expect that the airlines don't perceive that a bubble is in their future, but instead they see an opportunity to acquire newer and more fuel efficient planes for replacement and growth. It would be irrational for airlines to order these new aircraft if they perceived a bubble forming. This is especially true in in Asia, where the demand for air travel appears to be expanding, and their thirst for growth has yet to be quenched. Yet, the same question comes up again under a slightly different guise – will the industry move quickly to over capacity, particularly with the average seating capacity of aircraft increasing as airlines ignore the smallest models from Airbus and Boeing.

Let's take a look at the big picture to get more of a sense of what could be going on. The following chart orders for aircraft from 1958, from when the jet age began through this year. It's what we call looking at the very long run, a necessary analytic step to determine cyclical behavior. When analyzing the chart it becomes quite apparent that certain patterns are evident in both series - orders have similar peaks and valleys to the business cycle, with a small lag in time. From the year 2000 on, it is quite evident that the global business cycle and the US cycle also exhibit common swings, with aircraft orders following a similar pattern, particularly for single aisle aircraft.



It is notable how orders took off in 2009. The business cycle recovered from its sharp drop, but single aisle orders took off like a rocket. That order peak corresponds with the introduction of the A320neo, and continued into the following year with the introduction of the Boeing 737MAX. Twin aisle orders took two years to recover. If orders were to follow historical trends to the relationship of economic

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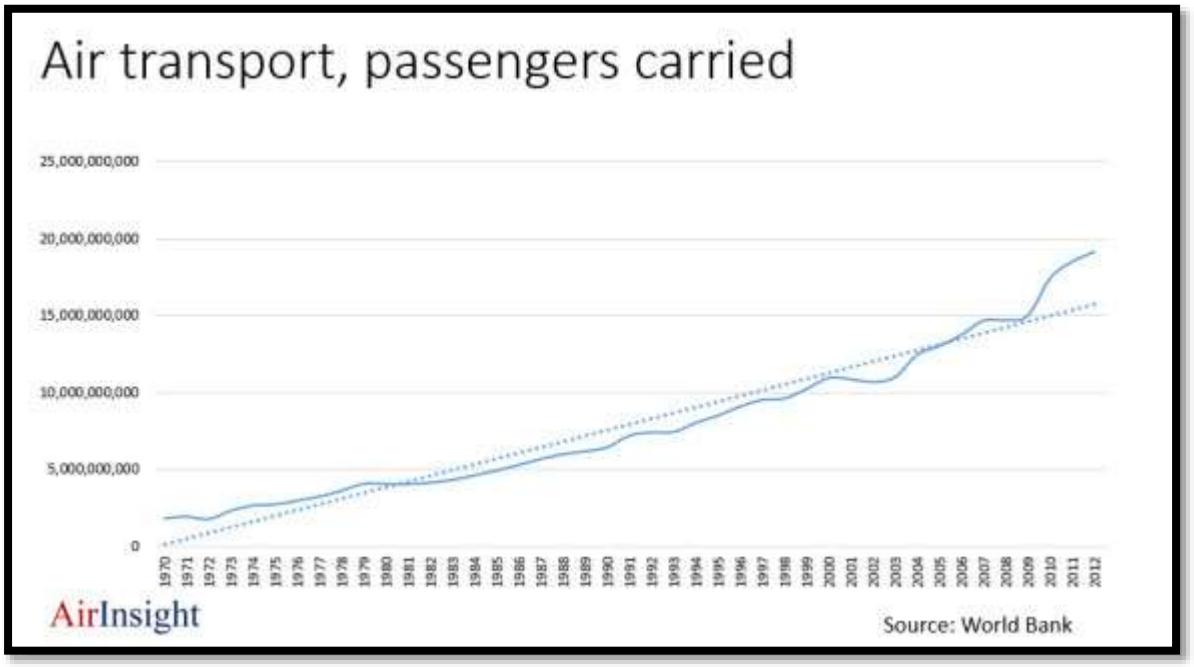
growth, we would have expected a drop off in 2012-2013. However, no drop off has occurred, indicating that a potential "over-ordering" situation may be occurring.

Traffic growth is also related to GDP, and is the underpinning of aircraft demand. Once again we have chosen to examine a long period of data in order to evaluate cyclical relationships. We've inserted a trend line that shows that since the late 2000s, air travel demand is growing faster than the long-term trend line. Clearly, this is a very good sign for airlines and supports a bullish view of the business. But this growth is geographically quite distinct – with slower growth in North America and Europe and rapid growth in Asia and the subcontinent.

The traffic demands in Asia are fueled by burgeoning economic growth and the development of an emerging middle class in India and China. Higher relative wealth enables air travel, and fast growing LCCs in the region now provide low cost air travel to a larger potential population of travelers. These trends make it clear why Tony Fernades does not see a bubble, at least in relevant Asian markets.



Even though the traffic data seems to support the view that the sky has no limit, this defies every business cycle the industry has known. Busts follow booms; it was always so. Take a look the next chart.

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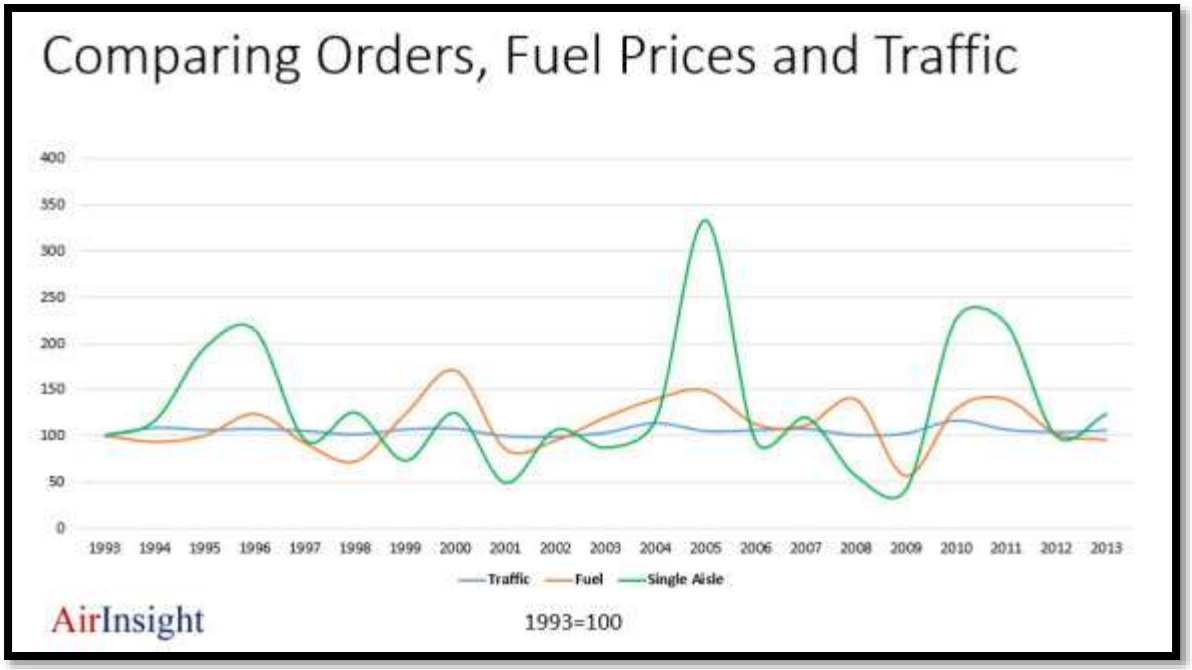

This chart tracks growth in orders and traffic, as well as the current fuel price. Using 1993 as a base year, note the apparent exuberance in single aisle aircraft orders. The growth rate for new orders appears to have little relation to traffic, and periodic spikes that reflect when airlines are flush with cash, as opposed to being constrained in down periods.

We would not expect a direct correlation because aircraft have a finite life, and capacity must be added for both replacement and growth. As a result the growth rate should be higher for aircraft orders than traffic growth, as replacement aircraft also needs to be figured into the equation. But still, the order numbers appear too high in the last couple of years.

Are fuel prices playing a role, and causing aircraft to be retired early? We suspect that many of the single aisle orders are in fact being driven by replacement of older aircraft with higher fuel costs, such as MD80s that are coming out of service and being replaced with A320 and 737NG. But that only accounts for 1,191 MD80 replacements. Take out the 737 Classics and replacing these accounts for another 1,988 aircraft. Even so, the volume of orders seems to remain out of sync with the business cycle. Airbus and Boeing are sitting on an all-time record high backlog, equivalent to seven years' worth of production.

We have previously surmised that the single aisle duopoly is swamping the market with their production power to ensure that new entrants, including Bombardier, COMAC and Irkut do not gain a significant foothold in the 130+ seat market. Through aggressive pricing, Airbus and Boeing can capture the potential customers for new models just before they enter service, and ensure a competitive price advantage by spreading development costs over a larger production base.

Airbus and Boeing are both increasing their production capacities to produce additional aircraft just as the first signs of trouble are showing. Lion Air has major orders from both manufacturers that, in our view, all of which may not be delivered, especially when Asian markets experience an economic downturn.

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Historically, bubbles tend to build and burst just as production capacity is maximized, and deliveries are ready for aircraft that are no longer needed. Can the airline industry really absorb 100 single aisle aircraft from the big two OEMs *every month*, plus deliveries from Bombardier, Embraer, COMAC and Irkut?

The airline industry is historically cyclical, corresponding with economic cycles. And today's economic policies in the US and EU, despite our best hopes, do not appear sustainable over the longer term. There will be a bust, and a bubble that will inevitably burst.

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Premium #113 - FILLING THE GAPS IN THE COMMERCIAL AIRCRAFT MARKET

3/18/2014

Despite the proliferation of new aircraft models, we count 25 (as shown in the following chart) to be introduced between 2014 and 2020. There are some significant market gaps remaining that could provide substantial opportunities for an OEM that is able to fill the need.

New Aircraft Models

Single Aisle	Twin Aisle
A319neo	A350-800
A320neo	A350-900
A321neo	A350-1000
737-7MAX	787-9
737-8MAX	787-10
737-9MAX	777-8
CS100	777-9
CS300	
ARJ-21	
C919-100	
E2-175	
E2-190	
E2-195	
MRJ-70	
MRJ-90	
Yak 242-200	
Yak 242-300	
Yak 242-400	

Most gaps are created by seat size, though it appears clear that the market is now well covered for the entire 70-525 seat range. But some gaps are not created by seat size, but instead by the optimal range designed for aircraft to operate, along with the routes airlines want to fly them on. A good example for this comes from Delta Air Lines, with their recent statements about the issuance of a RFP for new wide-body aircraft.

Delta, with their large transatlantic presence, needs to replace their Boeing 767 fleet, which is currently optimized for a range of about 5,000 nautical miles. With most transatlantic routes in the 3,300-4,000 mile range, airlines need the added capability to ensure flight completion when facing headwinds and adverse conditions. Thus, Delta is seeking an aircraft optimized to a 5,000-5,500NM range capability.

The problem is that the newest, and most fuel-efficient models, have been optimized for 7,500-8,500 mile long ultra haul sectors, including the Boeing 787, Airbus A350XWB and Boeing 777X. As a result, the only aircraft that best fits the requirements is the Airbus A330, which has earlier generation engine

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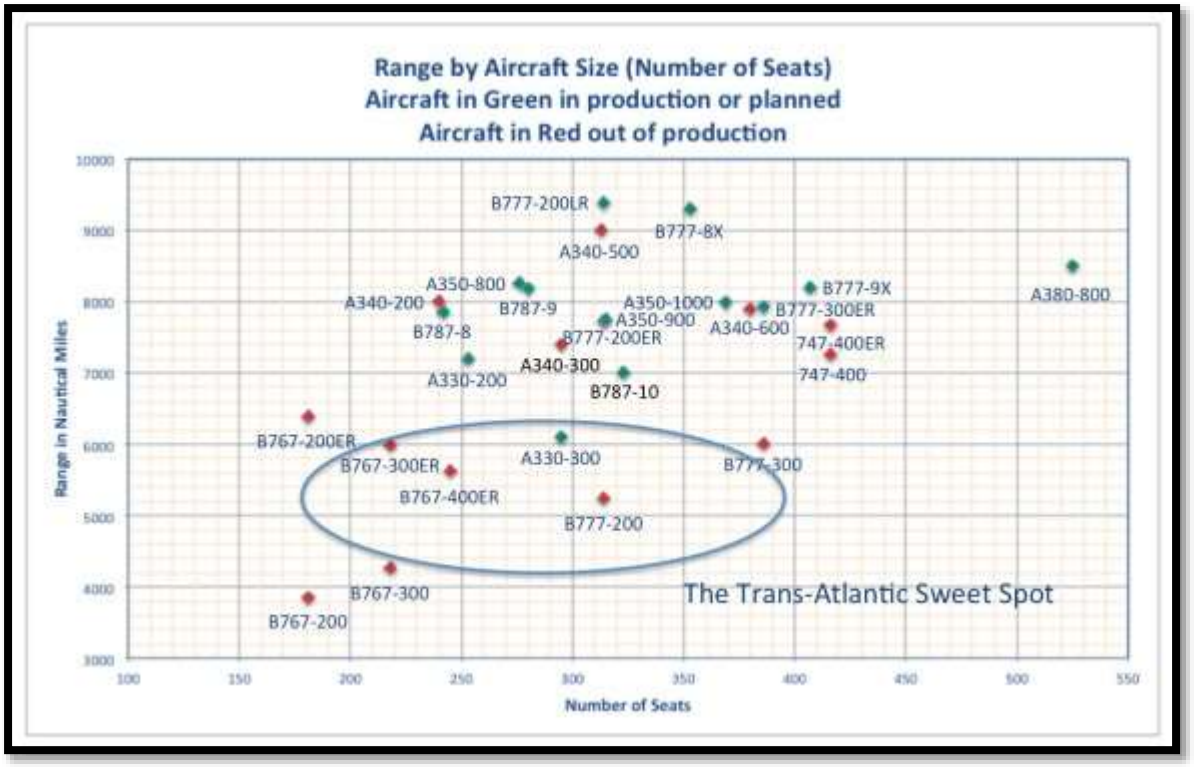
technology and is not as fuel-efficient as Delta would like. Hence the talk of the as yet non-existent A330neo.

Take a look at this chart. Should Airbus create an A330neo?



The ideal option for Delta would be an A330neo, with more modern engines. Tony Fernandes, who heads Air Asia, is also interested in the A330neo, as it is the perfect sized aircraft and is also optimized for the right stage length for their inter-Asian and Asia-Europe operations.

The chart highlights the range capabilities for today's wide-body aircraft, and clearly illustrates that range has grown significantly from the current generation of aircraft. Current and planned aircraft are shown in green, and aircraft out of production in red. The medium range market is now essentially the A330's to conquer. This provides a strong opportunity for Airbus. Many airlines are not interested in an aircraft "that under-fly their range" according to Delta's Anderson.

There has been considerable chatter within the industry, and even at AirInsight, regarding the A330neo, but Airbus has been adamant that no decisions has been made, as reaffirmed in a recent podcast with Airbus' Crawford Hamilton here. But with two major customers now publicly asking for the aircraft, could Airbus be the only OEM filling a sweet spot in range that not only encompasses trans-Atlantic, but Inter-Asian flights as well?

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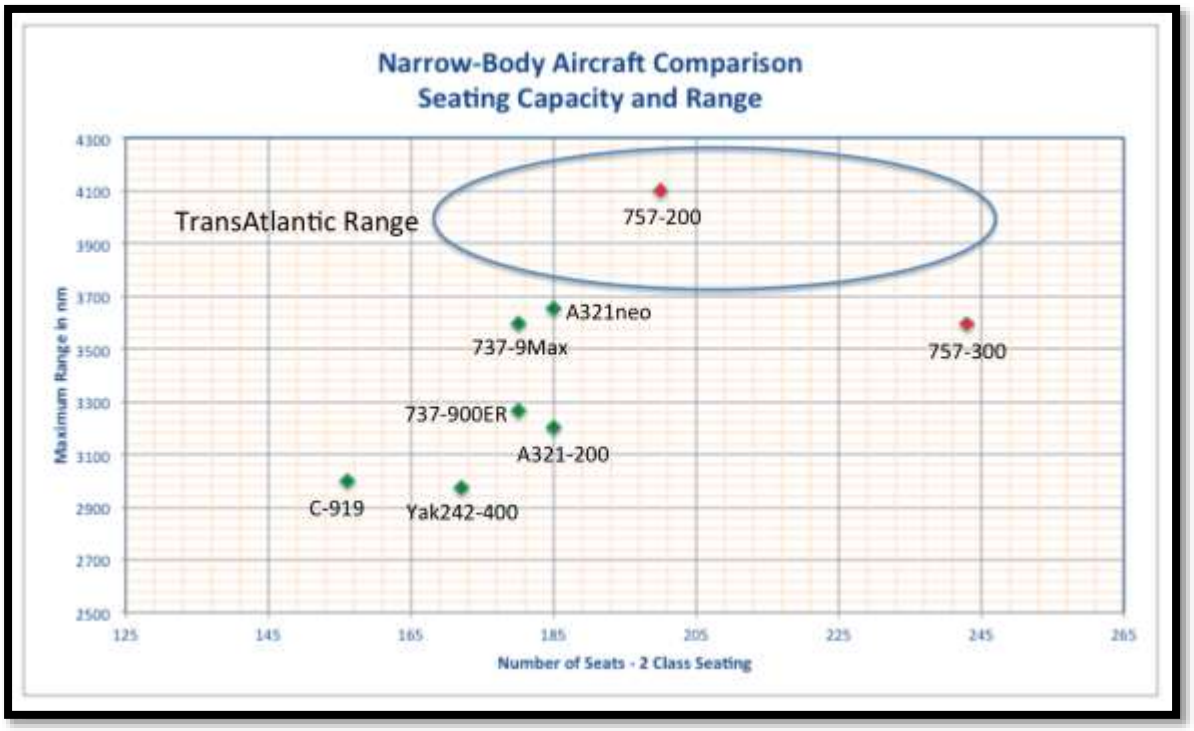
The "757 Gap"

Perhaps the most gaping hole in the industry is replacing the Boeing 757-200. The 757 offered a unique combination of narrow-body economics, larger seating capacity and longer range than any other narrow-body, and was quite successful. In essence, the 757 became the replacement for the DC-8-60 and 70 series to handle long-thin routes under 4,000nm. With 4,000nm range, the 757 also became the only narrow-body to provide the range required for transatlantic operations against the winds coming west. The aircraft became popular in that role as airlines "right sized" routes from smaller cities non-stop to other smaller cities, avoiding hubs congestion or feeding hubs from smaller cities. It proved to be a great route development aircraft.

Today's narrow-bodies don't come close to matching the range and seating capacity of the 757, as shown in the chart below:



The closest aircraft to filling the "757 Gap" is the A321neo, which is finding success in transcontinental US roles with JetBlue and American, but still lacks the range for year round trans-Atlantic operations. This is a gap that Boeing could have filled with the 787-3, the cancelled shorter range version of the 787.

Should a replacement for the 757 be a single aisle, or a twin aisle aircraft? Or perhaps a twin aisle within a narrow-body framework, as long advocated by several carriers, including SAS designed as a "people pleasing plane." Whoever fills this gap will find a replacement market of more than 1,000 aircraft, and likely a growth market of 1,500 more if the efficiency of a new technology aircraft is superior to the existing A321neo and 737-9 designs.

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Engine Technology is Driving Change

While materials and technology have significantly contributed to the efficiency of the 787 and A350 through the use of composite materials and advanced systems, engine technology continues to be the major driver of change. Each new generation of engine offers a fuel burn improvement of about 15%, which in today's market is quite significant.

With Airbus and Boeing each adapting new engines to existing products quite successfully in the narrow-body arena, and the 777-9 effectively doing that, plus more, in the wide body arena, the question is whether Airbus will also jump in as noted in our A330 discussion above. Moreover, Tim Clark CEO at Emirates, is asking for re-engining of the A380 for his next order of 50 aircraft, as the fuel efficiency advantage of the super-jumbo is no longer what it once was against the new technology 777.

Aircraft families can last a long time -- witness the longevity of the 737, A320 and the 777 designs. Will the A330 and A380 join them with re-engined models to remain competitive, or begin the gradual fade out to obsolescence? Customers are demanding more from Airbus. The question now is will they get it.

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Premium #114 - CYBER ATTACKS AND COMMERCIAL AIRCRAFT

3/25/2014

Advanced aircraft, run by sophisticated electronics, provide a number of benefits. Aircraft using fly be wire systems (for example) are more efficient and by eliminating traditional hydraulic and mechanical controls, also save weight and fuel burn.

E-enabled aircraft allow for extensive performance tracking and maintenance information to be sent to the ground automatically. The downside is that this data exchange potentially opens aircraft systems to the threat of cyber-attack using computer viruses or even malware that might enable remote access to flight control systems. How large is that risk really? Is it something the aviation industry should be concerned with? What needs to be done to close any gaps?

The Threat

Today's aircraft are sophisticated machines, with tremendous on-board computing power. Flight management systems, avionics, and computer controls for fly-by-wire systems are all sophisticated systems that are powered by computer software. We all know that computer software is subject to intentional disruption through viruses or could execute different commands through malware. Think not of a virus on your PC, think Stuxnet. The consequences to an aircraft from a viral or malware attack, in the worst case, could be catastrophic.

Vulnerabilities

The most modern of aircraft designs, including the 787, A350, and CSeries, are all e-Enabled aircraft, with many elements connected through a computer network that encompasses numerous systems within the aircraft. In most aircraft, because of weight restrictions, the passenger entertainment and Wi-Fi communications systems also share the same data bus and satellite antenna as the flight management system and other flight control elements. That, in itself, creates a potential network entry point for a cyber-attack. Airlines and vendors will dispute this vociferously, of course.

On the ground, e-Enabled aircraft typically download considerable amounts of data. They also upload new data. What if the upload laptop is corrupted, thereby loading a virus or malware through a maintenance port as software updates are entered into the aircraft during routine maintenance? Yes, this has happened. The airlines and aircraft need not be identified.

A flight crew may also be a potential source for the introduction of malware. Many pilots utilize Apple iPads or other tablets as Electronic Flight Bags, and utilize these devices for open internet connections (e-mail, social media, etc.) at hotels and airports. Wi-Fi connections are typically not secure, particularly free connections which tend to be advertising driven, and malware could potentially be introduced. We know of one highly security conscious carrier that prohibits the use of its Apple iPads for any purpose other than approved EFB applications. But in speaking with pilots at other carriers, we found that they routinely use the "EFB" devices for e-mail, downloaded movies, and other entertainment while at hotels, as they don't want to carry a second personal iPad or laptop on trips.

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The Threat isn't Just a Threat - but Reality

Vulnerabilities abound, but how real is the threat? We've heard of three incidents, from normally reliable sources, in which attempts to corrupt a system have been thwarted. Two of these incidents were aimed at A380s at different carriers, but detected prior to any damage being done. A laptop that contained a virus was used to download maintenance data, with the laptops apparently infected through the previous use of a USB thumb drive.

A more serious event occurred with a carrier operating 787s. In this case, malware reached the internal network through a maintenance laptop, which the OEM became aware of before the airline, which was reportedly unaware of the incident. This resulted in the need to bring the aircraft in to ostensibly "update" the system software. However, we understand, through well-placed sources, that the entire software suite for the aircraft was reloaded over a four-day period for each aircraft to eliminate any potential malware or virus for this carrier's 787 fleet.

Naturally, the OEMs and carriers deny any serious issues with cyber-attacks, indicating that cyber-attack attempts to date have been largely unsuccessful. Perhaps attempts so far have been somewhat amateurish in nature, without the sophistication of more experienced "hackers" and "cyber-criminals." Nonetheless, the existence of these initial attacks, and the timid response of the industry to tighten up vulnerabilities is somewhat disconcerting. News that Boeing and FAA have reduced 777 vulnerability to cyber-attack should catch attention. This vulnerability was never mentioned before the November 2013 FAA statement.

What Needs to be Done

Computer security on aircraft needs to be tightened in several areas -- access to the aircraft systems from the on-board network, access to the aircraft systems from the cockpit and access to aircraft systems from the maintenance ports. This requires a new awareness of threats, including the potential threat of a remote take-over of a flight management system through the installation of malware on an aircraft. The industry dismissed an example of how this could be done as unrealistic. Perhaps, but for how long? Will OEMs offer a guarantee?

After all, we have systems that enable personnel in the United States to fly drones and attack targets half a world away in Afghanistan; cyber-criminals could develop software to remotely operate an aircraft if they have access to flight management systems and the on-board network. The Iranians claim to have captured one the US' most secret drones and also sent another captured drone to Russia. Now there is a claim from Russia that it managed to down a US drone over Ukraine.

Tightening Access to the Network On-Board

With passenger Wi-Fi systems piggybacking on the same satellites used to send vital data regarding airframe and engine performance, firewalls need to be constructed that segregate these systems completely. There is a need to make certain no unauthorized person could hack into the aircraft's critical systems, especially to issue commands to the FMS or autopilot. One airline we spoke with described pilots having their EFB access the aircraft's connectivity using a wired solution to avoid the more vulnerable Wi-Fi. But airlines generally are focused on lowest costs. Few airlines will secure their data flows unless forced to by law.

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Tightening Access in Maintenance Operations

Today's modern aircraft up and download significant amounts of data, both in real-time and once a plane lands. Airbus, Boeing and Bombardier have different systems and different data structures and standards for each of their e-Enabled aircraft. We anticipate Embraer will also have its own version of e-Enablement. But this lack of standards is not the key problem, it merely adds complexities.

Vulnerability occurs when unsecured computers are used to download and upload data from or to an aircraft. If the computer is infected, possibly through previous use of a compromised thumb drive or via internet access, malware could be spread to the aircraft. This has been the most common way viruses have been introduced into aircraft to date.

Managing that process requires tightening up internal controls on the use of those computers, and keeping them clean. Firewalls, anti-virus software, malware checks, but mostly enforced procedures that keep thumb drives and non-aircraft related activities from being performed by aircraft related laptops are essential in that process. Many corporations do not allow visitors to enter their premises carrying a thumb dive. But this requires a level of discipline few carriers yet comprehend. Adding to the complexity is the fact that many airlines use outside MRO services based overseas. One can easily imagine the layer of vulnerability this adds.

Tightening Access for Flight Crews

The electronic flight bag, ever more typically a tablet computer, enables pilots to preload route information and quickly access critical information like flight charts, eliminating the need for heavy paper charts in the cockpit. But with these devices, that could upload data to the flight management systems, comes risk. It is difficult to enforce rules against flight crews using these tablets for other applications. Trading off the convenience of these devices which enable crews to handle legitimate corporate email and other communications, for example, for locked down systems is tough. But this vulnerability must be closed or managed.

Improving Software Security

The avionics companies have done an excellent job with software, but that software is typically written in C++ or other commonly understood languages. Even proprietary software written using commonly understood languages is vulnerable, particularly for Unix-based languages that are exposed through back doors that are well understood in the hacking community. Do the avionics manufacturers need a new language, which has limited commands and can be better secured? We believe this may, in time, be necessary.

The Bottom Line

As we transition from older hydraulic aircraft to newer e-enabled aircraft that utilize computers to activate flight control surfaces, the consequences of a cyber-attack on an aircraft have grown significantly. Vulnerabilities exist, and need to be closed. But the industry is moving slowly in recognizing the risks associated with these exposures, and needs to quickly fill the gaps to ensure that aircraft are secure from attack, and systems are not vulnerable to cyber-criminals.

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Premium #115 - REVISITING UNINTERRUPTIBLE AUTOPILOTS

4/1/2014

In the wake of the disappearance and assumed crash of Malaysian flight 370, industry chatter regarding uninterruptible autopilots installed on Boeing aircraft has intensified. Boeing was awarded a patent for this technology in 2006, and reportedly began installations a year later. According to an August 2009 story (requires a login) from FlightGlobal, Airbus considered equipping the A350XWB with an automated system that would put the aircraft into an unaided emergency descent should unsafe cabin pressure be detected.

An uninterruptible autopilot is a device that could be activated in the event of a hijacking, or attempted takeover, of the aircraft that locks out control of the aircraft from the cockpit and enables the aircraft to be remotely flown to a safe location and landed. The technology is essentially similar to that used in remote control flying of drones.

A description of this technology was outlined in a 2006 article in FlightGlobal, and reported in the press here, here, and here around the time when it was introduced. The system can be automatically activated by pressure sensors in the reinforced cockpit doors that can detect an attempt at forced entry, and activate the system. At that point, control of the aircraft would move to a remote piloting facility either controlled either by the airline, or more likely a government security agency such as Homeland Security in the United States.

A lawsuit was filed by a former airline pilot, citing a portion of US FAA FAR 121 that requires the captain to remain in control of the aircraft. In response to his lawsuit, the pilot stated that Boeing admitted that it had indeed installed such (uninterruptible autopilot) equipment on commercial aircraft, and had planned to upgrade the entire Boeing fleet by 2009. He indicated on March 3, 2007, in a response to the lawsuit, that Boeing said such devices had been deployed on commercial aircraft, and that within two years, or 2009, all Boeing's would have this type of autopilot. Most travelers, and many industry observers, remain unaware that these devices have apparently been installed on Boeing commercial aircraft. Boeing chose not to respond to our inquiries.

The benefits of an uninterruptible autopilot are significant. In the event of a hijacking or indication that a crew-member wants to commit suicide, control of the aircraft can be regained, and a full Category IIIa automatic landing can be made at more than 108 airports so equipped worldwide. This would save the aircraft, its cargo and most importantly, the passengers on board. Had this technology been available in 2001, the 9/11 incidents could have been averted.

The risks, however, are also significant. Is it safe from hackers and cyber-threats? What if a rogue element with technology knowledge could remotely take over an aircraft? Last year at a hacker conference a pilot demonstrated how to take control of an airplane using an Android smartphone. He was ridiculed by the industry afterwards and now refuses to speak about this to the media.

We understand that the uninterruptible autopilot software for the system was built by Thales, and routing for emergencies to an alternate airport is provided by software developed by Raytheon (ARES),

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two companies with outstanding technical capabilities. Thales could have also worked on this technology with Airbus. Airbus also did not to respond to our inquiries.

Perhaps the most important overriding question is who can activate this uninterruptible autopilot system remotely, and under what circumstances? Not all governments act in good faith, and the potential for abuse of such a system to eliminate political enemies, or to protect intellectual property from falling in the wrong hands could result in a tragedy.

Bottom Line: The capability to remotely control civilian airliners from the ground might represent a new level of cyber-security threat, which needs to be at the forefront of discussion on how to better secure computer systems on-board airliners. A discussion of who controls a flight after the uninterruptible autopilot is activated, and how it is activated is appropriate. We'd like to see airlines, rather than governments, in control of this process, as they have a vested interest in bringing airliners down safely with their paying customers.

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Premium #116 - Sukhoi's Superjet - Competitive and Initially Successful in Western Operations

4/8/2014

The Sukhoi SSJ has been quietly developing its footprint. Historically, expectations for an aircraft built in Russia center around robust construction but sub-par technology and efficiency; the SSJ is radically different from those expectations. Primarily, its creator, Sukhoi is a world class builder of fighters. Their aircraft serve not only as frontline equipment for Russia, but are also found in 26 Air Forces, many of which can afford to buy from western suppliers - such as India, Malaysia and Egypt. Secondly, Sukhoi is developing Russia's fifth generation fighter, the PAK FA also in tandem with developing a larger civilian airliner called the MS-21. Sukhoi is an aerospace firm with the technology and IP to produce aircraft at global standards.

The SSJ is a Sukhoi design that utilizes engines built by Powerjet, a collaboration between France's SAFRAN and Russia's Saturn. As the following image illustrates the SSJ utilizes systems from many of the most respected western aviation suppliers. With modern systems, a modern and efficient engine, and a well-engineered airframe. Superjet is a formidable aircraft.

The SSJ is marketed in the west by Superjet International, a joint venture between Italy's Alenia Aermacchi (51%) and Russia's Sukhoi Holding Company (49%). Superjet International also provides global customer support for international customers of the aircraft. In short, the SSJ accomplishes cutting edge design with first tier western partners. It is a compelling offering that is attracting attention because the aircraft is priced lower than its competitors, Bombardier and Embraer.

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Reluctance by western airlines to buy the aircraft is being eroded by the aircraft's performance. Airlines are both risk averse and price sensitive, and once the perceived risk of the SSJ is overcome, its price point will likely drive orders from more western airlines. Superjet claims 180 firm orders to date. The SSJ list price is $35.4m (Base) and $36.2m (LR) and we understand actual pricing typically ranges between $25-$28m.

What reduces the risk of buying a Russian aircraft? Performance and customer support. Mexico's Interjet is the first western airline with SSJ's in service. From EIS in September 2013 through March 2014, their five SSJ100s now in service have accumulated over 4,000 flight hours and over 3,800 cycles. During the period Interjet's SSJs experienced no flight operational cancellations and delivered a dispatch reliability of 99% - already substantially better than the Boeing 787. We have been told that the aircraft is showing significantly lower (double digit) fuel burn than expected, as Russian engineers tend to be conservative in their estimates. Performance has been sufficient for Interjet to exercise ten additional options in addition to its 20 firm orders. As SSJ performance becomes better known among airlines, western interest in the SSJ is likely to increase, particularly given its low capital cost. Currently 28 SSJs are operated by eight airlines and to date have accumulated more than 40,000 flight hours.

The SSJ has not yet obtained FAA certification, which should be forthcoming shortly. The SSJ already has EASA certification, and Interjet will soon begin flights into the US.

Superjet expects to grow their production rate to 40 aircraft in 2014, and plans 50 in 2015. The main effort in production improvement is aimed at decreasing labor intensity of the final assembly process. Sukhoi is optimizing production processes by introducing a system of visual production quality tracking. Each final assembly process result is documented visually with Samsung tablets and stored in a database. This has led to much faster tracking of production faults. Having revealed the most common problems, they quickly improve faulty processes to avoid future faults. In addition, Superjet also introduced lean-manufacturing technologies to ensure lower production losses at the each stage of production. This has led to savings, for example, of 40% of the time a final assembly shop employee spends waiting for required tools.

The SSJ competes in a tough segment against experienced firms like Bombardier and Embraer. The SSJ100 is a state-of-the-art regional jet. It provides the comfort of a narrow-body with the reduced costs and flexibility of a regional jet. Operators confirm the SSJ has the characteristics of a small mainliner but with very low operating costs. Superjet estimates market size at 3,750 aircraft over the next 20 years for the 91-120 segment and they target a market share of 25%. Moreover, the SSJ is being evaluated for a combi and freighter. The partners are also reviewing a stretched version dubbed SSJ100NG.

The following chart summarizes our estimate of operating economics for the SSJ, which are quite similar to today's competitors. If fuel burn is, as Interjet has experienced, about 10% lower than the estimates from Superjet on which we based our calculations, the economics could be significantly better than shown below. With its low capital cost, overall costs, including capital, are compelling.

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SSJ Economics - Single Class Configuration					
Trip Distance NM	500	1000	1500	2000	2500
Fuel @ $3.25/G	$2,563	$4,539	$6,627	$8,784	$10,349
Crew	$720	$1,230	$1,732	$2,242	$2,737
Maintenance	$779	$1,447	$2,120	$2,791	$3,455
Landing Fees	$361	$361	$361	$361	$361
Total	**$4,423**	**$7,577**	**$10,840**	**$14,178**	**$16,902**
Cost/Seat Mile	$0.0903	$0.0773	$0.0737	$0.0723	$0.0690
Cost/Aircraft Mile	$8.85	$7.58	$7.23	$7.09	$6.76

The Bottom Line: Russia has built a competitive aircraft that is doing well with its first Western customer, Interjet. The success of that experience should result in additional international sales, and the Superjet will not be simply an airplane built in Russia for the Russian market.

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Premium #117 - WILL BOEING'S PARTNERING FOR SUCCESS PROGRAM BACKFIRE?

4/15/2014

Very few company initiatives will have as dramatic an impact that the "Partnering for Success" program introduced by Boeing creates. This new program fundamentally changes the way Boeing does business with companies that manufacture components for its aircraft, which is about 2/3rds of the content.

The new program, in a nutshell, calls for a 15-25% price reduction to Boeing, in exchange for participation in the anticipated higher volumes as the industry continues to grow and Boeing expands production rates. As a part of the program, Boeing also increases its control of the aftermarket, prohibiting direct sales of most spares, providing Boeing another opportunity for mark-ups to its end-user airline customers.
Boeing plans to have all of its suppliers agree to the terms of this new partnership deal, or find alternative suppliers. Suppliers who do not agree to comply will be placed on a "no fly" list that will result in that supplier not being invited to participate on future program bids. We understand that Boeing is taking a hard line in negotiations.

The Rationale
Why is Boeing doing this? There are several reasons. First, because they perceive their margins to be lower than those of their suppliers (about 16% to 10.8% last year), and as the OEM, they believe they deserve a larger share of the pie. Second, suppliers provide the majority of the content on an aircraft, making suppliers an obvious target for cost reduction and margin growth. Third, Boeing is fighting intense competition from Airbus, Bombardier and Embraer in the narrow-body space, and wants to reduce costs to gain competitive advantage in what has become a dogfight for new aircraft orders. Airlines in the single aisle market are intensely focused on lowest costs as LCCs grow ever stronger. OEMs have to accommodate this reality.

Economic theory suggests that a duopoly should not be engaged in a price war, but instead increasing prices and reaping higher margins. But the opposite is happening in the market. The reason Boeing and Airbus are aggressively competing on price is in part because of the threat of new competitors. The Bombardier CSeries and Embraer E2-195 are encroaching and winning over customers in traditional 737-7MAX and A319 markets, while the Chinese C919 and Russian MS-21 will directly compete with Airbus and Boeing in the larger bread and butter narrow-bodies.

It is this threat that is driving both manufacturers to over-produce and expand production levels that will inevitably create a narrow-body bubble in the coming decade. The handwriting is on the wall, and Boeing and Airbus market share will inevitably decline, with Bombardier, Embraer, COMAC and Irkut taking a slice of the narrow-body pie. The question is how quickly, and by how much; which is what Boeing and Airbus are trying to prevent.

The short-term strategy for the duopoly is to preclude the new competition from gaining a foothold by pricing aircraft at low margins. Airbus margin last year was a paltry 4%, and they have publicly stated that they "don't intend to make the same mistake with Bombardier that Boeing did when Airbus entered the market." In plain English, they will try to preclude them a gaining a foothold for the CSeries.

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How do you preclude new competitors from market entry? By pricing so low that they can't profitably compete. In recent years, we've seen the largest discounts from Boeing and Airbus rise from the traditional 30% to over 50% in several instances.

One would think that in a duopoly, prices should rise, rather than fall. But the duopoly is fighting a battle to sustain itself - one that it will eventually lose as the developing economies solidify their industrial development - national priorities for Brazil, Russia, and China, and a strategic goal for Quebec and Canada. In the interim, there will be some margin shed. The "Partnering for Success" is essentially about spreading that margin reduction throughout the supply chain.

Boeing and Airbus recognize that new aircraft like the CSeries are more efficient than their older models, even when re-engined, and will need to price to the point of economic indifference for customers to order their aircraft. They also recognize that Bombardier is a master at stretching airplanes, witness the CRJ doubling from 50 to 100 seats. As a result, they are pushing larger aircraft at low prices, as their smaller models cannot compete economically with Embraer or Bombardier in the 130 seat market. An example would be the easyJet order for A320s to replace its A319s. By heavily discounting those models, the duopoly squeezes margins on competing programs below the point at which they can be profitable, and thereby retain market share for another decade. So far, it is working to some degree, but not well enough to preclude successful market entry for the new players. And once those new and more efficient aircraft are in operation, demand will grow.

A Chilly Reception So Far

Needless to say, the new Boeing program has not been well received in the supplier community, many of whom are asking how they can cut 15-25% when that represents their entire margin. Reports after the Speednews Industry Suppliers conference in March indicated that the supplier community remains quite angry about the situation, but is somewhat over a barrel.

How large is the impact of this program? Even the Federal Reserve, in a report on the northeast economy, mentioned "Boeing has been putting exceptional pressure on its suppliers to lower prices." When the Fed takes the time to comment on a corporate initiative, it must be having a significant impact.

Saying No and its Impact

The first major supplier to say no to Boeing was United Technologies, the current maker of the landing gear for the Boeing 777. Boeing, as a result, replaced them with a new supplier, Heroux-Devtek based in Quebec. However, that company is small by comparison (revenues of $233 million versus $63 billion for UT in 2013) and has never produced landing gear for commercial aircraft. Is Boeing taking a calculated risk that the company can perform well with its "transformative" contract that brings a small supplier into the big arena? We believe this brings significant additional development risk to the 777-X.

Interestingly, Heroux-Devtek is a supplier to UT for some parts for the current 777 landing gear, and has a non-compete clause in their contract with UTC. That clause is going to arbitration, and the result could significantly impact their program participation if the panel favors UT in its decision.

This is not to say Heroux-Devtech is not a competent firm, nor lacks talent. They are aggressive and aspirational, and now have a significant opportunity. But the risk remains as to whether they can deliver

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from both design and production standpoints. A lot of jobs could be moving from the US to Longueuil, Quebec.

Several major suppliers have accepted Boeing's terms and joined the PFS program, including Rockwell Collins, Spirit, B/E Aerospace, and Hexcel.

Increasing Risks for Boeing

Earlier this year, Boeing summed up the status of its supply chain as about 1/3rd joined, 1/3rd in negotiations, and 1/3rd in limbo. Today, we estimate that more than half the supply chain has grudgingly accepted Boeing's terms. But for many smaller suppliers, participation presents a critical challenge.

The small suppliers may be taking the brunt of the impact. A 2011 study by Price Waterhouse Coopers of 100 aerospace suppliers indicated that 20% were at high risk of being unable to keep up with production increases and were financially weak. The result is that many small suppliers are grappling with the decision of whether to invest and grow, to sell to a larger and financially more stable player, or to simply fold and not participate because the investment required doesn't provide a sufficient return. We believe the PFS program at Boeing could result in a new round of supplier consolidation, as a 15-20% cost reduction will squeeze them beyond the point at which they could survive independently. This presents some interesting roll-up opportunities for the private equity community. But it also represents a risk if some existing suppliers find themselves in trouble, and the supply chain is disrupted. All it takes is one fastener on a $200 million airplane, as Boeing discovered with the 787, to cause program delays costing it many millions of dollars.

In addition, with new suppliers taking over the contracts from experienced suppliers, is Boeing placing its higher production schedules at risk? Their experience with the 787, and the need for Boeing to acquire Vought and experience with Alenia to improve unacceptable delivery performance underscores the type of risks that can be associated with inexperienced suppliers taking on major roles for new programs. Sometimes it just doesn't work well. After the 787 debacle, there were some lessons for Boeing to learn. The question is, have they learned them, or will history repeat itself?

Will procurement tie the hands of Boeing engineers by not permitting them to select the most experienced or productive suppliers because they are on the "no fly" list? This is indeed a possibility, and risks for the 777-X program increase with each experienced 777 supplier that is replaced.

Boeing has taken the Wal-Mart strategy of extracting more from its supply chain. But in this case, when products are not consumer oriented but highly specialized, that strategy has a higher risk of backfiring.

The Bottom Line:

Airbus' recent market dominance and the emergence of new competitors has Boeing's senior executive team strategizing on how to keep as much of their profit and market share as possible. As Boeing hasn't been winning competitively to the degree it once did, it is now trying to win on price, and at the same time thwart new competitors.

Taking additional margin from the supply chain is one mechanism to reduce product costs to permit lower pricing. But there is a risk that this process could backfire and result in their most experienced suppliers knocking on the doors in Toulouse, Montreal, San Jose de Campos, and Beijing to provide their

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most innovative ideas to the competition. In a game of technological leapfrog, you can't afford to alienate the innovators in the supply chain.

The new program, in a nutshell, calls for a 15-25% price reduction to Boeing, in exchange for participation in the anticipated higher volumes as the industry continues to grow and Boeing expands production rates. As a part of the program, Boeing also increases its control of the aftermarket, prohibiting direct sales of most spares, providing Boeing another opportunity for mark-ups to its end-user airline customers.

Boeing plans to have all of its suppliers agree to the terms of this new partnership deal, or find alternative suppliers. Suppliers who do not agree to comply will be placed on a "no fly" list that will result in that supplier not being invited to participate on future program bids. We understand that Boeing is taking a hard line in negotiations.

The Rationale

Why is Boeing doing this? There are several reasons. First, because they perceive their margins to be lower than those of their suppliers (about 16% to 10.8% last year), and as the OEM, they believe they deserve a larger share of the pie. Second, suppliers provide the majority of the content on an aircraft, making suppliers an obvious target for cost reduction and margin growth. Third, Boeing is fighting intense competition from Airbus, Bombardier and Embraer in the narrow-body space, and wants to reduce costs to gain competitive advantage in what has become a dogfight for new aircraft orders. Airlines in the single aisle market are intensely focused on lowest costs as LCCs grow ever stronger. OEMs have to accommodate this reality.

Economic theory suggests that a duopoly should not be engaged in a price war, but instead increasing prices and reaping higher margins. But the opposite is happening in the market. The reason Boeing and Airbus are aggressively competing on price is in part because of the threat of new competitors. The Bombardier CSeries and Embraer E2-195 are encroaching and winning over customers in traditional 737-7MAX and A319 markets, while the Chinese C919 and Russian MS-21 will directly compete with Airbus and Boeing in the larger bread and butter narrow-bodies.

It is this threat that is driving both manufacturers to over-produce and expand production levels that will inevitably create a narrow-body bubble in the coming decade. The handwriting is on the wall, and Boeing and Airbus market share will inevitably decline, with Bombardier, Embraer, COMAC and Irkut taking a slice of the narrow-body pie. The question is how quickly, and by how much; which is what Boeing and Airbus are trying to prevent.

The short-term strategy for the duopoly is to preclude the new competition from gaining a foothold by pricing aircraft at low margins. Airbus margin last year was a paltry 4%, and they have publicly stated that they "don't intend to make the same mistake with Bombardier that Boeing did when Airbus entered the market." In plain English, they will try to preclude them a gaining a foothold for the CSeries.

How do you preclude new competitors from market entry? By pricing so low that they can't profitably compete. In recent years, we've seen the largest discounts from Boeing and Airbus rise from the traditional 30% to over 50% in several instances.

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One would think that in a duopoly, prices should rise, rather than fall. But the duopoly is fighting a battle to sustain itself - one that it will eventually lose as the developing economies solidify their industrial development - national priorities for Brazil, Russia, and China, and a strategic goal for Quebec and Canada. In the interim, there will be some margin shed. The "Partnering for Success" is essentially about spreading that margin reduction throughout the supply chain.

Boeing and Airbus recognize that new aircraft like the CSeries are more efficient than their older models, even when re-engined, and will need to price to the point of economic indifference for customers to order their aircraft. They also recognize that Bombardier is a master at stretching airplanes, witness the CRJ doubling from 50 to 100 seats. As a result, they are pushing larger aircraft at low prices, as their smaller models cannot compete economically with Embraer or Bombardier in the 130 seat market. An example would be the easyJet order for A320s to replace its A319s. By heavily discounting those models, the duopoly squeezes margins on competing programs below the point at which they can be profitable, and thereby retain market share for another decade. So far, it is working to some degree, but not well enough to preclude successful market entry for the new players. And once those new and more efficient aircraft are in operation, demand will grow.

A Chilly Reception So Far

Needless to say, the new Boeing program has not been well received in the supplier community, many of whom are asking how they can cut 15-25% when that represents their entire margin. Reports after the Speednews Industry Suppliers conference in March indicated that the supplier community remains quite angry about the situation, but is somewhat over a barrel.

How large is the impact of this program? Even the Federal Reserve, in a report on the northeast economy, mentioned “Boeing has been putting exceptional pressure on its suppliers to lower prices.” When the Fed takes the time to comment on a corporate initiative, it must be having a significant impact.

Saying No and its Impact

The first major supplier to say no to Boeing was United Technologies, the current manufacturer of the landing gear for the Boeing 777. Boeing, as a result, replaced them with a new supplier, Heroux-Devtek based in Quebec. However, that company is small by comparison (revenues of $233 million versus $63 billion for UT in 2013) and has never produced landing gear for commercial aircraft. Is Boeing taking a calculated risk that the company can perform well with its “transformative” contract that brings a small supplier into the big arena? We believe this brings significant additional development risk to the 777-X.

Interestingly, Heroux-Devtek is a supplier to UT for some parts for the current 777 landing gear, and has a non-compete clause in their contract with UTC. That clause is going to arbitration, and the result could significantly impact their program participation if the panel favors UT in its decision.

This is not to say Heroux-Devtech is not a competent firm, nor lacks talent. They are aggressive and aspirational, and now have a significant opportunity. But the risk remains as to whether they can deliver from both design and production standpoints. A lot of jobs could be moving from the US to Longueuil, Quebec.

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Several major suppliers have accepted Boeing's terms and joined the PFS program, including Rockwell Collins, Spirit, B/E Aerospace, and Hexcel.

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Airbus' recent market dominance and the emergence of new competitors has Boeing's senior executive team strategizing on how to keep as much of their profit and market share as possible. As Boeing hasn't been winning competitively to the degree it once did, it is now trying to win on price, and at the same time thwart new competitors.

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As the 900 pound gorilla, Boeing will get its reductions, but they will come at a cost.

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Premium #118 – Scimitar Cuts Fuel Burn

4/22/2014

Recently a number of airlines flying Boeing 737s have switched to the latest Aviation Partners' (APB) winglet. The new device is called Split Scimitar, as shown in the image. Its shape is quite different from the previous blended winglets seen on 737s.

United Airlines was the launch customer and other airlines have ordered the new Scimitar device. The new device is said to improve fuel burn from the previous winglet's 3.5% to 5.5%, a very significant savings.

The table lists the Scimitar orders to date.

Operator	Minor Model(s)	Firm	Options	Total
AeroMexico	737-800/700/900	13	22	35
Air Transat	737-800	4	6	10
Alaska	737-800/900ER/900/700	111	100	211
Copa	737-800, 700	26	74	100
Southwest	737-700/700	85	600	685
TUI Group	737-800	80	20	100
United	737-800, 700, 900	313	15	328
WestJet	737-800/700/700	18	104	122
		650	941	1591

Southwest calculates that the blended winglet saved the airline 55 million gallons of fuel at an average $3.16 per gallon. In 2013, this amounted to $175m in savings, or 13% of the airline's operating profit. The list price for winglets according to APB is $1 million (737) for the blended version (uninstalled) and for the Scimitar upgrade, another $555,000. Southwest has plans to retrofit 52 737-800s and forward fit 33 more set for delivery. The potential (we don't think Southwest pays list prices) $47m cost can be recovered quickly. But an aircraft's wing in some cases must be reinforced to handle the additional

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weight, and the current blended winglet requires substantial strengthening prior to converting it to a Split Scimitar.

In order to get a view from airlines we contacted several of the launch customers with a few questions.

Is the current APB 737 winglet outdated?

Copa – "I wouldn't say it is outdated, as a matter of fact the new Scimitar Winglet is just a modification to the current winglet that provides additional reduction in fuel burn. This is how the technology works in aviation, continually looking for ways to improve safety and performance. For certain operators and depending on their type usage of the aircraft this modification may not be necessary."

Alaska – "Alaska still loves APB's blended winglets. Over the years they have saved the airline millions of gallons of fuel. APB has found a way to make a proven, fuel saving product even better. "

United – "Not at all – it's an improvement. It makes the existing winglet even better. We put winglets on every aircraft that we plan to operate for a long period of time. United burns close to about 1% of the world's annual oil supply and expects that the winglets, when combined with the SSW, will save United more than $200M (or 65 million gallons) per year on a run rate basis."

Was APB's reputation for delivering on the current 737 winglet sufficient to decide on the upgrade?

Copa – "Of course. APB current winglet has provided airlines good savings and lower carbon footprint for the environment. They also have strong engineering group and have been very cooperative."

Alaska – "No. APB's track record is stellar but we needed to verify the savings before we made another multimillion dollar investment in winglets. Our engineers looked at the data and estimated how the split winglets would perform in real world conditions on our fleet."

United – "Yes, APB has a very good track record of delivering on their commitments. We validate APB's estimates before purchasing the winglets, but APB partners with Boeing to validate and audit the design using various tools such as CFD, wind tunnel testings and flight testing to prove their technology. . We definitely see savings when we install winglets, but are measuring very small percentages in fuel burn. The longer you cruise, the better the winglets perform."

How long do you estimate it will take to recover the cost of the upgrade?

Copa – "I cannot tell you exactly how it works for us, but depending on the type of operation of the airline, on average, it should be between around two to three years to recover the cost."

Alaska – "The scimitar winglets will save 58 thousand gallons per aircraft per year. Using a reasonable fuel cost per gallon, we estimate that the total cost of the upgrade will be recovered in about two years."

United – "It depends on many different factors such as fuel price, stage length, utilization and whether you install the winglet on a stand-alone basis or in conjunction with other maintenance work, but we expect paybacks in about two years.

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What is the key driver to make the decision to switch to the Scimitar?

Copa – "Mainly reduction in fuel burn and cleaner environment."

Alaska – "Once we verified the fuel savings, both the economic case and the environmental case were compelling. Consumers demand low fares and saving fuel helps us keep costs low so we can offer low fares. Alaska's customers expect us to be good corporate citizens. Reducing energy use and carbon emissions is a crucial part of Alaska's commitment to be the airline industry leader in environmental stewardship."

United – "Being more fuel efficient was the key driver in our decision. Fuel is our biggest and most volatile expense. The winglets are a natural hedge. Not only is it good for the environment, but the more fuel efficient United is, the less volatile our expenses. "

Does your airline plan to retrofit 737s or only forward for on new deliveries?

Copa – "We are installing it going forward, but we are also modifying a certain number of existing aircraft based on age, and type of operation."

Alaska – "We have already installed blended winglets on every jet in our fleet that is winglet capable. Our plan is to modify all of those units with the scimitar as quickly as practical. When complete, we will have split winglets on every winglet capable jet Alaska flies. Boeing's 737-MAX will come with split winglets factory installed."

United – "Our plan is to put the Scimitar on all our 737s. As the launch customer, United has provided 737-800s and -900ER to APB for flight testing. Our new 737 deliveries will arrive with winglets installed by Boeing and then we will retro-fit with the SSW when it's convenient. A -900ERmod is a simpler retrofit since the wing does not have to be reinforced like the 737-800."

Is there anything you can share on your decision process?

Copa – "Our decision was based on our interest to reduce fuel burn and to help in protecting the environment. The performance of the existing Winglet also helped us in our decision making process."

Alaska – "Saving fuel has always been a priority at Alaska. We fly the most fuel efficient airline fleet in North America. The scimitar project was hatched by our fuel conservation manager, Mignon Hoover. Mignon reviewed the technical data and concluded that the savings were substantial. She helped assemble a team that included engineering, flight operations, maintenance, procurement and fleet experts. The group evaluated all aspects of the project, created a solid plan and put together a business case. Alaska's leaders and board of directors wholeheartedly supported the project."

United – "Our decision to launch the SSW was fairly straight forward. The economics of the SSW are compelling and allows us to be more efficient and reduce our carbon emissions. We believe most 737 operators are going to adopt this technology. We plan to put the SSW on our entire fleet because of the savings and commonality benefits. With a common fleet, we can schedule the plane for more payload or range because it burns less fuel while simplifying our operation.

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The Bottom Line

The Scimitar winglets should provide a significant improvement in economics, with a compelling return on investment. Just as blended winglets took hold in the industry, we believe Scimitar winglets will also gain increasing success, as a 2% savings in fuel burn, in an industry with tight margins, is compelling. Expect to see different looking winglets soon as airlines introduce them into their fleets.

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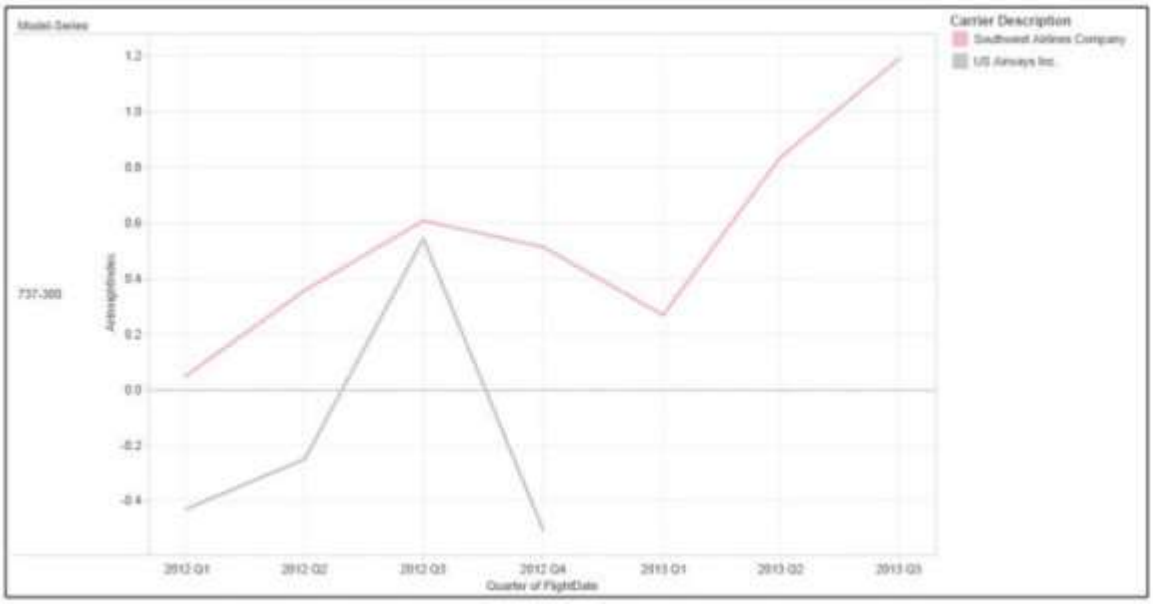
Premium #119 - 737 Usage in Pictures

4/29/2014

We developed the AirInsight Index as a method to study airline operational performance. The tool has proven useful and generates intriguing looks at the operational performance among US carriers. Let's take a look at 737 use among US-based airlines.

The AirInsight Index "ideal" is the zero line. If the curve goes above zero, the index indicates worsening performance. Curves below the zero line mean improving performance. The Index consists of a combination of data, including on-time arrivals and costs. The charts below are based on thousands of flights for each aircraft and are, in our view, statistically valid.

First the 737-300. As the chart illustrates, the aircraft is aging. US Airways has retired its fleet. Southwest keeps on flying this aircraft and they are not doing especially well. Indeed, during the 2Q and 3Q of 2013, the worst performing tail numbers were all at over 50% in terms of late arrivals. We estimate that the airline is seeing rising operational losses from its 737-300 fleet.



Next the 737-400, another aging aircraft. As the chart shows, the airlines are seeing performance degrade in an operational sense. The trend seems to suggest we can expect more of the same going forward. Alaska has 24 and US Airways has 25 of these aircraft in service. The opportunity to convert the -400s to P2F makes sense, and we expect this to provide a successful "second life" for the -400 once these carriers retire the aircraft.

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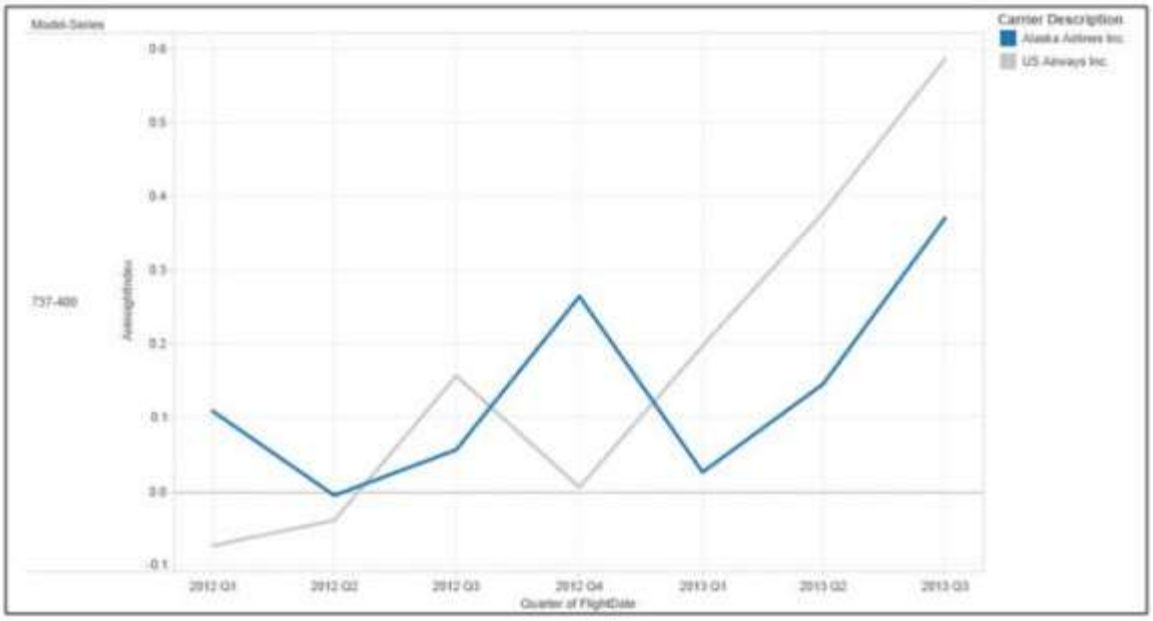
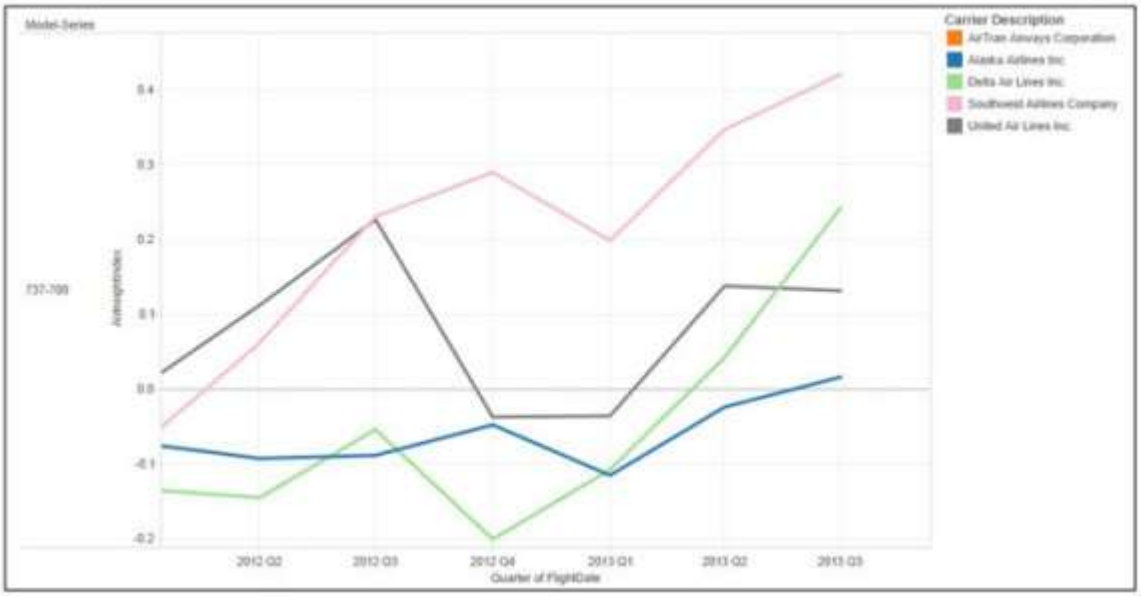


Next we start with the NG models, first the 737-700. Southwest is a big operator of this aircraft and should not be seeing such a rise in operational impact. We ascribe this rise in impact to merging operations with AirTran. AirTran shows up in the legend, but all their data has been added to Southwest in the chart. Interestingly we note Delta is also seeing a sharp rise in its Index numbers. United has seen some improvement while Alaska has shown its operational use of the -700 is the most effective among US carriers.



Next we look at the 737-800. The stand out performance here is once again at Alaska. Delta was also doing very well for some time but as 2013 wore on, it jumped the zero line. The -800 is a new aircraft for Southwest and we are not surprised to see some settling in as it grapples with a much larger airplane

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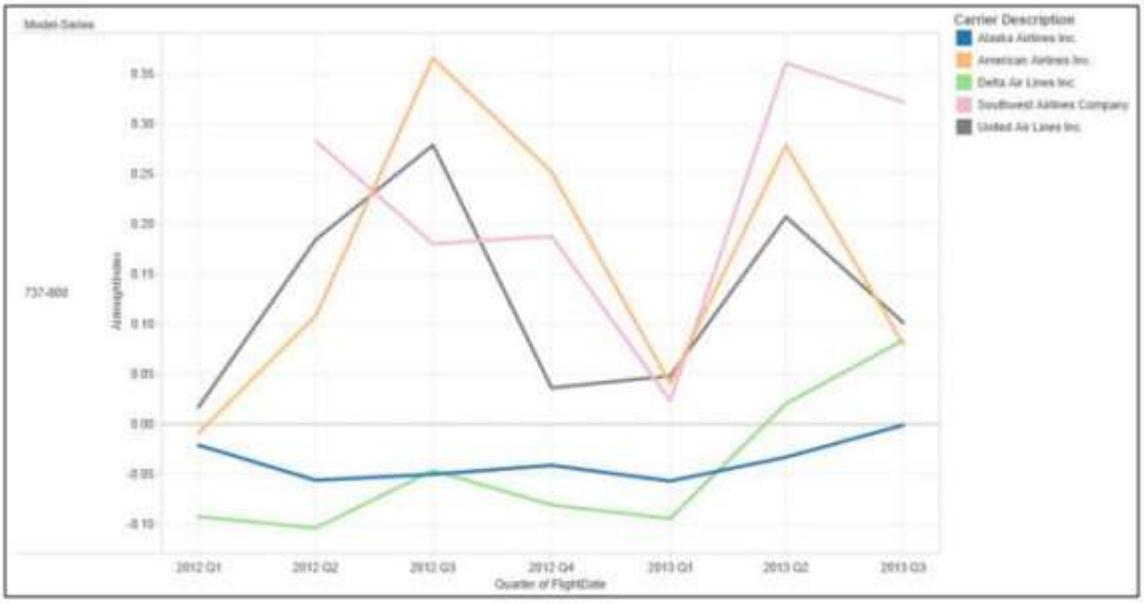
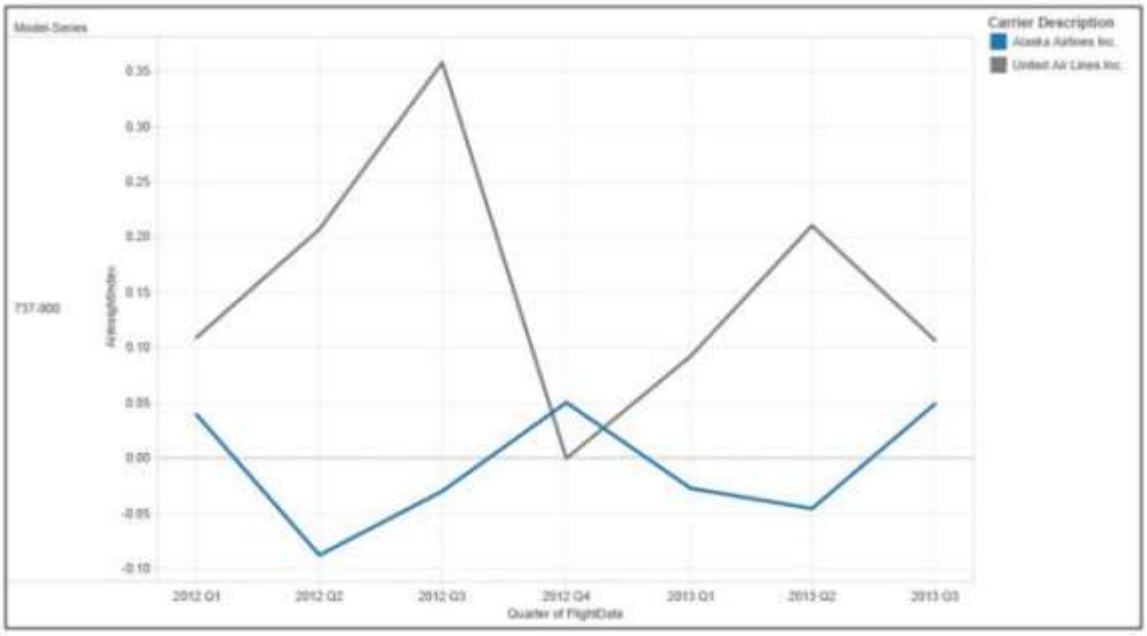
than it has used to date. American and United saw some wild tandem swings with other operators as summer traffic delays kicked in.



Next we have the 737-900. There were two airlines flying this aircraft in the period - Delta only recently started flying them. Once again we see Alaska doing well on an operational basis. United saw some gyrations, but may be getting its hands on the airplane and seeing steady improvements as the year wore on.



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In summary we think Alaska Airlines seems to be doing a good job on an operational basis; arguably the best among US-based 737 operators. Based on our calculations the airline is delivering better on-time arrivals, ensuring its costs closely approximate plan.

The Bottom Line: Successful airlines execute well, flight after flight, day after day. Once operational delays creep in, schedules go awry, crews and equipment go out of sync and costs spiral while revenue stays fixed. The 737 Classics appear to be aging, and the impact is shown in our metrics. The -800 is a workhorse, but Alaska seems to be more consistent than other carriers. The -900 appears to be improving, and is becoming more effective, despite its transcon runway limitations that impact schedule reliability more than other models. Running an airline is somewhat akin to conducting an orchestra, and weaker players need to be identified.

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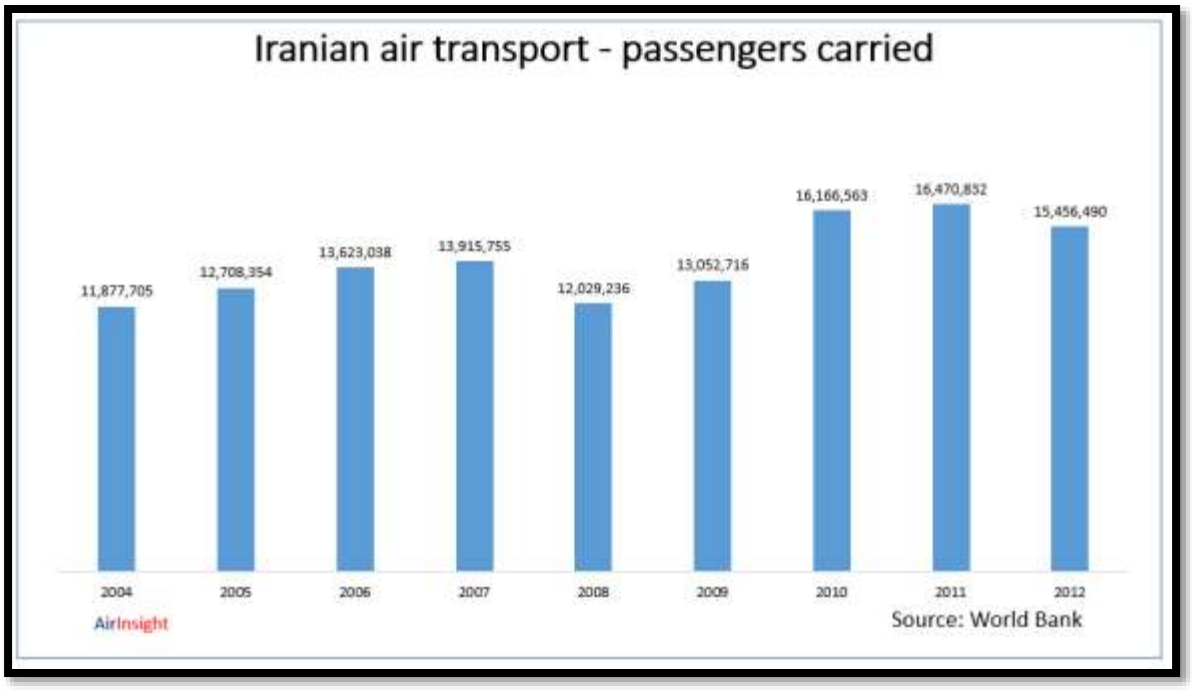
Premium #120 – IRAN - The Next Market Frontier for Commercial Aircraft

5/6/2014

Recent geo-political events in Iran have led to hope that the economic sanctions, which began May 22, 1979 when President Jimmy Carter seized Iranian assets and have evolved since, may soon be loosened or ending. While there remains to be major progress on this front, after 20 plus years of sanctions on aircraft, the impact on Iranian airlines is now reaching a crisis level as aircraft age beyond the point of efficient maintenance.

Iran has become a country of interest for aerospace firms around the world. The industry has been waiting and watching this market for decades, particularly as the sanctions have resulted in safety impacts that are well documented by ICAO[1] and here and here. Iran has seen stable air traffic demand, even with a number of fatal accidents due to flying obsolete aircraft and a shortage of spares, as shown below.



The excitement among the aerospace industry it is being stirred because it appears that some sanctions may be lifted, leading to a large demand for modern aircraft after years of dealing with obsolete models, this will no doubt generate quite a bit of new business. Iran's FARS news quotes Alireza Jahangirian, Iran's Head of the Civil Aviation Organization, as saying "The National Development Fund of Iran has allocated $500 million to purchase new passenger planes, and initial agreement has been obtained for another $500 million to buy aircraft and related spare parts". Mr. Jahangirian has also been quoted as saying "Iranian airlines will be ready to buy 40 passenger planes every year for 10 years if sanctions are lifted."

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A half billion dollars is not as eye popping as it once was. The large aircraft orders from the Gulf carriers have somewhat spoiled the OEMs. But the knowledge that there is a customer will to purchase 40 aircraft per year for as long as a decade is would draw anyone's attention.

On May 1st, Bombardier's CEO noted that he too was watching the Iranian developments closely. He said "Our role right now is to understand when sanctions could be lifted and how we could take advantage of a market we feel will be important for all of our products."

Iranian airlines have been facing tougher conditions than in any other country. Since the imposition of aircraft sanctions by President Clinton in 1995, 1,700 people have died in Iranian aircraft crashes. Iranian airlines have been forced to be creative to maneuver around the sanctions. They have sourced aircraft from Russia, bought spares using black markets, and even registered aircraft in other countries. But the poor safety record ensures that most of its airlines cannot fly to the EU. Recently, Iran Air completed the last commercial flight of a Boeing 747-100, which they retired after more than 40 years of operation.

The Iranian commercial aircraft fleet is old and varied; it is an MRO nightmare. Operating an airline in such a challenging environment is one of the most difficult tasks in the world. While we only list the major OEMs here, the Iranian national fleet averages 25 years old. With a total of 780 aging aircraft, this is a very significant replacement market. Aircraft types long retired in the west remain active in the Iranian fleet, as shown below:

	Number	Avg. Age
Airbus	208	22.8
A300-600	33	23.8
A300-600R	34	18.5
A300B2-200	18	31.2
A300B4-100	3	34.9
A300B4-200	15	29.0
A300B4-200F	6	31.4
A300C4-200	3	26.9
A310-200	11	27.1
A310-300	36	22.6
A320-200	41	17.5
A321-200	3	12.9
A340-300	5	18.1

	Number	Avg. Age
Boeing	146	34.5
707-320C	42	37.0
727-200	21	35.5
727-200F	6	32.9
737-200	3	35.9
747-100B	2	32.7
747-100F	21	42.3
747-200B	2	35.9
747-200C	6	30.5
747-200F	9	34.8
747-200M	9	34.2
747-300M	6	27.1
747-400	9	21.8
747-SP	10	35.7

Although the talk is for 400 aircraft over a decade, in truth, the entire national fleet needs to be replaced soon. The most modern aircraft flown in Iran is the ATR 72-200, and even these are over 15 years old. Breaking down Iran's passenger fleet we note the following.

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The single aisle segment offers the largest volume for replacement possibilities. The Airbus A320 family and the Boeing 737 are two of the more attractive solutions for replacement purposes. But what will airlines in Iran focus on? Will they follow the lead of western airlines and up-size to the 180 to 200 seats segment and replace aircraft on a less than one for one basis, or will they optimize equipment to their current traffic levels, recognizing that if all sanctions are not lifted, traffic growth may not be robust? Time will tell.

Segment	Avg Seats	Aircraft
Turbo Prop	63	60
Single Aisle	151	424
Twin Aisle	320	175
		659

The former option does not preclude opportunities for the less than 150 seats market, currently led by Bombardier, Superjetiran and Embraer. We expect to see those firms express interest in this segment to replace the 125 existing Fokker 100s, along with other firms like ATR showing interest in the turboprop segment. Iran's most common single aisle aircraft, the Fokker 100, Tupolev Tu-154 and McDonnell-Douglas MD-82 are, by current measures, fuel burn inefficient. Iran is a large country, as shown in the map below, and its airlines are going to require feeder services like any other market.

In terms of the twin aisle segment, it is clear that virtually every aircraft is need of replacement. Iran has the world's largest fleets of aging Airbus A300s (103) and A310s (44), long out of passenger service in Europe and North America. Unfortunately, there are few aircraft available for replacement as the A350

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and 787 are on back order for five plus years, and even A330 remains popular. While leasing firms may be able to help, their aircraft for the most part are yet to be delivered or already spoken for.

For regional routes, the aging A300s and A310s could be replaced by used A330s and 767s. There are 190 767s and 54 A330s parked that the Iranians could tap. The table lists the available models. But we would suspect, at this point, that the Iranian airlines want the newest aircraft possible, not 15 year old aircraft.

Model	Aircraft	Model	Aircraft
767-200	36	A330-200	44
767-200ER	69	A330-300	10
767-300	30		
767-300ER	55		
Total	190	Total	54

For longer hauls, the Iranians need to replace their 747-200s with more modern aircraft. The 747-400 is approaching economic obsolescence, and likely not a strong candidate. The A380 backlog remains significant, with only 30 annual deliveries. We don't see Iranian airlines buying A380s of 747-8s. In the interim, there are 68 A340s parked which could fit some of the requirements, as shown in the table below. Of particular interest are the relatively young A340-500 and -600 models, which will soon offer the Rolls Royce "4 for the price of 2" engine maintenance arrangements. With engine maintenance the key drawback, these aircraft could find a potential home in Iran, at least for the near term.

Model	Aircraft
A340-200	9
A340-300	28
A340-500	18
A340-600	13
Total	68

The used aircraft market appears to be the quickest way for Iranian carriers to update their fleets. It could also provide a larger number of aircraft than purchasing more expensive all new aircraft, which would need to occur over time to accommodate required delivery positions.

Globally, we've seen criticism of the US-led economic sanctions in aviation as violation of a fundamental human right, the right to safe travel. Is it time yet for relief for economic sanctions in aviation? While the politicians decide, Airbus, Boeing, Bombardier, and Embraer are waiting in the wings for orders that are ready to replace an aging fleet.

[1] The safety deficiencies arising out of the United States sanctions against the civil aviation of the Islamic Republic of Iran, International Civil Aviation Organization, 20 September 2007.

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Premium #121 - Regulatory Over-Reaction: The Looming Pilot Shortage for Regional Airlines

5/20/2014

Regional airlines are finding it difficult to fill their pilot hiring requirements, as a shortage of qualified applications because of a change in a federal rule that raised the minimum number of flight hours for an entry-level first officer from 250 to 1,500 hours, a 500% increase. Of course, without enough pilots, regional airlines cannot operate optimally. Republic Airways has grounded 27 aircraft due to a shortage of pilots, more regional airlines are likely to follow.

There are a number of factors that lead to the pilot shortage, but the single factor that most exacerbated the change is the regulatory change. This law alters the economics and mechanisms of flight training through which most entry-level pilots enter the business.

An accident near Buffalo, New York on February 12, 2009 involving a Colgan Air Dash 8-400 operating as Continental Connection flight 3407, highlighted pilot training and proficiency as major contributing factors to the deaths of 45 passengers and 4 flight crew members. The NTSB report concluded that a number of factors impacted the crew: fatigue, training, and poor decision making resulted in the fatal crash. Inappropriate pilot response to icing and a subsequent aerodynamic stall resulting in the fatal crash.[1]

Subsequent to that crash and investigation, Congress mandated new rules for the FAA to implement via "The Airline Safety and FAA Extension Act of 2010" that resulted in co-pilots being required to hold Airline Transport Pilot (ATP) ratings instead of Commercial Pilot licenses to become first officers on regional airlines. On August 1, 2013, new rules raised the minimum number of flight hours for a first officer from 250 to 1,500 hours.

There are typically four career paths for an aspiring pilot to obtain an ATP certificate:

- General Aviation unstructured training
- General Aviation structured training (e.g. flight schools)
- College and University Professional Pilot Degree Programs
- Military Aviation

The change in rule-making mandated by Congress dramatically changed the economics for a prospective pilot looking to build the flight hours to obtain an ATP certificate and a co-pilot position in the industry. Military aviation candidates are generally unaffected by these changes. But the typical civilian routes to a job have become considerably more expensive. For civilian pilots, gaining an additional 1,250 hours of flight time is expensive, with a typical light aircraft renting for $200 per hour, including fuel. That means an expenditure of roughly $200,000 per student to meet the new requirements, a princely sum when one considers that entry level first officer salaries at regional airlines average $22,400. The return on investment simply isn't there for a student.

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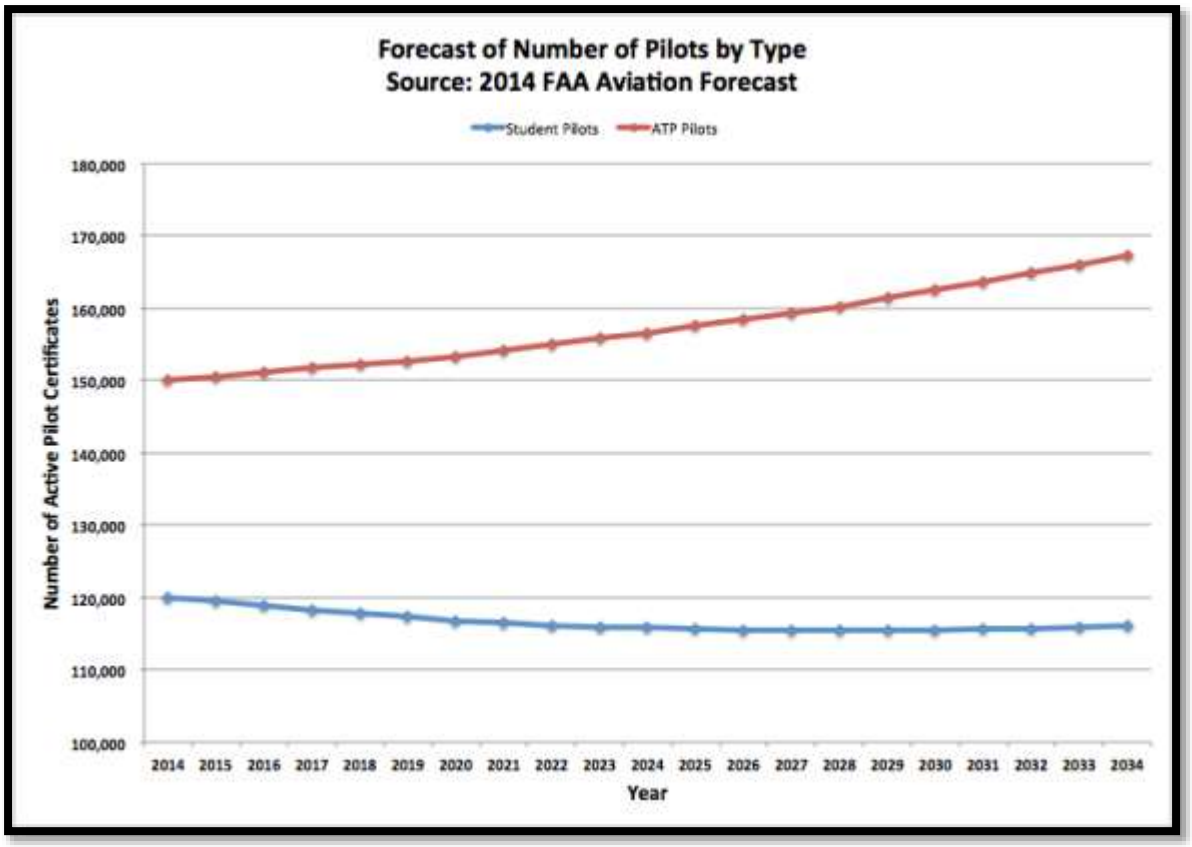
While some can mitigate a portion of that expense as flight instructors, the number of student pilot starts is not rising as fast as the potential pool of flight instructors seeking to gain additional hours to meet the new requirements.

As a result, with the choice of accumulating an overwhelming debt that will be difficult to repay, or walking away from their dreams, many potential pilots have taken the latter route, shrinking the pool of candidate for regional airlines.

Looking ahead, the 2014 FAA forecast calls for a drop in student pilot certificates from 2014-2034, as shown in the following chart. At the same time, it calls for an increase in the number of active ATP pilot certificates. Clearly, there is an emerging gap, and either the rate of students reaching ATP certification must increase, or shortfall will occur.



The FAA forecast also calls for an increase in the overall airline fleets, as shown in the chart below combining mainline and regional carriers.

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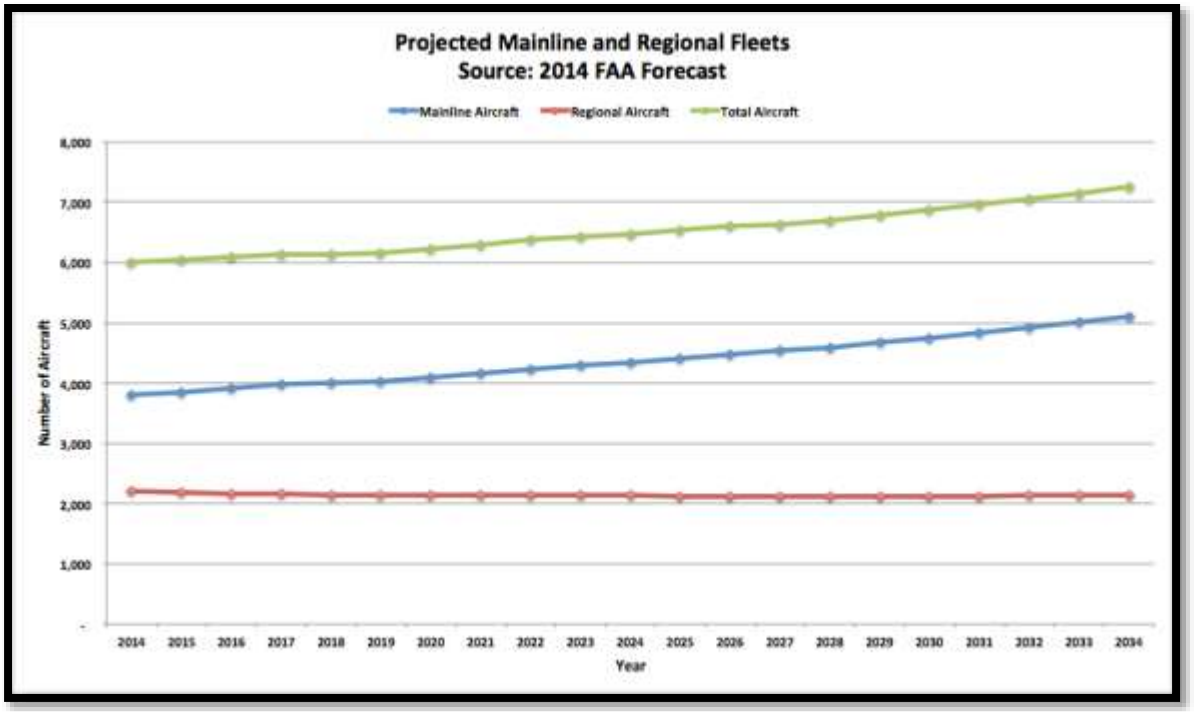
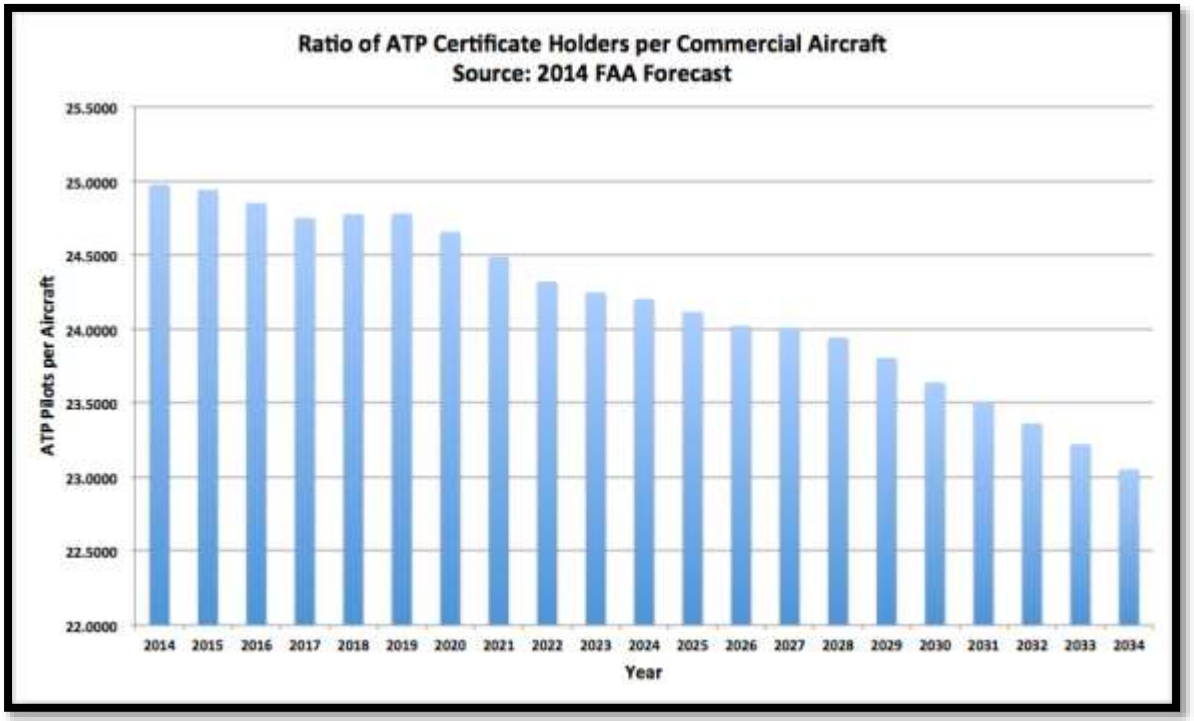


If one computes the ratio of active ATP pilot certificates to aircraft, it becomes clear that the number of available pilots per aircraft will drop in the future, indicating a potential shortage of pilots. Using the FAA forecast data from the above charts, the ratio indicates that the number of pilots per aircraft today will drop from 25 ATP pilots per aircraft in 2014 to 23 ATP pilots per aircraft in 2034, an 8% decrease.



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Becoming an airline captain is no longer the lucrative job it once was. Starting first officer salaries at major airlines average about $61,000 per year[1], a significant step-up from that of a regional airline first officer. Until recently, a pilot would begin his career working for a regional, after obtaining a Commercial Pilot certificate and instrument rating, which would typically require about 250 hours of training, and then step-up to a major airline after 2-3 years of regional airline cockpit experience. Today, that stepping stone simply is no longer easy to reach.

The current crisis will be exacerbated by the requirements of the major airlines, which will have some 18,000 pilots reaching mandatory retirement age by 2022. The 2,250 pilots required per year by the majors will likely come from regionals, who in turn need to recruit new pilots to replace those who step upward in their careers. But candidates to replace those regional pilots are no longer coming forward like they once did, because of the economic burden and heavy requirements for a job with a paltry annual salary.

How Can the Industry React?

One way of reducing the need for pilots is to fly larger aircraft, so more people can be flown on fewer planes. But scope clauses in major airline contracts typically restrict regional carriers to aircraft that are 76 seats or less in the US, so the new 100-130 seat jets from Embraer and Bombardier must be flown by mainline pilots by the major carrier itself. A change in scope clauses to allow larger aircraft by regional airlines may become necessary if there are too few pilots to fly aircraft.

Republic Airways announced in February that it was taking 27 smaller 50 seats jets out of service, replacing them with larger 75 seat Embraer E175 models due to the pilot shortage. Earlier this year, United announced closure of its Cleveland hub, and elimination of 70% of regional flights, citing both losses and the new pilot training rules[2]. While that increase in gauge can help in the short-term, it certainly doesn't alleviate the problem, which will be exacerbated with the retirement bubble over the next eight years.

Mesa Airways closed its "Go!" unit in Hawaii, and will either retire its smaller aircraft or attempt to redeploy them in mainland service. Those pilots will likely be transferred to other Mesa units. While the "Go!" unit may not have been profitable, the need for pilots on Mesa's more profitable routes was a contributing factor to their decision-making process.

Earlier this year, American Eagle announced that it was reducing its flight operations significantly after pilots rejected a new contract offer from the carrier that would have raised wages. With smaller aircraft come higher seat-mile costs, which can often be as expensive as prevailing revenue yields in highly competitive markets. At American Eagle, the decision appears to be to cease flying rather than fly unprofitably. Other carriers, including Great Lakes Airlines and Silver Airlines, have reduced flights due to pilot shortages.

These may be the first shots in the war for survival, and there is a strong possibility that we will see several regional airlines in financial difficulty due to a lack of flight crews and be forced to cease operations.

The General Accounting Office recently examined this issue, and issued a report in February 2014 entitled "Aviation Workforce, Current and Future Availability of Airline Pilots" that had mixed

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conclusions on the topic. Many in the regional aviation industry were quite critical, as the report did not conclude that there was a shortage in pilots, as it looked at the air transportation industry as a whole and did not focus on the impact of the recent regulatory changes on supply. This has provided politicians with cover to continue to support the regulatory changes that many in the industry fee have swung the pendulum too far in one direction.

What can the industry do? There are international models that could be followed, but these will change the economics of the industry. Carriers like Lufthansa and Singapore airlines have traditionally had flight academies, with flight training in good weather areas like Arizona, to professionally train pilots and accumulate the necessary hours. But this is an expensive process, and requires student to commit to a period of employment with the carrier in exchange for the education.

Paying for training would place an additional economic burden on regional carriers, which today are operating on paper thin margins. The economic burden to accumulate 1,250 additional flight hours, without productive income to offset that training, would then fall to the airline, which they frankly cannot afford.

While the major carriers could step in, they would likely train their own employees, rather than those for the regional stepping stone, as most regionals today are not majority owned by their code-sharing partners, but operate under fixed price contracts. Could higher salaries prove more attractive? The answer is yes, but under current arrangements, this is virtually impossible give the slim financial margin of most regionals.

Today, 36.6% of the US commercial fleet is operated by regional carriers. Without a continuing supply of pilots, those flights, from smaller cities to hubs and smaller cities to smaller cities, will be at risk. Poor public policy and politically mandated regulations with counterintuitive impacts are placing a segment of the aviation economy unduly at risk, and with the lure of much higher pay and job openings at major carriers, it will be impossible to keep regional pilots from jumping ship. When they can no longer be replaced, regional airlines will have a more difficult time remaining viable.

Airline stocks have soared recently, with profitability at major carriers. But you might want to consider short-selling regional airline stocks, as in a couple of years, the pilot shortage will come home to roost, and if not inhibit their ability to fly, certainly inhibit their bottom line.

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[1] http://www.businessweek.com/articles/2014-02-11/yes-theres-a-pilot-shortage-salaries-start-at-21-000

[2] Source, USA Today: http://www.usatoday.com/story/money/business/2014/02/28/gao-pilot-shortage-airlines-colgan-crash/5894307/

[1] NTSB Accident Report NTSB/AAR-10/01 PB2010-910401

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Premium #122 – Is it smart to delay a fleet renewal?

5/27/2014

The airline business is notoriously cyclical. It is also capital intensive. This combination provides an effective barrier to entry since capital sources typically don't like cash flow gyrations. While those gyrations highlight industry risk, with risk comes opportunity. If an airline can lower its capital requirements and if market conditions (as is now seen in the US post consolidation) remain stable, it can generate strong profits. Delta Airlines and American Airlines represent a contrast in philosophies, Delta choosing to continue to operate older aircraft, which it can obtain at lower capital costs, while American has massive orders to replace its narrow-body fleet with more modern aircraft. Which philosophy will deliver the better financial results?

To get an idea if a policy to delay fleet renewal has merit, we undertook a study of the MD-80 series aircraft in service among US carriers. The MD80 fleet is mainly in use at American and Delta, with a smaller fleet now operating at Allegiant. The Allegiant fleet, however, does much less flying than those of American and Delta.

American is retiring its fleet as it takes delivery of new Airbus and Boeing single aisle aircraft. Delta has publicly stated its commitment to keeping older aircraft in service, and has even started buying used MD90s from other airlines at attractive prices to add to its current fleet.

We start our analysis by seeing if using older aircraft poses any kind of operational challenge. Airline fleets work hard, and the FAA keeps track of "Service Difficulty Report" (SDRs); airlines are required to report breakdowns. The following charts show SDRs reported to the FAA over the past five years. Note the older MD-series aircraft at Delta have many more SDRs reported than do its 737NGs. At American the opposite is true – the MD-80s have a lower number of SDRs than its 737NGs. The evidence suggest that at Delta there might be a case, on operational cost grounds to revisit the idea of keeping older aircraft.

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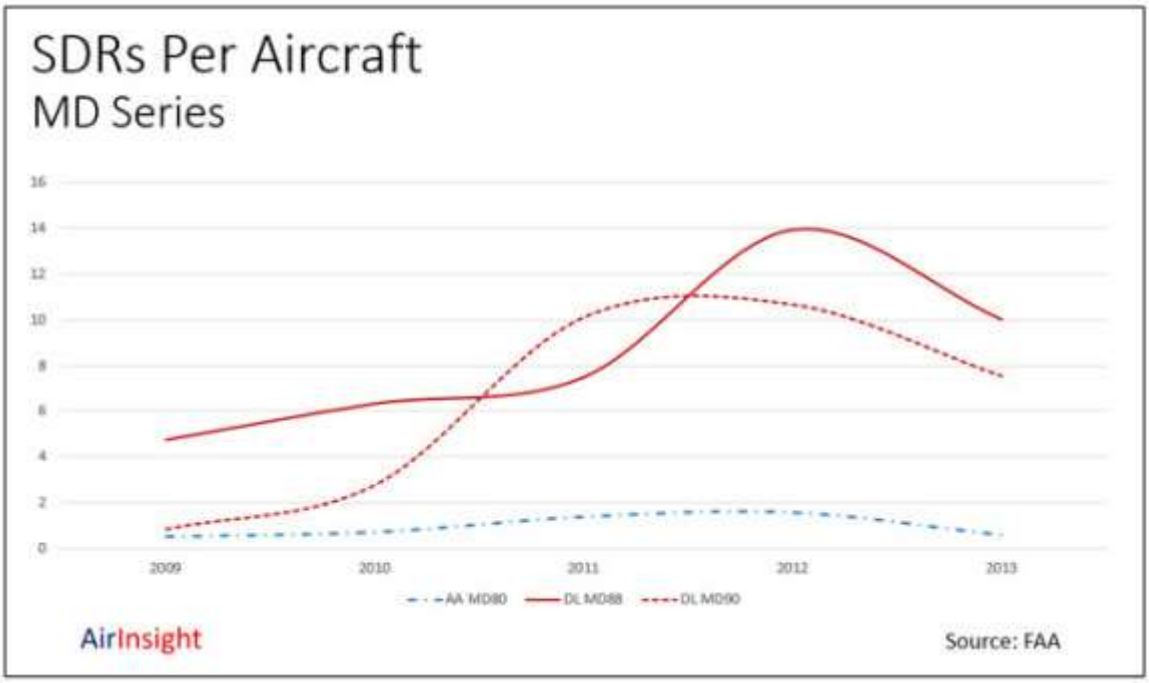

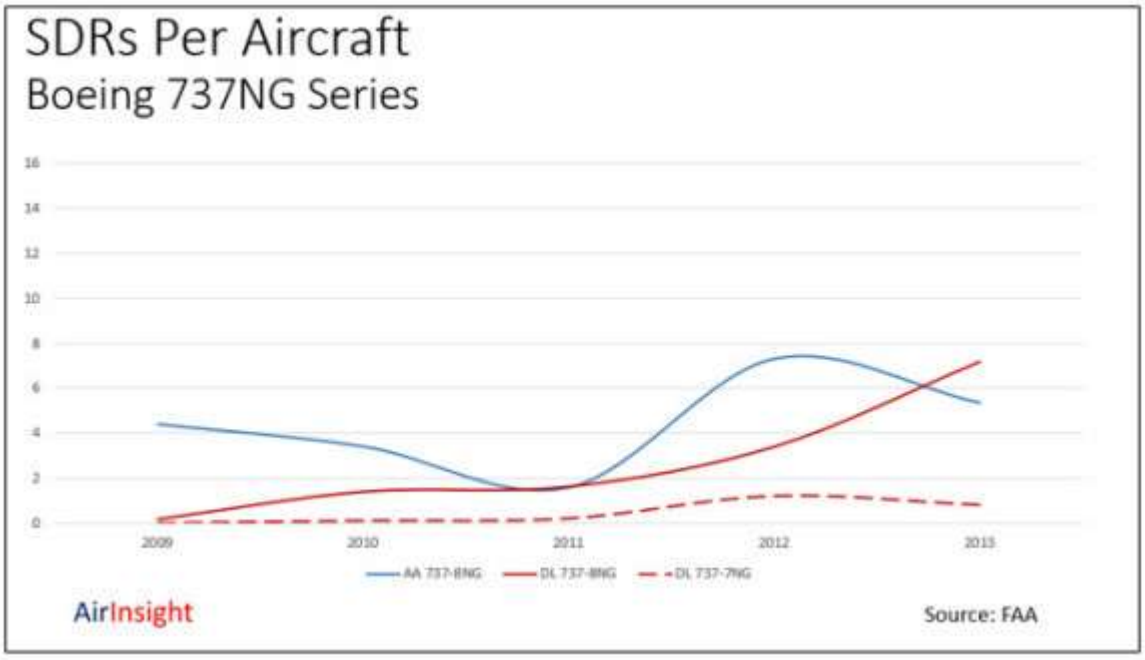

Does this prove Delta is making a mistake sticking with older aircraft? We need to see more data. Using the DoT's Form 41 data we derive the following chart. Note that the fleet is flying fewer hours as American's fleet is reduced. At one time American operated the largest MD80 fleet.

The US DoT collects data via Form 41 that dates back to the regulated period and Civil Aeronautics Board. While airlines can, and do, make varying assumptions regarding allocations of overhead that can skew results, this remains the best publicly available data for analytical purposes. Counter intuitive

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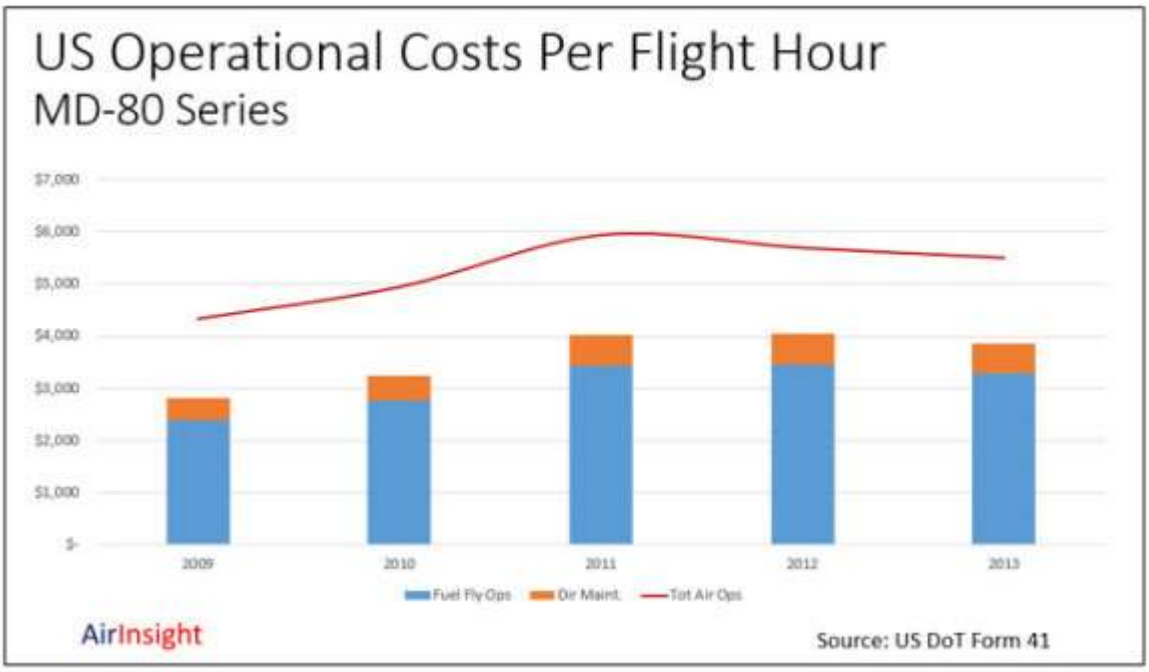
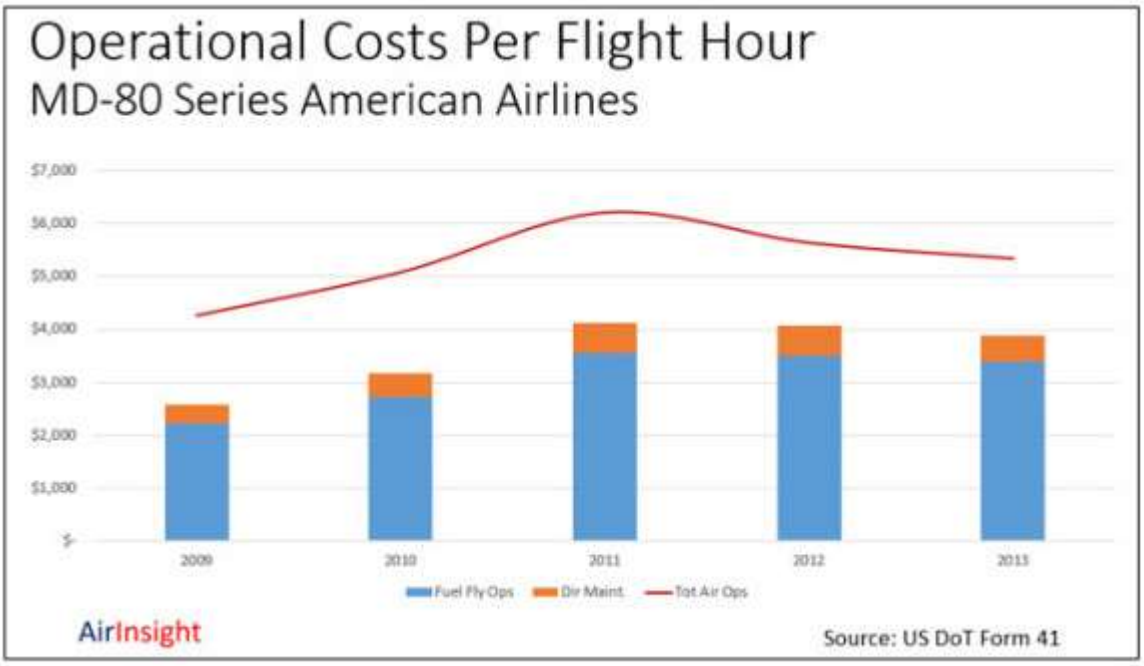
results appear when we examine the costs and hours flown for the MD-80 series. The cost per hour for the MD-80 declined slightly in 2013 from 2012. This may be a direct result of slightly lower fuel prices.



While it appears that hours and costs are declining for these MD-80 operators, we need to show more detail to be able to see what the impacts are between American and Delta. The following chart lays out the costs and hours the airlines have filed with the DoT.



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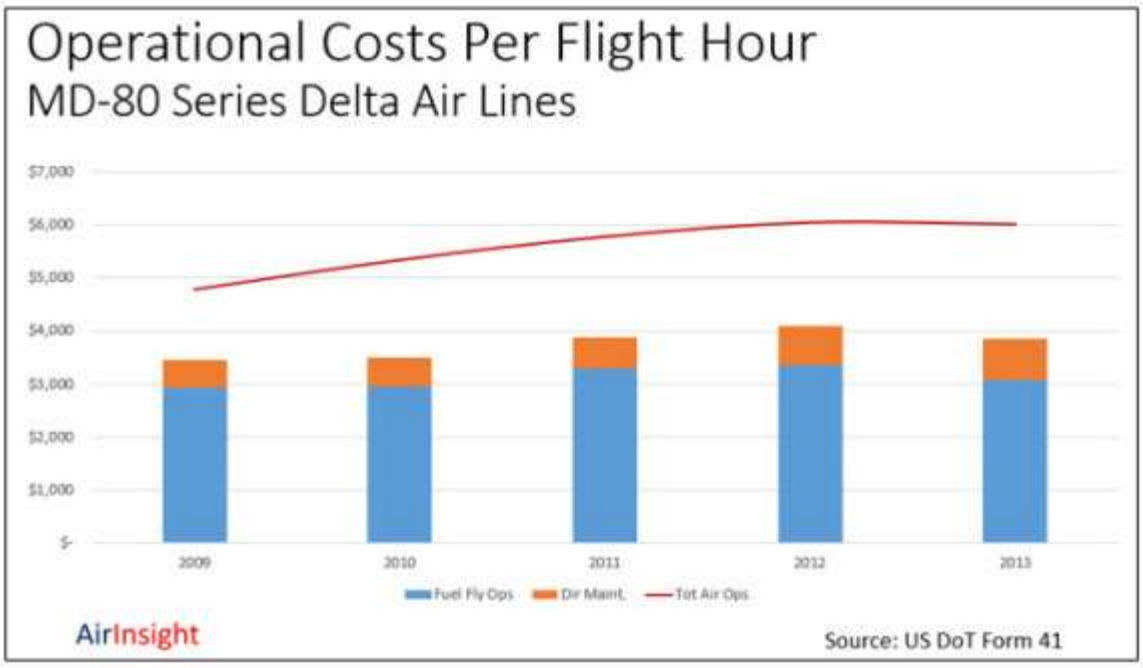

The MD-80 series of aircraft have seen a steady rise in costs. Even as load factors have risen to their highest levels in years, and fares have also risen, these aircraft must be growing less profitable. Even with FAA mandated maintenance standards, the rise in costs along with rising SDRs must give one pause. This appears to be the case more at Delta than American.

The following table lists the Delta single aisle fleet costs on a per seat air hour basis. The data is compiled from Form 41 and uses typical Delta seating. The lowest cost aircraft in the fleet for 2013 was the 737-800. Bear in mind the fleet is a mix from the Northwest days – the Airbus aircraft are much older than the Delta-bought 737s.

Delta Air Lines Cost Per Seat Per Air Hour						
	Seats	2009	2010	2011	2012	2013
757-200	182	$27.03	$29.32	$33.55	$35.85	$35.04
737-800	160	$27.77	$31.79	$34.42	$35.45	$35.01
737-700	124	$19.77	$34.20	$37.98	$42.48	$41.68
737-900	180					$43.44
MD88	149	$32.18	$35.93	$38.87	$40.69	$40.47
MD90	160	$24.09	$30.97	$34.19	$36.95	$35.99
A319	126	$33.71	$35.40	$45.64	$54.19	$50.72
A320	150	$29.33	$25.80	$32.65	$37.94	$37.35

The following chart allows an evaluation of rising costs per seat air hour over the five years. Using 2009 as a base year, the 737-700 has seen the greatest rise in costs. Delta only has ten of these though. The A319 in the previous table shows up as the most expensive aircraft per seat hour, and in the following

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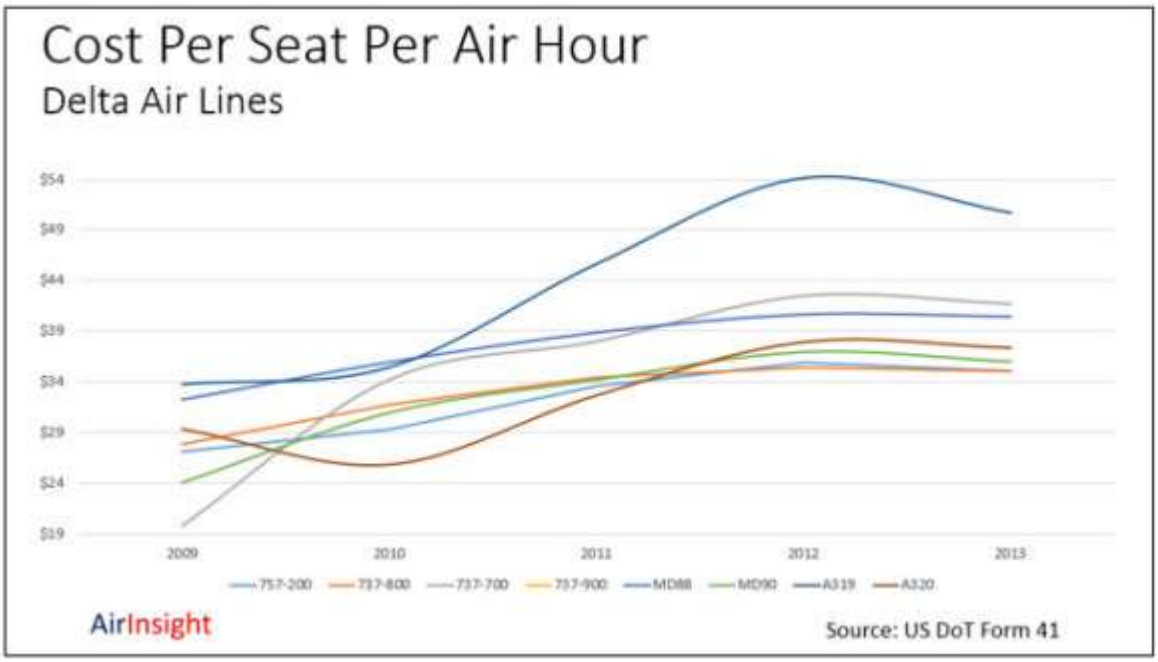
table we see that it has experienced a 50% increase in costs over the period. The MD-90 has seen a similar growth in seat hour costs, but have been acquired at lower costs.



Delta's older 757s and MD-88s have similar cost increases to its 737-800s. It appears from the data that it is difficult to argue its policy of keeping older aircraft is sub-optimal in terms of operational costs.

That said, we can identify sub-fleets are outliers worthy of consideration for retirement or replacement. The numbers for the A319 and 737-700 highlight that shrinks are not as attractive as they may be made out to be by the OEMs.

Acquiring more MD-90s may prove to be a good move by Delta since these aircraft are estimated values between $5-9m each. The MD-90s's key proposition is its capital efficiency, which easily makes up for its operational costs. Delta cannot find a lower cost 160-seat aircraft.

Our analysis of the costs per minute and the flight arrival delays indicates that Delta has a cost disadvantage of about 11% compared to American for the MD-80s. By replacing MD-80s with new 737s, American is driving down its operational cost base because not only is the new aircraft more fuel efficient and comes with a maintenance holiday. Whereas the MD-80s require more maintenance as they get older and parts wear out. But American is buying new which drives up capital costs.

Despite its higher cost base, and higher delays, we suggest that Delta's policy of keeping older aircraft in serviced may successful. The retiring of the DC-9s was a positive for the airline, and we believe the same will occur with retiring the sub fleets of 737-700s and A319s. Of course that creates a new problem in terms of replacement. But for this analysis, we think the MD-90 and MD-88 at Delta provide good value. Its policy of keeping older aircraft in service appears to be working in financial terms. Delaying fleet renewal at Delta may be strategically clever too, as the current level of backorders precludes acquiring new aircraft at steep discounts. If there is a downturn or bubble, Delta can step in, with its capital saved and negotiate aggressively. It should be able to re-fleet on its terms.

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Premium #123 - The Decade of Incrementalism is Coming

6/3/2014

Over the last decade, we've seen several new aircraft programs, each of which has suffered delays and exceeded both development timeframes and budgets. These programs, A380, 787, CSeries and A350, all created expectations for the development of new aircraft, which in the past were routinely a 48 month process. Today, a new aircraft program appears to be a 60-72 month process, with delays expected.

The current period of innovation introduced significant benefits to the industry - including the widespread acceptance of carbon fiber for structural use, more advanced systems and avionics including advanced fly by wire controls, plus innovations in engine technology that reduce both fuel burn and environmental impacts. But the innovation appears to be slowing down, if not stopping, at Boeing and Airbus, which are now taking a new approach. Once the A350 and CSeries are introduced, we don't expect another new program to be announced for more than a decade.

Re-engining programs are now taking hold, with A320neo having initiating the process, thus forcing Boeing to follow with the 737MAX. On the wide body side, rather than develop a new large aircraft, Boeing is using the re-engining and stretching the 777, and Airbus is contemplating both A330neo and A380neo models to rebuild the economic competitiveness of those airframes.

For Boeing and Airbus, there are no "all new" aircraft currently on the drawing board, and a new aircraft announcement is unlikely until the investment in the current and future re-engined models can be recouped. The era of the derivative aircraft has arrived, and we are unlikely to see new models announced before 2020 and not introduced until 2025 or beyond. What you see today is what you will get, with incremental improvements.

This doesn't mean that incremental improvements can't be significant - just look at how Boeing and Airbus have improved 737 and A320 over the years since EIS. Today's 737NGs are significantly more economically effective than the first models from 1998. But the days of all new aircraft may be behind us until the next breakthrough in engine technology, and whether an open rotor or geared turbofan concept will win the day. We're betting on the latter, as that technology will not require a major redesign of airframes and engine placement, making both new airframes and additional re-engining programs feasible.

With each new aircraft program a "bet the company" decision, and a recent track record of limited market success with some models, Airbus and Boeing are both wary of new development programs. Boeing has been unsuccessful with the 717, 737-600 and 747-8, each market failures. Development costs for the Boeing 787 are estimated between $23 and $25 billion, a significant amount to be recouped over the life of the program. It will likely require double the current order book, and another decade, for Boeing to break even on this program.

Airbus was unsuccessful with A318, A340-500 and -600. The Airbus A380, while a technical marvel and success for Airbus, has not sold anywhere near Airbus forecasts or expectations, and has not assumed the role of replacement for the venerable Boeing 747. That role has fallen to smaller twin-engined

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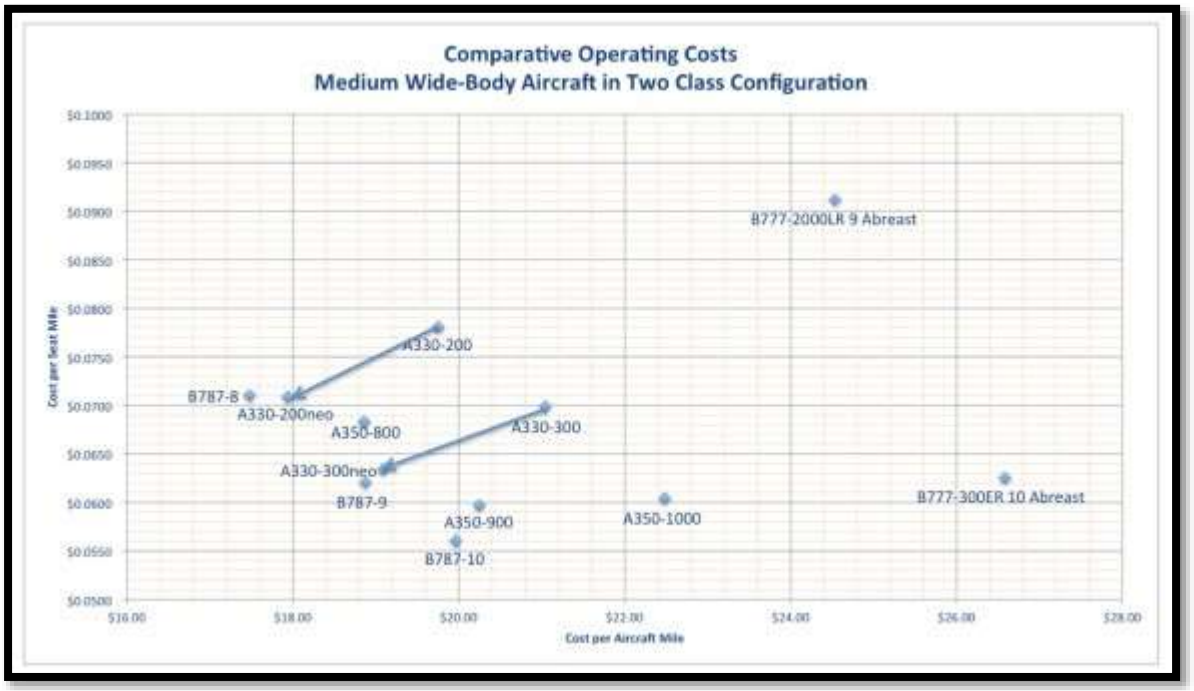
aircraft, including the 777 and A350. With seat-mile economics for the A380 now being challenged by those smaller aircraft that are less expensive and provide lower risk to airlines, it will need an economic improvement from re-engining just to remain competitive by 2020. As a result, the A380 is unlikely to become a best seller, recoup its development cost, nor turn a profit for Airbus.

Is it any wonder the big two are becoming more risk-averse? For aircraft OEMs, recouping the cost of a new development program is increasingly difficult as technology innovation has become more expensive, both from a development and production perspective. Carbon fiber aircraft aren't as easy or inexpensive to produce as aluminum aircraft, and although weight benefits provide performance improvements, is that differential large enough to justify the additional capital cost? In some cases, the answer is no.

In our report on the A330neo, we examined comparative operating costs for a variety of aircraft, including its A350 sibling and the Boeing 787. As the chart below illustrates, the differential between an A330neo, assuming an 11% fuel burn improvement, and the A350 and 787 models is not as significant as one might think. An A330-300neo will come very close to the 787-9 in terms of operating economics, but will likely have a significant price advantage. On an overall basis, including capital costs, the A330-300neo would likely be less expensive to own and operate than the 787-9.



The newest, high tech aircraft, including 787 and A350, are capable of flying the longest haul missions. These capabilities, however, are not needed for 90% of the flights operated by airlines, many of whom require typically only 2/3rds of the range capabilities for typical operations. If they had their choice, they would choose an aircraft optimized for the ranges that they fly, and not carry the additional structural weight designed in to accommodate fuel for longer-range missions. The A330neo fills that role quite well.

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Bottom Line: The era of incrementalism at the big two has begun. With no major new programs on the drawing board, this will likely lead to the need for a step-function change in technology in the 2025-2030 time frame. The question is whether Airbus and Boeing be ready to step-up to the plate with extraordinary designs, or if incrementalism will prevail.

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Premium #124 – The A380neo and Engine Selection

6/10/2014

The need for airlines operating the A380 to remain competitive was ratcheted up after Boeing announced its 777X program at the Dubai air show, when the region's airlines all placed orders. The timing and location of Boeing's launch was not accidental. The Gulf carriers are global leaders in acquiring new aircraft, particularly wide bodies that can serve long-range operations. The Gulf airlines, with miniscule domestic traffic, require the ability to act as hubs on a global scale, connecting from disparate cities through their region to everywhere else.

The A380's market success to date rests mostly on the orders of one airline, Emirates. With 140 orders to date, it represents 43% of the total A380s order book. Emirates and Airbus have a co-dependency in terms of the A380. Neither can afford the other to fail. The degree to which this is true is such that Emirates' CEO, Tim Clark, observed at the Doha IATA meeting his airline would keep acquiring A380s even if Airbus did not re-engine the airplane. He told Reuters "If they don't produce it (A380neo) we will take it under the old version. There is nothing out there that resembles what the A380 can do."

What is also intriguing about the IATA meeting was that Boeing played an unusual spoiler game. Whereas Emirates has an established pattern of "negotiating in the media", Boeing has never done this. Yet Bloomberg has a story that shows this happening. It is quite clear that Emirates is getting a lot of attention from the big OEMs around its anticipated Very Large Aircraft acquisitions. As the premier VLA-focused airline in the world, this should be no surprise.

Take a look at the economic issues driving the VLA business. As pointed out, the 777-X is proving disruptive. This is because, with increased size and passenger density (from 9 abreast to 10 abreast on the 777), the -9 will be extremely competitive on a cost per seat mile basis with the existing A380, albeit less roomy. The 11% improvement in seat-mile costs from the change in seating, combined with another double digit improvement from new engines and aerodynamic improvements, will make the 777-9 quite economically competitive.

There are only two ways to ensure the A380 stays economically competitive – either to increase revenue per flight or cut operating costs - or both. An idea to increase the seating density in economy to 11-abreast has been rejected by Emirates. The airline could still tweak its premium seating by reducing first class and increasing business. But this would have less impact. A more impactful way would be to encourage Airbus to update the A380 using technologies from the A350. Emirates has been vocal on this matter for some time because it offers the greater economic impact.

The chart below shows comparative aircraft-mile and seat-mile cost estimates for the A380 and 777-X models calculated for a 5,000nm mission. While Airbus may have a valid point on comfort with its seat width campaign, and the numbers would be different if we used 9-abreast seating. But Boeing will deliver the airplane with tighter seat width, and reality must be recognized. The 777-9 will deliver lower seat-mile costs than today's A380, and slightly lower than an A380neo.

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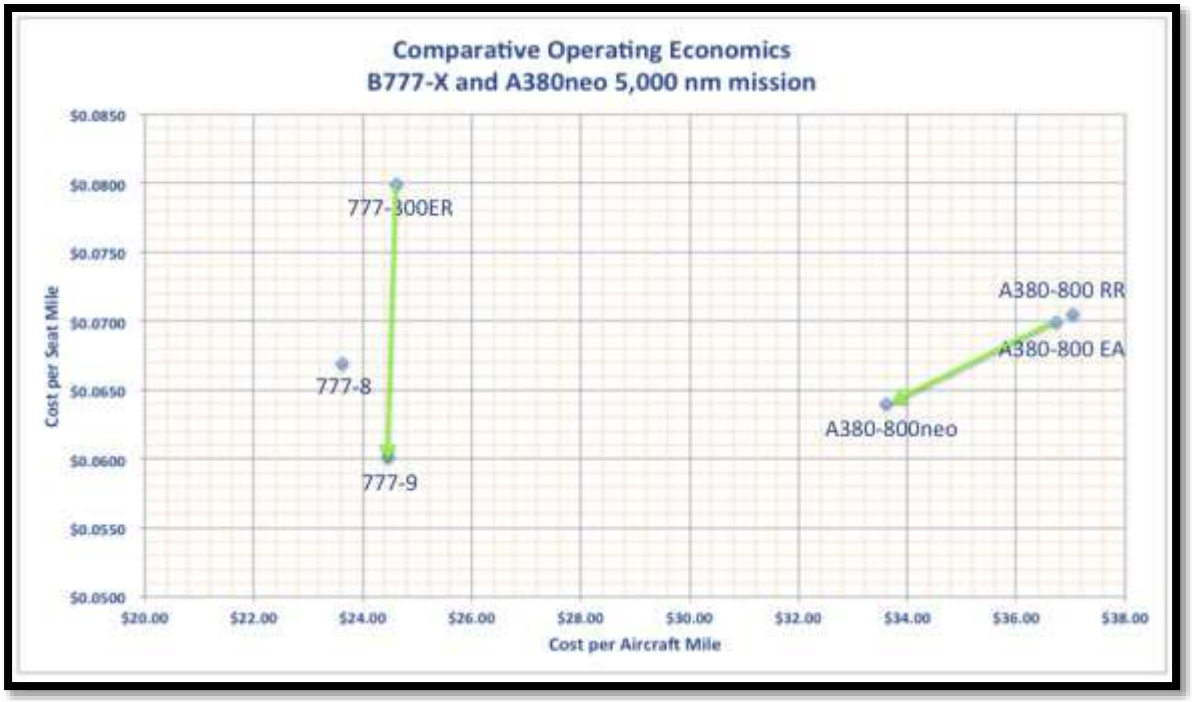

Emirates has 126 of its 208 aircraft fleet tied up in 777s, of which 95 are -300ERs. Emirates knows the 777 very well, which is why it has 150 777X's on order – 115 of which are long range VLA -9s. But with commitments for140 A380s, the airline would like that aircraft to improve operating economics by 12%, according to Tim Clark.

As the chart indicates, an A380neo is an idea with merit. This drives down A380 costs to remain competitive with the 777-9 on a seat mile basis, while retaining a significant comfort advantage. Because airlines seek lower costs, the requirement to continually improve aircraft is understandable. But the story is only half done.

The real battle here is not persuading Airbus to improve the A380. Airbus wants this just as much as Emirates. A more efficient A380 can only help Airbus sell more of them. The real battle will be between engine makers on the A380, because this will be the source of the greatest impact on operating economics.

Are Rolls-Royce and Engine Alliance hard at work trying to ensure they have engines for an A380neo? We understand that Airbus has not sent out any product definition requirements to the engine makers as yet. Airbus is keeping quiet for now. But, as usual, Emirates is vocal. Questioning Engine Alliance's (EA is an alliance between GE and P&W) "appetite" for the A380neo seems an odd statement. After all, every A380 Emirates has ordered so far comes with EA engines. EA also has the honor of being listed in Airbus' "Orange Book" as the more fuel-efficient engine for the A380.

There have been rumors swirling for some time that Airbus has an unannounced deal with Rolls-Royce on an A380neo. Is there anything real and public that says Rolls-Royce is the obvious A380neo exclusive engine supplier? Mr. Clark wants a lower cost airplane and will go with whoever gets him there.

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Moreover, of first 90 A380s Emirates ordered, in four waves with engine competitions in each wave, EA has won every time. Could counting EA out be premature?

Two leading journalists who closely follow the engine business and have excellent access to the players in the industry shared some thoughts with us. We asked them these questions:

- Why is the feeling that Rolls-Royce has this in the bag?
- What makes people think EA won't put up a fight for the deal?
- Would you say Tim Clark's words are the usual public pressure?

Their responses are illuminating.

1. *I guess this is more Tim's view at Emirates, but it also reflects what GE and Rolls are saying on the sidelines. If Rolls really does get the A330neo then it's the right sized engine (and right technology) for the A380neo. GE doesn't really have the appetite for another development effort – and its relationship with PW on GP makes it almost impossible to go it alone anyway. On the other hand, ever since the big falling out between the two over the alternate engine for the F-35 there was little chance of ever going beyond the basic GP7200. So EA is in effect between a rock and a hard place. That sort of answers why EA won't put up much of a fight – the numbers are too low for GE and PW to make a real business case – particularly if they can't leverage the A330neo. In this case no I would not – I think GE for sure has made its decision and, to be honest, there isn't likely to be many tears shed over this at Evendale.*

2. *Rolls-Royce wants to do it, GE does not. Why not EA? No idea, I guess Pratt and GE don't ever want to do an engine together again and GE alone can't for legal reasons I suspect even if they wanted to. Finally, no, I think Clark is serious.*

Readers can now understand why influential voices are something we pay attention to. As the saying goes, "where's there's smoke, there's fire".

We requested input from Engine Alliance and Rolls-Royce on engines for an A380neo. It seems that Airbus has not yet formally provided details to the engine makers as to what they might be working with regarding an A380neo. This means neither has a formal response to what remains a concept airplane.

Rolls-Royce response: *"Only thing we can say is that we are in continual discussion with airframers about their potential future programmes, but beyond that you would have to go to the individual airframer."*

Engine Alliance response: Dean Athans, president of the Engine Alliance – "*The GP7200 engine remains the quietest, most reliable, most fuel efficient engine for the A380. It is the only A380 engine to have received three separate performance improvements. With excellent performance retention, GP7200 engines will save operators close to 4 million gallons of fuel over the life of a single A380. The GP7200 engine was designed for severe environments. With ample temperature margins, it is the only A380 engine without hot-day thrust limits and temperature-related engine maintenance with robust EGT margin. No other engine family comes close to the GP7200 and its predecessor member company engine experience in hot and sandy environments. In spite of the conditions, the GP7200 remains the most reliable engine for the A380.*

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The Engine Alliance remains committed to the A380 and is continuously investing to support and improve the GP7200. As examples, we announced performance improvements in 2012 that have been implemented, and durability improvements announced last year will come through our production lines this year. During the last two years, we have expanded our engineering funding and staffing to further enhance the technical benefits of the engine and better reflect our growing fleet size and customer base.

At the Dubai Airshow in Nov. 2013, we discussed that we are constantly evaluating potential product improvements and are working on a multi-generational program plan. This effort is on track, and we expect to know which elements of the plan we will pursue by the end of 2014.

In regard to the EA's potential plans for a re-engined A380, we remain in discussion with Airbus on the A380 and its future. Airbus needs to decide the technical requirements at an aircraft level. At that point, the EA would evaluate our technical portfolio and the associated business case to determine our next steps".

Bottom Line

It appears that even as the "where's there's smoke there's fire" adage applies, everyone is being careful. Airbus is being pushed by Emirates and Boeing. Airbus, for good reason, is wary of the expense a re-engine program requires. Both engine suppliers are wary too – the A380 has not sold anywhere near the levels Airbus has hoped. Airbus will have a tough time getting serious capital investment from engine makers because the ROI looks weak when thinking of a 2020 timeline. A neo program will help sales, but that would still be a big bet in terms of ROI. Of course there is also the A330neo program to throw in to make matters interesting. But how much commonality would there be between the engines for these two aircraft? Even thinking of a neo for the A350 in the 2025 timeframe doesn't help much. Layers of uncertainty don't help.

Airbus is under no severe pressure to define an A380neo just yet. The 777X program is just getting started and the hurdles this program creates for the A380 are still murky. For now Boeing has credible, but theoretical, numbers that help it sell the aircraft. Tim Clark's wish for a 12% improvement in A380 economics is at this stage just that – a wish. His goal may be too high or even too low. An A380 operator who we contacted says they too would like to see an improved A380, but appear to be under no pressure for an A380neo solution. At this stage it appears the tectonic plates are perhaps thinking about shifting. But it will be a while before something starts moving.

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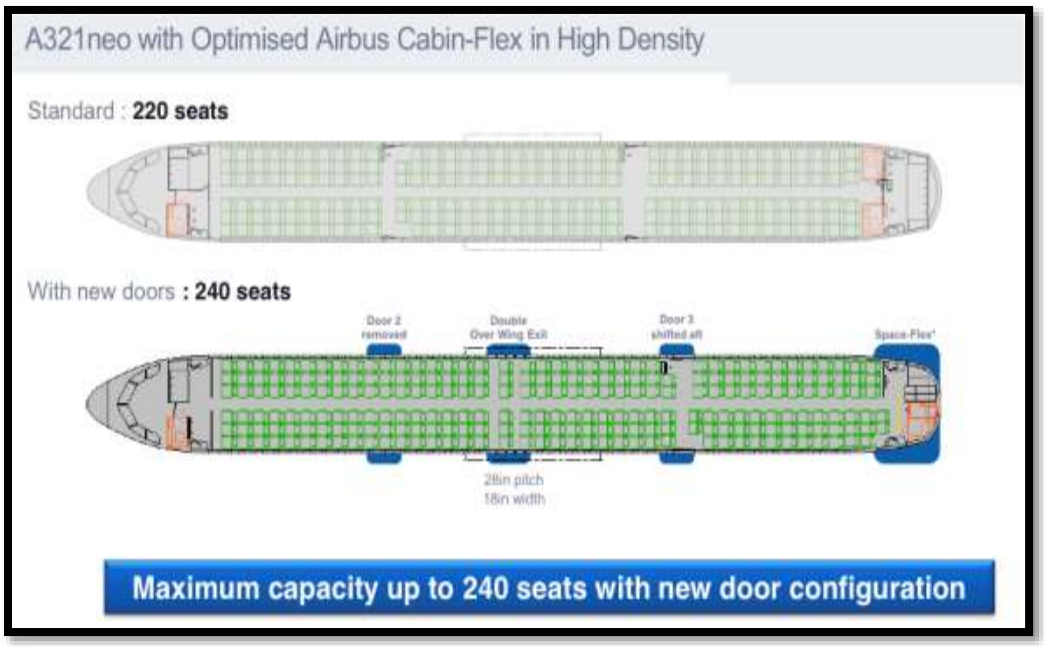
Premium #125 - THE TIGHT SQUEEZE AND ITS CONSEQUENCES

6/17/2014

Airbus, at its Innovation Days last week, announced that it is increasing the maximum capacity of its A320 and A321 aircraft. Maximum seating is moving from today's 180 and 220 seats to a maximum capacity of 189 and 240, respectively in an all economy configuration.

The following chart shows the increase in high density capacity on the A321:



Boeing, aware of the Airbus action, are working themselves to increase maximum seating capacities for their 737 models as well. Bombardier also has a high density option offering 160 seats in the normally 130 seat CS300.

Interestingly, while Airbus is touting wider 18 inch seats in economy class to differentiate their aircraft from Boeing, they are enabling airlines to decrease the distance between seats at the same time to increase capacity. Yes, a wider seat is better, but I'd also like to be able to cross my legs and open my laptop to work. Passenger space is a cube - length x width x height, and anything that reduces that "personal space" is noticeable, despite claims of "equivalent comfort" and legroom.

Of course, these new maxima come after the introduction of thin-line seats that have already increased capacity at many airlines. United installed thin-line seats on its A319 and A320 aircraft, increase capacity by 6 seats, as has Southwest on its fleet of Boeing 737s. Alaska has increased its 737-800s by 6 seats and 737-900s by 9 seats by moving to thin line seats. Lufthansa added two rows, or 12 seats, to its European cabin configuration on A320s.

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Thin-line seats enable airlines to decrease the pitch between rows and add additional passenger capacity to the same airplane. That's one mechanism to quickly improve seat-mile economics. Moving from 32" pitch conventional seats to 30" pitch slim line seats on an A320 typically adds 12 seats, or a 9% improvement in seat-mile economics. That's a bit better, in terms of overall operating costs, than replacing a CEO with a NEO, at lot lower capital expenditure.

There are also operational Issues to consider. For example, an 80%+ load factor already means about one hour for a turn among network carriers. Even Southwest is now seeing slower turns with the bigger airplanes and increased seat capacity. Imagine then increasing seat capacity by a further 5%-10% - this has to slow down turns even more. Does the additional revenue cover the additional cost? If we already see air rage with current seating and load factors, the new higher capacity cannot make things better.

Of course, initial experiences with thin-line seats were mixed, as Lufthansa found out after increasing the capacity of its A320s from 150 to 162. The new slim line seats generated many complaints, and had to be modified to add padding after customer complaints. United and Southwest have also introduced thin-line seats with tighter pitch, but not always to rave reviews.

With higher density seating already in place at many carriers, what will these new even higher exit limits portend? Will we move from 30" to 29" or 28" pitch in economy? The question is how low can you go before passengers strenuously reject to being in the equivalent of a sardine can? Low cost and holiday carriers are currently moving to 29" and even 28" seat pitch. From our perspective, the sardine can has arrived. Take a look at this video of an Arik flight which was delayed for an hour, with no cabin air conditioning. Combining the sardine can effect with poor customer care creates, in our view, a situation that is fraught with risk for both airline and passengers.

Air rage is certainly increasing, as highlighted last week by yet another aircraft being forced to make an emergency landing due to an out of control passenger. Over the last few years, air rage incidents reported have increased twelvefold globally, and the trend doesn't appear to be slowing. IATA has noticed this issue. Flight attendants are unhappy at being forced to take on the role of policemen in the cabin, and while alcohol remains a major cause, can claustrophobia caused by tightly packed cabins at high load factors be making a difference? While air rage statistics vary by country, and are not consistently collected, more than 10,000 annual incidents of "interference with flight crew" is a good surrogate statistic showing an alarming trend.

The reality is that in the age of social media and camera phones, the power does not lie exclusively in the hands of the airline. Take a look at this video of a delayed Ryanair flight.

Last week we also saw another example of the increasing incidence of air rage featured on network news, thanks to cell phone video. A passenger had to be forcibly constrained by other passengers assisting the flight crew, who had such a difficult time that an emergency landing was required to eject the unruly passenger. In another recent incident, a passenger was shown having been "duct taped" to his seat to be restrained by fellow passengers, with arms and legs wrapped to prevent movement. Whoever though law enforcement techniques would be included in cabin attendant training?

Monarch Airlines announced this week that it will be eliminating reclining seats to eliminate one of the "causes" of air rage. Somehow, we don't think it is reclining seats that cause problems, but rather the

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narrow 28 inch standard seat pitch that caused passengers to recline into the lap of passengers one row behind.

We believe several factors are influencing the incidence of air rage, and that further reducing seat pitch will simply exacerbate the problem. These include:

- Larger people, particularly in Western countries - people around the world are getting bigger
- No empty seats, thanks to effective revenue management ensuring every middle seat and armrest is occupied
- Thin-line seats that are less comfortable than earlier seats, regardless of what the manufacturer's say, now used on 10+ hour flights
- The lack of legroom and the inability to cross ones legs or comfortably shift positions on seats of 17 inches or less width
- Seat pitch is too tight to open a laptop on your tray table and work or otherwise "escape" the restricted environment
- An air travel experience that has become progressively worse over the last 14 years, with the hassles of security, ancillary fees, and reduced service levels.

Whether seat width or seat pitch, it all comes down to the perception of "personal space" and others invading that space. We believe the most recent changes are going a too far in reducing the area in which a passenger is constrained.

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Premium #126 – The Regional Jet Market Evolves

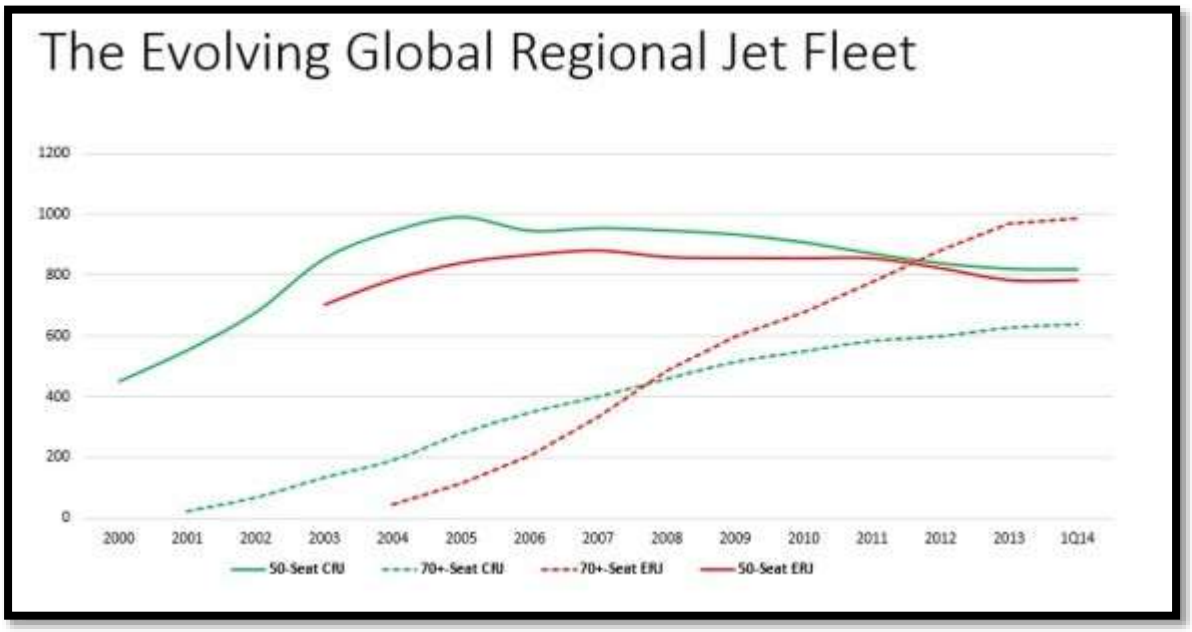
6/24/2014

The regional jet market continues to live in the shadow of the mainline aircraft segment. However changes are taking place that seem to be redefining both the single-aisle mainline segment and the regional jet segment. Typically thought of as the sub-100 seat segment, regional jets are starting to cross this barrier. Looking back, we've seen the 19-seat aircraft disappear, then 34-seat aircraft disappear, now the 50-seaters are disappearing. What constitutes a regional jet nowadays?

Last week we discussed the implications of the higher seating capacity being added to single-aisle aircraft by Airbus and Boeing. It appears that the two big OEMs are moving their focus upward in capacity terms. Does this leave the sub-150 seat market with a gap? Does it look like regional jets can

move into this space?

The following chart illustrates how the global regional fleet is rapidly evolving away from older aircraft. The solid lines show the 50-seat aircraft from the two main OEMs in the segment. The dashed lines show the 70+-seat aircraft from the same firms. As the chart shows, the largest aircraft, the Embraer E-Jet is the most popular. Size matters.



Airlines constantly seek lowest costs and the evidence is that larger aircraft, *all things being equal*, provide this. When fuel was cheaper, the idea of a 50-seat jet was novel and embraced by both passengers and airlines alike. It was especially attractive in the United States where many small communities could be connected to a hub. Speed between the outlying communities and the hub made regional jets attractive. It also extended the size of the one-hour regional catchment area from 250 miles using turboprops to 500 miles using a jet, offering more small cities the opportunity to connect through more distant hubs.

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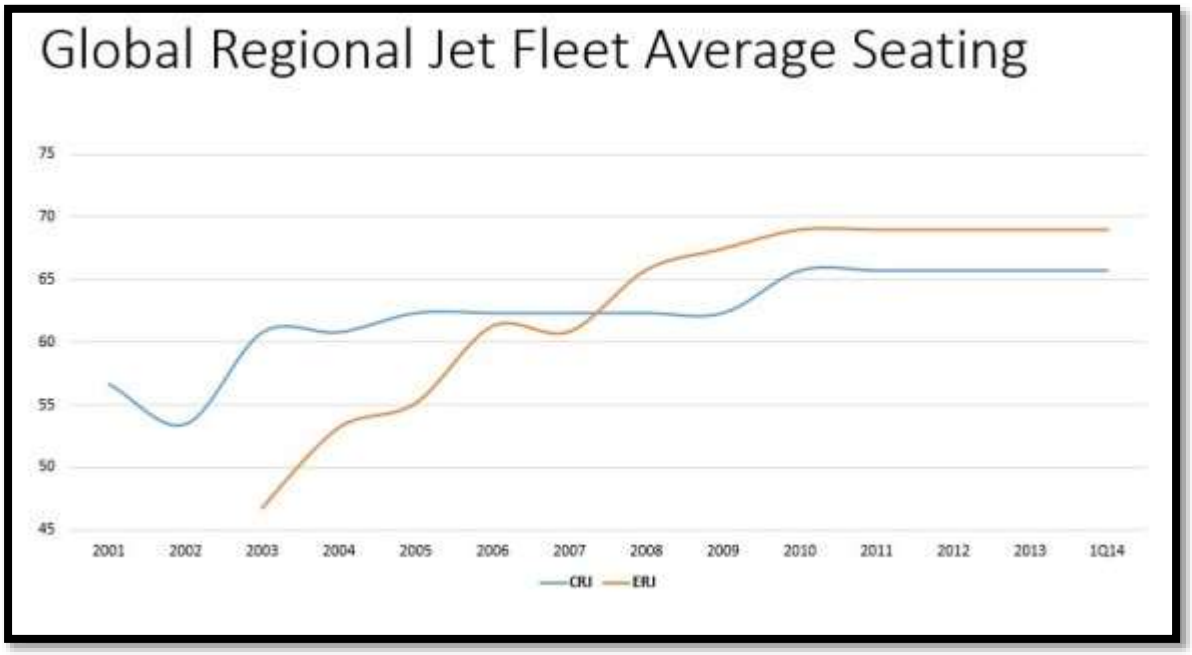
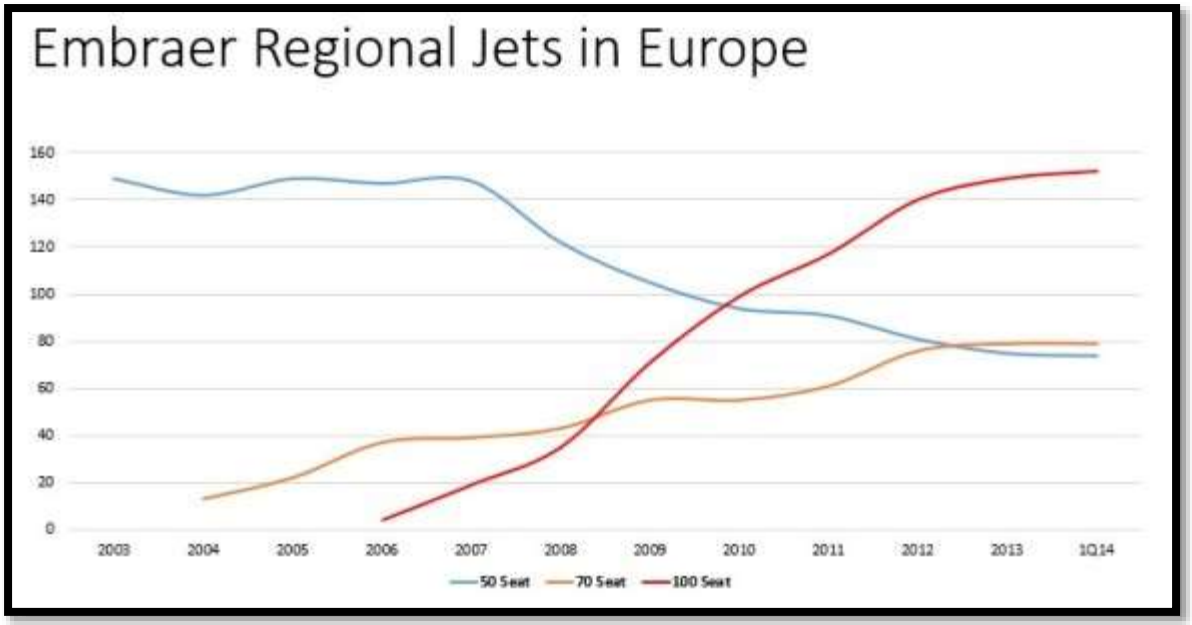
The following chart illustrates the steady growth in regional jet seating capacity. From 2011 the industry appears to have settled on a standard just below 70 seats, and within the US-scope clause.



The following chart illustrates the significant changes Embraer has seen in its fleet deployment in Europe. The smaller ERJs have seen a decline in use while the largest of Embraer's aircraft have seen wide acceptance.



The Embraer experience is not unique – Bombardier has seen the same thing, as the following chart illustrates. European regional airlines do not suffer from scope clause constraints as do regional airlines

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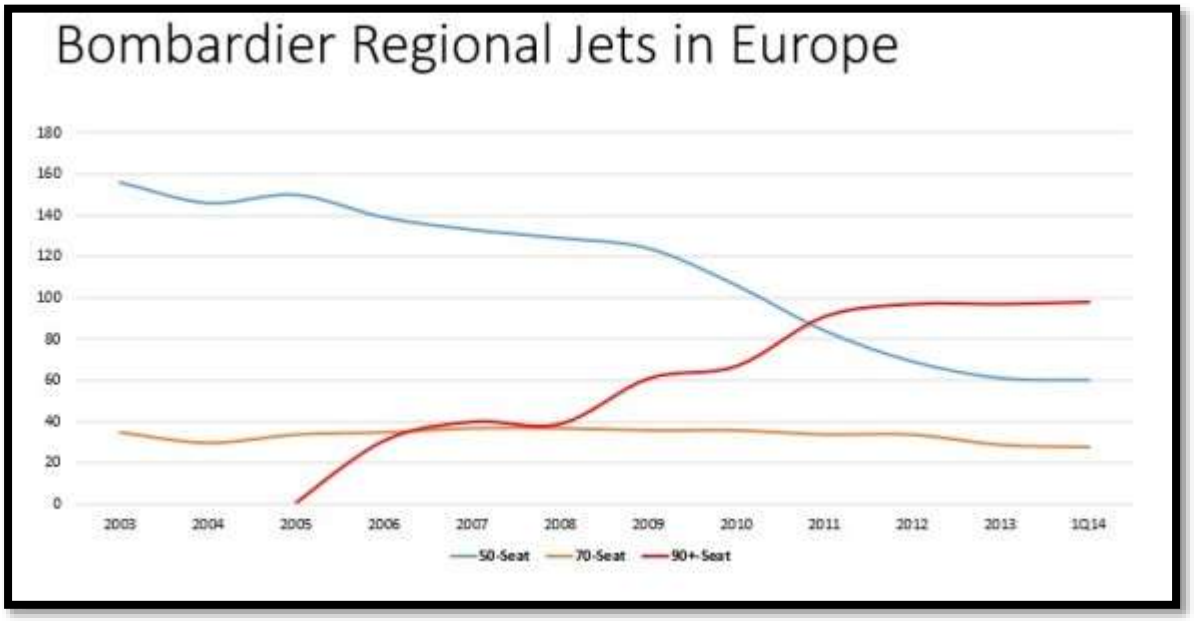
in the United States. This means they are more likely to seek larger aircraft. For example as of 1Q14, 64% of the world's CRJ-1000s were deployed in Europe. Embraer's E-190 has 17.8% and of the E-195 has 51.5% of the fleet deployed in Europe.



Even as regional airlines move to larger jets, the operational impacts on their business are changing as well. The following charts from the US-based Regional Airlines Association illustrate the changing seat capacity and stage lengths.

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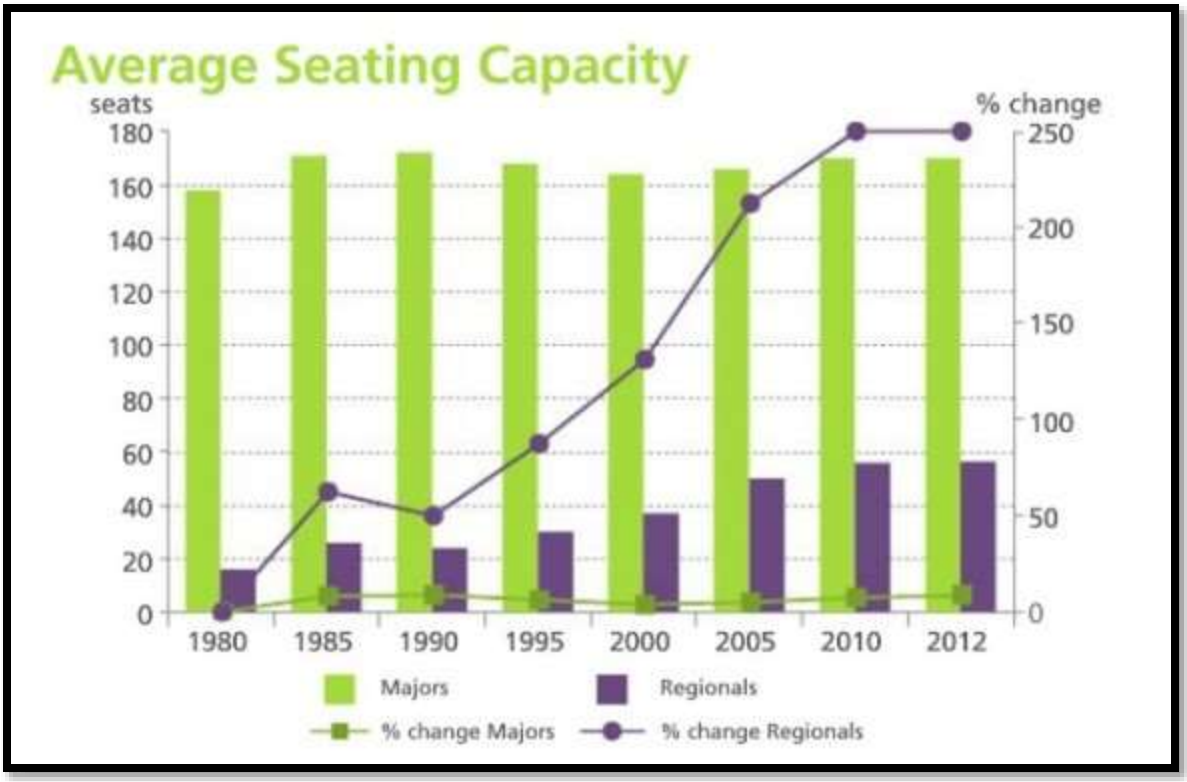

Whereas mainline aircraft hover around an average of 160 seats, regional aircraft seating is growing. Mainline airlines are also evolving fleets – moving from A319s to A320s, and A320s to A321s, and similarly from 737-700s to 737-800s.

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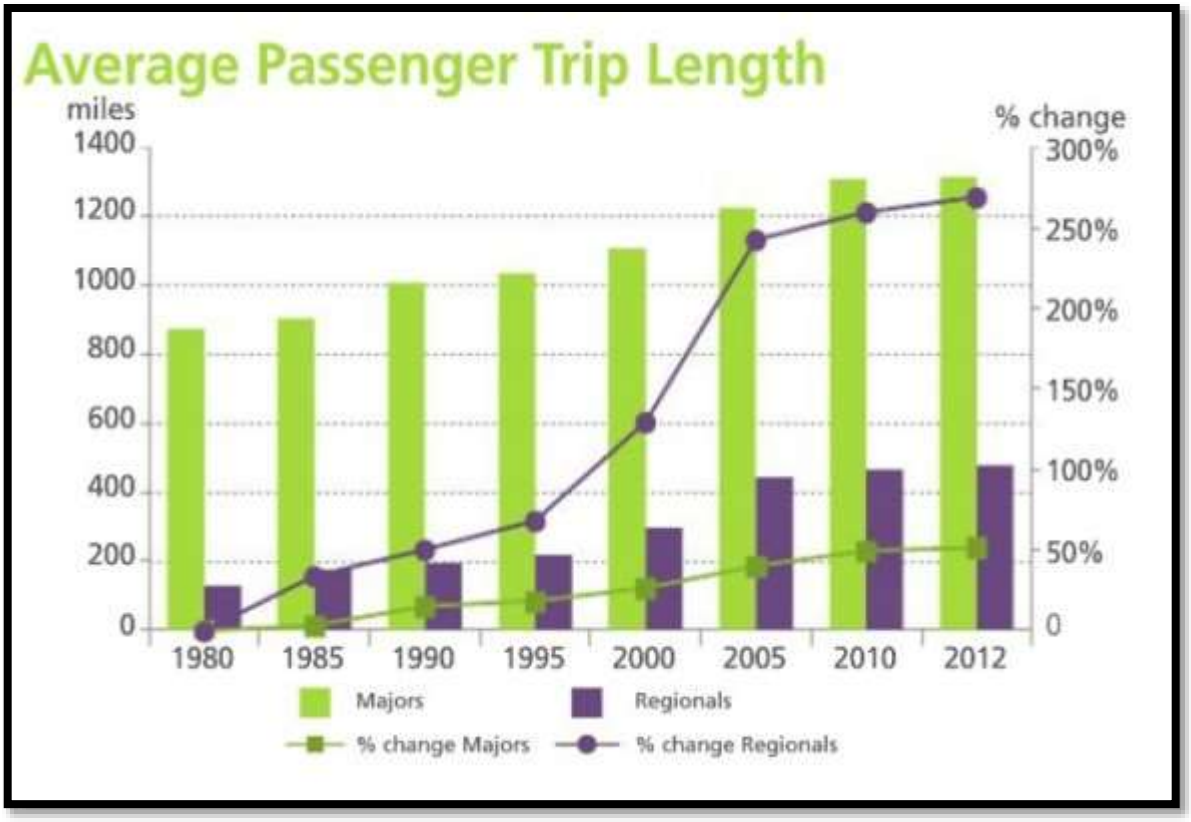

So

What does this evolution portend?

Industry consolidation has played a role obviously - but this is mostly in the United States. However the United States has been a leader in deployment of regional jets and therefore acts like a canary in the coalmine. Fortunately the biggest and most significant US consolidation steps are complete. In a way, the worst has happened. The US-regionals which survived may continue to exist.

Outside the United States regional airlines never saw as much growth potential, and did not have that far to fall when times went bad. Regional jet operators in Europe are typically major airlines feeding their own networks, such as KLM and Lufthansa. KLM, for example, selected the E-190 to replace its Fokkers after that company closed. KLM selected the E-190 because of its cargo capacity which is greater than that of the CRJ.

Another competitive force facing regional jets is improved turboprops. An example is Bombardier's Q400NG, with near jet speed capability at substantially better fuel burn. On routes under 500 miles the Q400 is a more economical aircraft and seats 74, which puts it right at the bottom of the newer larger regional jets in capacity terms. ATR and Bombardier have been trying to make sense of developing a 90-seater turboprop. Regional jets are seeing the floor being cut away under them by ever improving turboprops on routes, possibly up to 750 miles. The newest turboprops have noise and vibration cancellation technologies that make flights much more "jet-like".

US-based regional airlines face predictable revenue streams once they have landed a contract to fly for a major. But bidding for that service is tough. It is being made tougher as majors also evolve their business

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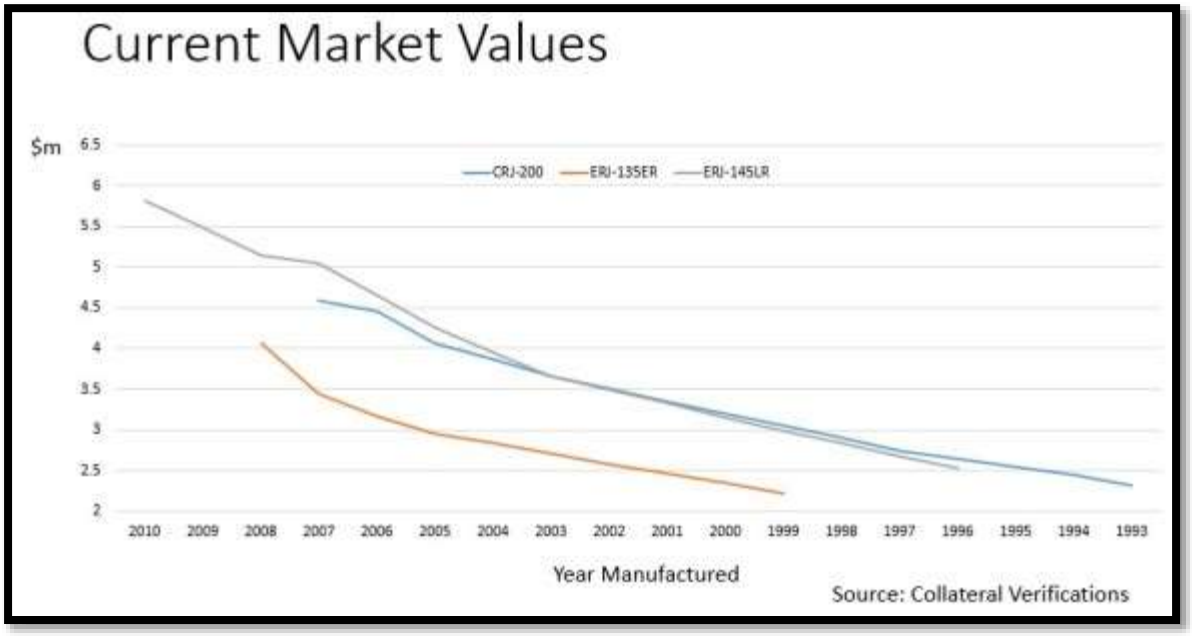
models. An example is American Airlines buying E-175s and then getting Compass, a regional airline, to fly them on its behalf. With each additional step taken by a major, the regional has less room to find efficiencies. A successful regional has to live off its margin – truly a game of survival.

Scope clause is an issue that makes the United States a unique market. Almost all of the US-based airline pilot union contracts — Alaska Airlines is a notable exception — forbids them from outsourcing flying to any aircraft certificated in the U.S. with an MTOW exceeding 86,000lb. Essentially, the scope clause provides job security for pilots governed by the provisions of a collective bargaining agreement. This is a complicated issue. Airlines continually chip away at scope, but with each chip they end up negotiating an offsetting benefit for pilots. Pilots are well placed among organized airline employee groups to protect their benefits. Absent scope clauses, we would see US-regionals flying even larger aircraft. Seat-mile economics would ensure this and are the primary driver for chipping away at scope clause restrictions.

Outside the United States regional airlines do not face scope clause restrictions. In these markets there is a clear drive to seek better economics. By reducing frequencies that larger aircraft allow, an airline can carry the same traffic at lower cost. Of course in some markets such as China and the EU, high speed rail acts as an effective competitor. Russia has attracted some retired western 50-seater regional jets. Since 50-seater aircraft are now trading at low capital costs, the operating economics are attractive. The next chart illustrates how values for 50 seat RJs have fallen. Clearly for certain markets, smaller and older regional aircraft can be put to good economic use. That said, even within the tough United States market, many 50-seater regional jets are still hard at work.



Bottom Line

The regional jet market faces ongoing evolutionary forces. Within the United States these are playing out of the consolidation and labor contracts. Outside the United States it is much more a game of economics and capital costs. Evolving technology in terms of high speed trains and better turboprops

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serve to keep the pressure on. But as we see it, the market for regional jets will respond by also deploying technologies such as better engines (better fuel burn, lower noise) and refining winglets and fuselage drag reduction. We also expect to regional airlines outside the United States acquiring larger regional jets as budgets allow.

1. Regional jets are growing – just like mainline jets.
2. There are artificial constraints restricting this segment of the US market. These include scope clauses, and capital availability for regional airlines.
3. The next generation aircraft from Embraer and Bombardier are even larger – 100-130-150 seat aircraft. These are likely to be attractive options to unconstrained regional airlines.
4. We've seen regional aircraft disappear – 19-seat and 34-seat turboprops are virtually gone. The 50-seat regional jet is going through a natural demise with no new replacements, and today's market is between 70-100 seats for pure regional jets (CRJ, MRJ, SSJ, E175, E190) and emerging into the 100-130 seat market (CS, E2). Plus, turboprops are growing in capabilities.

We come down to a key question - what is a regional jet? Are the CSeries and E2 regional or a mainline aircraft? In the US it is mainline (albeit a regional is the largest CSeries customer). In the rest of the world, it fits both – Malmo is a regional, but Gulf Air and Air Baltic are both mainline carriers.

The lines are blurring between regional and mainline with the new generation that will replace older 737-700 and A319 models, as well as smaller regional jets. And because they are "tweeners", they are harder to position for and market to airlines.

The new generation of aircraft can be both regional and mainline, depending on markets. The CS300 and E2-195 will be A319/737-700 sized aircraft, traditionally the territory of the majors. But because they come from the manufacturers of regional jets, are they the logical "step-up" for regional airlines as well? Probably not, because there is still a watershed at the 100-seat level, where other newcomers such as Mitsubishi and Superjet are focusing.

What it means is that the market from 100-150 seats is still being re-defined, and new aircraft could address both segments. Figuring out who the buyers are is the challenge, as Bombardier and Embraer are learning.

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Premium #127 - Delta and the A380

7/1/2014

The A380 and the North American market have not been a match so far. But is change in the winds? Mark Lapidus, CEO of aircraft lessor Amedeo, believes that he can sell Delta on the A380, despite its management stating that they think the airplane is too large for their route structure, and is not something they are currently considering. Is it wishful thinking at Amedeo or is there something to these statements?

Artist's Rendering of A380 in Delta Livery

European competitors, including Delta's SkyTeam partners are flying the A380 successfully to North America. Air France operates A380s from Paris to New York, Los Angeles, Washington DC and Montreal. Korean Air operates A380s from Seoul to New York, Los Angeles, and Atlanta. China Southern operates from Guangzhou to Los Angeles. Delta code-shares on many of those flights. Virgin Atlantic, in which Delta holds a 49% stake, has A380s on order that will also likely be used on North American routes, if delivered.

Delta is looking to replace its 747-400 and 767 fleets with new aircraft. If the A380 makes sense for others, why wouldn't it make sense for Delta? The answer might be found in an analysis of traffic, the mix of premium traffic in each market, yields, and operating costs. Delta's current fleet of 747-400s, which they inherited from Northwest post-merger, consists of 16 aircraft. Routes served by these aircraft are the natural targets for any potential A380 deployment.

Several of Delta's 747-400 routes have high traffic demand, and could likely accommodate A380s. These routes include New York JFK-Tel Aviv and New York JFK-Tokyo Narita, Detroit to Tokyo Narita, and Atlanta- Tokyo Narita.

We think Delta may need to acquire a very large aircraft (>400 seats) where they find themselves slot constrained. The obvious airport for this is Heathrow. Amedeo points out that 70% of the world's megacity airports are slot constrained already - Heathrow being the most constrained. Indeed within Europe, 99 airports are slot controlled already, as are 13 in North Asia and 35 in the rest of the Asia

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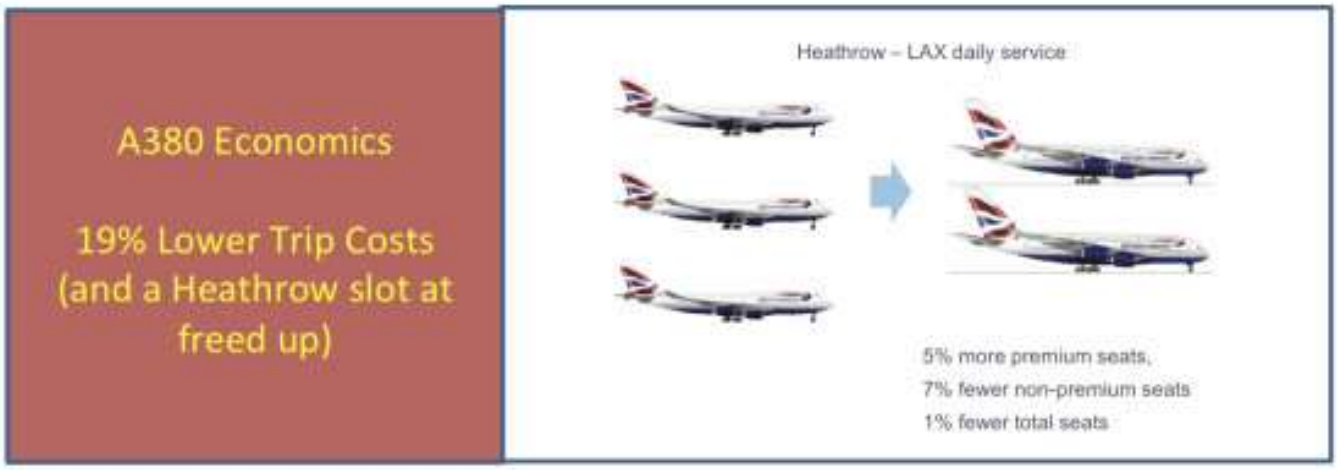
Pacific. On these grounds, given that Delta is one of the world's mega-carriers, discounting deployment of a very large aircraft at may be premature.

According to the UN, urban populations will swell from 54% to 67% of the global population. This means, says The Economist, “for the next 36 years the world’s cities will expand by the equivalent of six Sao Paulos every year”. AirInsight is confident that airport capacity growth will not match this level of growth - meaning ever more crowded airports with rising slot constraints. The need and demand for larger aircraft will grow accordingly. The question is when, rather than if, as traffic doubles over the next two decades.

Let’s examine some of the pros and cons of an A380 in Delta’s network, and the relative costs when compared with other aircraft.

Frequency versus Capacity
One of the arguments for the A380 is that it consolidates traffic from multiple flights and saves money on a route. The British Airways schedule from London-Los Angeles is an example, where it replaced three daily 747 operations with two A380s. From an economic perspective, this works. The following chart from Airbus shows how compelling the logic is.



Source: Airbus

Similarly, one could argue that markets like New York-London, with multiple daily flights, would benefit from consolidating frequencies. But are there competitive dynamics in these markets that make frequency a key decision factor for business travelers? Airlines depend on premium traffic with their corresponding high yields for profitability on international operations.

There are currently 20 daily flights between Heathrow and JFK. Thirteen daily flights are flown by the **one**world alliance (BA and American) while Sky Team alliance (Delta and Virgin) operates six daily flights. The case for these two alliances consolidating frequencies at peak times seems straight forward. The A380 is probably the best aircraft to accomplish this.

A competitive dynamic in certain markets is having flights at the "right time". And that right time even includes morning departures from the US arriving in the evening in Europe, as well as the traditional

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overnight flights, and both morning and late evening flights back to the US for business travelers who may need to put in a full work day before leaving for the US. Traffic volume certainly exists for A380 flights between New York to London, but is the market ready to give up some frequency for efficiency?

We think a strong case can made for the A380 in New York-London market. There is also the issue of optimization of valuable Heathrow slots to consider. An A380 makes better use of a valuable Heathrow slot than smaller aircraft, and if consolidating flights to an A380 frees up a slot for another potential market, a new opportunity is created for additional revenue or market development. The following chart (source: Amedeo) of the Los Angeles-Tokyo market shows that this market, as well, has an opportunity for flight consolidation and optimization of Narita airport and especially the rare Haneda airport slots.

Source: Amadeo

As consolidation among US airlines evolved, capacity control has been the industry watchword. By limiting capacity and increasing yields, US airlines are now leading the industry in profitability. The big four US airlines are carefully adding capacity at a deliberate rate, typically by replacing smaller narrow-bodies with larger ones. Such as 737-700s to -800s at Southwest, and replacing 50-seat CRJs with 110-seat Boeing 717's at Delta.

By replacing 376-seat 747-400s with 350-400 seat super twins, Delta will save operating costs with new technology aircraft. Further, it would not risk potentially lower yields by adding another 100-200 seats into markets on a daily basis with an A380.

However, the choices for Delta to offer equivalent seating to the 747-400 are few. Moreover, staying with equivalent seat capacity does not support market growth. Would replacing the 16 747-400s with, perhaps, eight to twelve A380s and four to eight super twins better enable market stimulation? Clearly fleet decisions require careful analysis of the tradeoffs to find the optimal risk/reward. We suggest the A380 may actually offer Delta more flexibility than super twins for certain markets. Is there enough of those markets to justify a sub-fleet of A380s?

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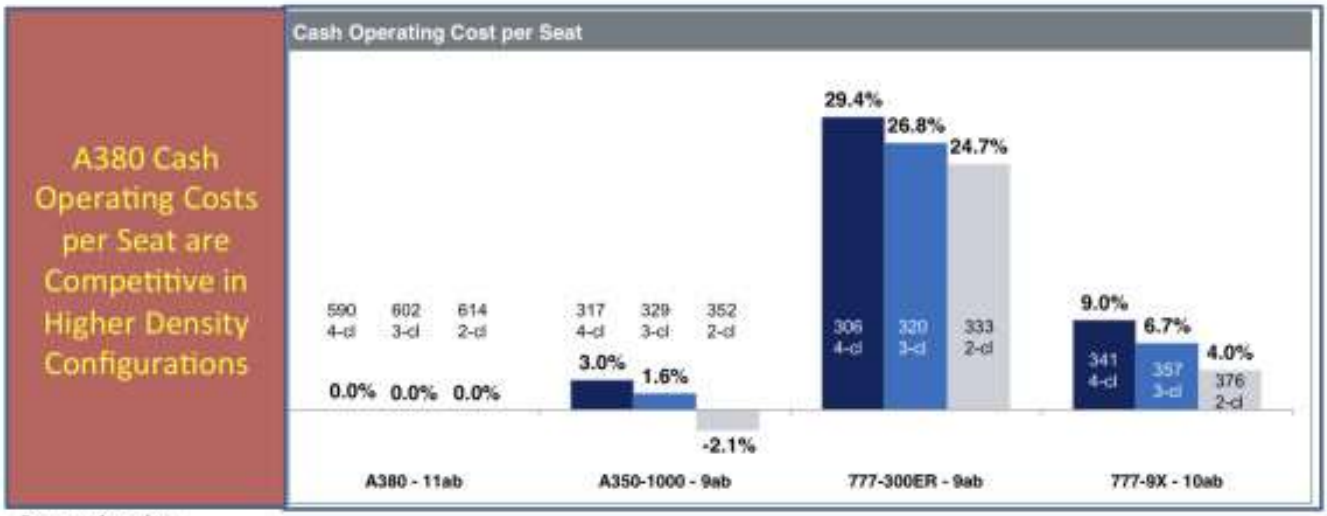
An important consideration is that Delta has made it clear it will not buy new technology aircraft until they are mature. Delta is alone among big airlines in buying older aircraft, some already out of production (i.e. MD-90), because they are inexpensive and offer highly predictable service, and an economic advantage when capital, as well as operating, costs are considered. Plus Delta has one of the finest MRO operations to support these aircraft. Consequently, are the aircraft choices Delta can select from more restricted to match that philosophy?

For long-range flights, Boeing's 777-300ER is an outstanding and proven option, as is the Airbus A330-300 and also the A380. Boeing will also likely offer attractive pricing as it wants to close the bridge between current 777s and the 777X, as would Airbus to extend the A330 program. Airbus' A350 is not mature, and so the only other Airbus option is the A380, which is much bigger and more expensive to fly than either the 777-300ER or A330-300.

Even so, Amedeo makes a compelling argument in the following chart. They show the A380 economics to be highly competitive against the 777-300ER and even the forthcoming A350-1000. Since Delta's management has demonstrated their focus on economics rather than the promise of next generation aircraft, these numbers provide an interesting contrast. Note that with a three-class configuration of 602 seats, the A380 would be 60% higher in capacity than the 376 seat 747-400s in Delta configuration, clearly not a one-for-one replacement.



Source: Amadeo

Today, Delta currently operates 777-200s at 9 abreast in economy, with an 18.5 inches seat width. At 10 abreast, the seat width shrinks to 17 inches in width. With an A380, the choice would be 10 abreast in economy with a 19 inches seat width, or 11 abreast in economy, with a seat width of 18 inches. We believe a comparison of 9 abreast for the 777 versus 10 abreast for A380, or 10 versus 11, respectively is fairer, and could change the seat-mile analysis in an “apples to apples” comparison.

Cabin Mix

One of the advantages of the A380, according to both Airbus and Amedeo, is that it offers opportunities to optimize cabins, including premium economy, to maximize revenues. The key is whether Delta could generate additional premium demand with its product. Delta offers a combined First/Business product, and a new Economy Comfort product. A four-class service, as offered by some A380 operators, does not

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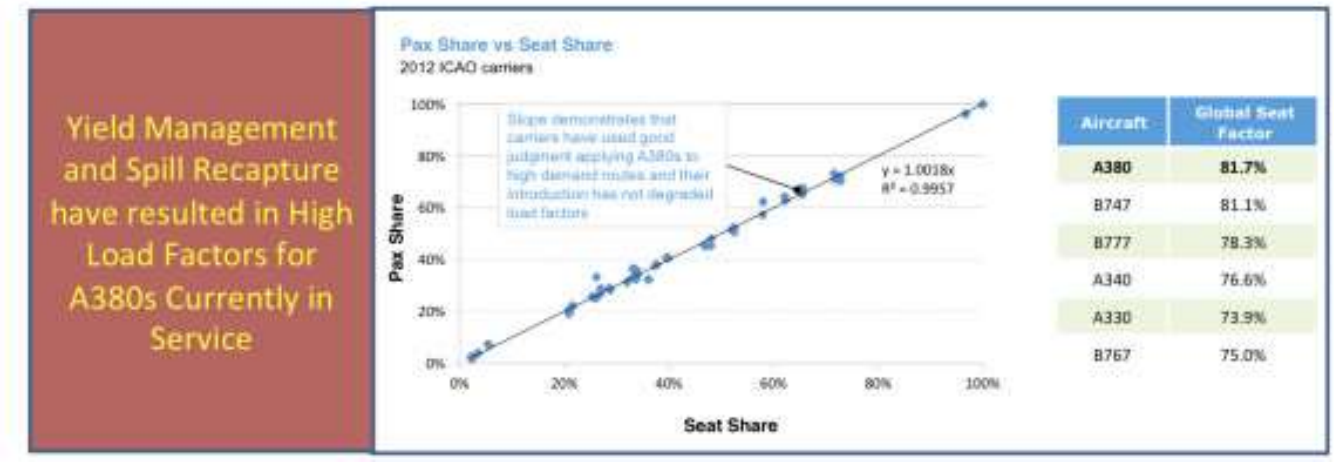
fit at Delta. Delta could configure an A380 cabin with extended premium seating, perhaps using the entire upper deck. Of course, it could also bulk up premium seating on a 777-300ER too, if premium traffic is available to fill the seats.

Passenger Preference

There is little doubt that passengers prefer the larger cabins of the A380 and 747 over smaller aircraft. But is that preference differential enough to draw traffic from competitors? Airbus touts high load factors for its A380 operators to support its thesis that the A380 attracts traffic.

The next graphic, supplied by Amedeo, further demonstrates the attraction of the A380 by comparing load factors for various aircraft types. Of course, airlines have been careful to place A380s on high-density routes, introducing a bias. The 747 also showed high passenger preference when it first entered service. Iconic aircraft attract traffic.



Amedeo makes a strong case that even though the A380 is much larger than the other aircraft, it does not appear deploying these aircraft is as risky as some might believe.

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Economics and the Bottom Line

Then there is the view that economics of a four-engined jet, even the A380, are merely competitive with today's twins, and will be inferior to the economics of the next generation super twins. Hence the talk of an A380neo. Detroit-Tokyo, about 5,581 nautical miles, is a typical Asian route for Delta. In the following analysis, we compare the economics of several aircraft on a cost per seat-mile and cost per air mile basis to examine what might be the best aircraft for this route.

The contenders from Boeing include the 747-400, 747-8i, 777-300ER, 777-9 and 787-10, and from Airbus include the A380-800, A350-1000, A350-900 and A330-300, and the potential A330-300neo.

Airbus cites Emirates as an example of the A380's compelling economics. Delta, and any other mega-carrier, cannot dismiss Emirates' experience. Emirates has demonstrated enviable growth, and has developed inroads into previously cozy markets wherever they fly. They have shown the A380 is highly disruptive and has demonstrated an ability to move passenger choice.

Source: Dow Jones Institutional News, April 30 ,2014

Our economic analyses are based on information gleaned from the aircraft manufacturers and airlines operating the aircraft. Our operating cost assumptions are normalized for uniform operating conditions, uniform rates for flight crews and landing and navigation fees. Fuel burn and maintenance costs are computed for the route length.

For seating capacity, we utilized Delta configurations, including nine abreast economy seating for 777-300ER and 777-9. While ten abreast is possible in this aircraft, Delta has maintained nine abreast on their 777-200LRs. We have assumed a First/Business, Economy Comfort and Economy configuration, and as a result, seat counts may not match typical three class configurations from Boeing and Airbus.

Our summary of operating costs for the Detroit-Narita route are as follows:

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Cost Esimates for Delta Operations from Detroit to Narita - 5,581 nm mission								
Aircraft	Delta Seating	Fuel Cost	Maintenance Cost	Crew Cost	Nav and Landing Fees	Total Op. Cost	Cost per AC Mile	Cost per Seat Mile
747-8	376	$ 127,554	$ 21,376	$ 17,527.71	$ 12,251.94	$ 178,709	$ 32.02	$ 0.0852
777-300ER	355	$ 105,232	$ 15,997	$ 16,927.16	$ 10,916.82	$ 149,073	$ 26.71	$ 0.0752
777-9	400	$ 91,552	$ 15,997	$ 16,927.16	$ 10,916.82	$ 135,393	$ 24.26	$ 0.0606
787-10	330	$ 71,581	$ 11,107	$ 16,326.60	$ 9,396.33	$ 108,411	$ 19.43	$ 0.0589
A380	565	$ 159,908	$ 25,536	$ 19,329.37	$ 13,910.93	$ 218,684	$ 39.18	$ 0.0694
A350-900	339	$ 76,021	$ 11,110	$ 16,326.60	$ 9,667.27	$ 113,124	$ 20.27	$ 0.0598
A350-1000	372	$ 86,747	$ 12,449	$ 16,326.60	$ 10,278.62	$ 125,800	$ 22.54	$ 0.0606
A330-300	293	$ 81,306	$ 11,301	$ 15,726.05	$ 8,896.66	$ 117,230	$ 21.01	$ 0.0717
A330-300neo	293	$ 72,362	$ 11,301	$ 15,726.05	$ 8,896.66	$ 108,286	$ 19.40	$ 0.0662

The next table compares the operating cost per aircraft mile and operating cost per seat mile for various candidates to replace the 747-400. On a cost per seat-mile basis, several of the newer aircraft, including 787-10, 777-9, A350-900, A350-1000, and the A330-300neo, beat the A380.

Delta can minimize its risk by flying lower capacity aircraft on certain routes, while maximizing revenue through increasing the premium/economy seating ratio and constraining supply to enable higher yields. Given the risk aversion of Delta management to new aircraft types, the A330-300neo appears to be the logical choice to replace 767s. But that covers the North Atlantic market. What should replace Delta's 747-400s?

Adding capital costs to operating costs paints a better picture of relative economics. Since Detroit-Narita is a 13.5 hour route, an airplane will typically make one trip per day, or 30 trips per month, on average. Using current lease rates for existing models, and estimated rates for new models, we calculate a total cost estimate to compare each aircraft.

Adding capital costs to the equation changes the picture somewhat; now the more fuel efficient new technology aircraft are the most expensive. Our estimated lease rates are based on data from aircraft appraisers and a Delphi method among industry experts regarding new technology aircraft.

Estimated Total Monthly Cost from Detroit to Narita - 5581 nm mission							
Aircraft	Delta Seating	Flight Op. Cost	Monthly Op. Cost	Monthly Lease	Total Month Op+ Cap	Monthly Seats	Cost per Seat
747-8	376	$ 178,709	$ 5,361,271	$ 1,250,000	$ 6,611,271	11,280	$ 586.11
777-300ER	355	$ 149,073	$ 4,472,195	$ 1,350,000	$ 5,822,195	10,650	$ 546.68
777-9	400	$ 135,393	$ 4,061,789	$ 1,600,000	$ 5,661,789	12,000	$ 471.82
787-10	330	$ 108,411	$ 3,252,337	$ 1,350,000	$ 4,602,337	9,900	$ 464.88
A380	565	$ 218,684	$ 6,560,533	$ 1,950,000	$ 8,510,533	16,950	$ 502.10
A350-900	339	$ 113,124	$ 3,393,733	$ 1,200,000	$ 4,593,733	10,170	$ 451.69
A350-1000	372	$ 125,800	$ 3,774,010	$ 1,400,000	$ 5,174,010	11,160	$ 463.62
A330-300	293	$ 117,230	$ 3,516,888	$ 925,000	$ 4,441,888	8,790	$ 505.33
A330-300neo	293	$ 108,286	$ 3,248,580	$ 1,075,000	$ 4,323,580	8,790	$ 491.87

Examining the total cost per seat, the new technology aircraft are in the lead, followed by A330neo and A380, with the 777-300ER and 747-8, each in less than maximum seating configuration, ranking last.

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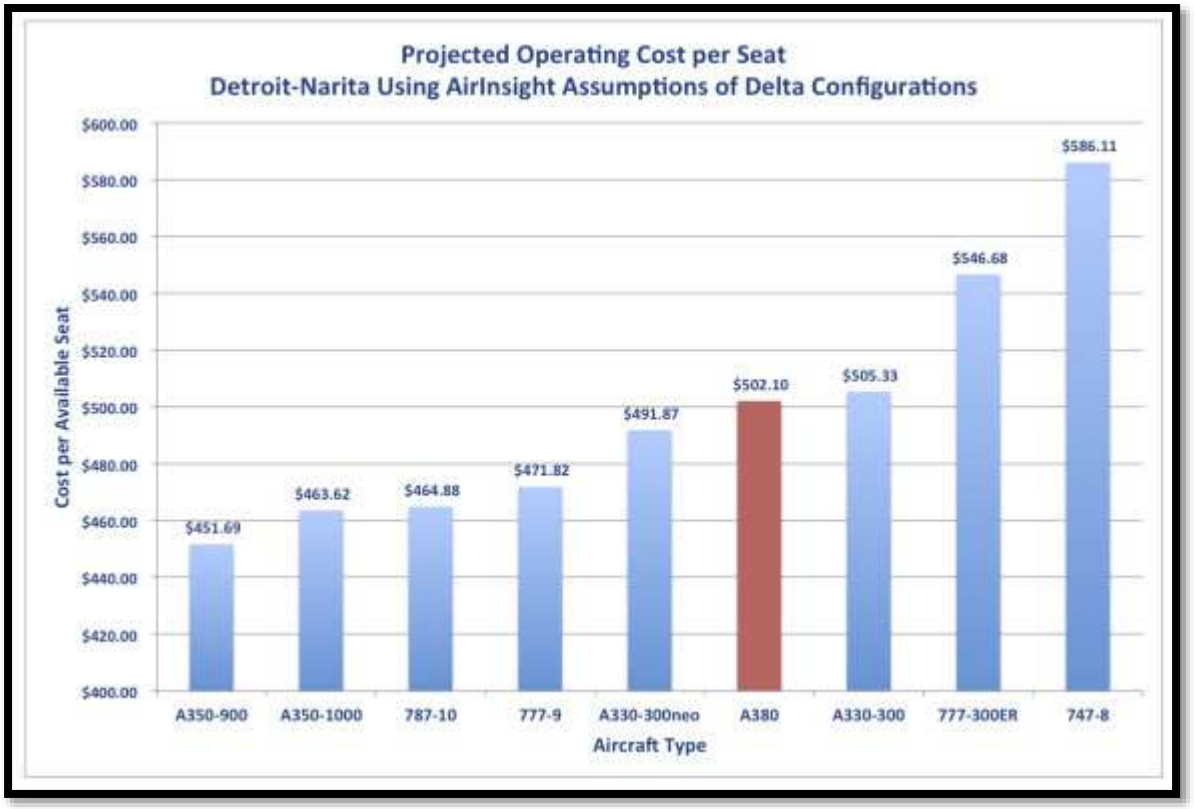

Does this mean the A380 has a shot a Delta? It clearly depends on traffic volumes. If traffic on a route can support 565 daily seats, in an assumed Delta configuration, the A380 does make sense. But if fewer seats are needed, smaller aircraft could fit the bill better. Of course the wrinkle is that Delta is unlikely to consider aircraft to the left of the A380 in the chart above because none of these is "mature."

For routes in which flight consolidation is a possibility, the economics change. For example, a market with two frequencies, with an A330-300 could be accommodated with a single A380 flight. Comparing the economics above shows that a single A380 would reduce costs by nearly $400,000 per month in direct costs. The indirect costs, however, for slots, gates, and crew training can also make a significant economic contribution, and would likely quickly make-up the difference in transition costs to support a sub-fleet of A380s.

Amedeo points out that a fleet of 12 A380s is the equivalent capacity to 22 A350-1000s, 23 777-30ERs or 21 777-9. As a result, flight crew requirements are reduced significantly, and the savings from flight crew and technician payrolls will more than cover the transition costs needed to introduce the A380 into the fleet, as shown below:

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The Externalities Factor:

A380 reduces Flight Crew Payroll, Technician Payroll, and Sourcing Issues

A380 Annual Savings (Based on a 4-Class Layout)

- Flight Crew Payroll: $30 Million (vs. A350-1000); $33 Million (vs. 777-300ER); $ 27 Million (vs. 777-9X)
- Technicians Payroll: $5.1 Million (vs. A350-1000); $5.8 Million (vs. 777-300ER); $ 4.5 Million (vs. 777-9X)

	A380-841BC	A350-1000	777-300ER	777-9X
Fleet	12	22	20	21
Flight Crew per Aircraft	7.4	7.4	7.4	7.4
Pilots per Crew	3	3	3	3
Total Pilots Required	200	488	511	466
Total Pilots Annual Salary (in US$)	**35,964,000**	65,934,000	68,931,000	62,937,000
Additional Pilots Annual Salary	**Base**	83%	92%	75%
Technicians per Aircraft	18	15	15	15
Total Technicians Required	216	330	345	315
Total Technicians Annual Salary (in US$)	**9,720,000**	14,850,000	15,525,000	14,175,000
Additional Technicians Annual Salary	**Base**	53%	60%	46%

Amedeo points out, and their CEO made this clear during a call with AirInsight, that Delta could reduce its costs by having fewer aircraft. For example, it does not need to replace 16 747-400s with 16 A380s. Eight A380s could do the job for appropriate routes with better economics and much greater revenue upside.

A key driver for selecting an A380 is traffic growth and airport constraints. If traffic continues to grow and more airports become constrained, larger aircraft are required. How big is this problem? It may not be significant now in many markets, but it is certain to become more of a problem. Once again, this uncertainty could be an advantage for the A380.

Could Delta engineer a short-term lease for A380, until the new super twins mature? A leased A380 fleet buys Delta flexibility, where it can be deployed without locking up capital in the event the next generation super twins deliver as promised. Another wrinkle to consider is that by keeping their cash in the bank, Delta could be ready to pounce during the next downturn when orders are cancelled and aircraft prices become more attractive.

Based on Delta's aversion to unproven aircraft, we believe Delta will select A330s or possibly the A330neo to replace its 767 fleet. The question remains, what will replace their 747-400s? Could Amedeo pull off an A380 deal and can the make the case that the aircraft is compelling at Delta for certain routes? We don't have the traffic, growth projections, or knowledge of yields to analyze those facts in detail. But, for certain routes, such as JFK-LHR, an A380 may make sense.

Could those routes potentially be code-shared using the existing Virgin Atlantic A380 aircraft on order? Could creative financial arrangements by Amedeo or Airbus, with perhaps help from the European Investment Bank (which should be a special delight for Delta) tip the balance in the A380s favor? And if so, when? The jury remains out.

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Premium #128 – Farnborough Expectations

7/8/2014

Next week is the biggest air show of the year. The industry looks forward to it because so much news is announced that it sets the tone for the rest of the year.

Big picture:

There are no blockbuster announcements expected at the show in terms of new programs or new aircraft. We expect the show to be the usual stage to highlight orders. With A350 set to enter service soon and the 787-9 in service, Airbus vs Boeing will focus on their new programs. We expect each to tout their new aircraft, specifically 787 and 777X vs A350.

We think the two big players are nearly fully booked for single aisle aircraft but with planned production increases, there is likely to be room for some additional orders. (AirAsia is usually a big show buyer but they seem to be slowing down and the same for Lion Air.) We could see some orders from Africa though –they have been behind the wave for some time and seem to be catching up. Perhaps a MAX order from

Ethiopian is in the cards. Possibly a 787-9 order from Norwegian.

Airbus –

- We expect focus to be on two programs – A350 and A320neo. Airbus can be expected to be pushing sales on the former, highlighting the near perfectly executed flight test program. The message will be the A350 is doing exactly what Airbus said it would do – it's a low risk program and customers should be lining up for the aircraft.
- Because of the A350 flight test success, Airbus will also push the message that the same can be expected for the A320neo. John Leahy and his team like to talk about the fan size on the A320neo being much larger than that on the 737MAX; ergo better fuel burn on the neo. This drives CFM batty, they don't want any talk about fan size because it leads to questions about how CFM can ensure the neo and MAX have the same performance.
- A330neo is on everyone's mind. Airbus advised us to dial down expectations. Consequently we do not expect to hear about Delta being the launch customer. Airbus seems to be getting a lot of positive customer interest in the aircraft. John Leahy thinks the market is good for 1,000 aircraft – which means it probably can achieve even more sales than that. The A330neo is likely to be highly disruptive to the 787's pricing. Which means Boeing will have to consider big discounts to try attract former 767 customers who now fly A330s back into the fold. An A330neo is going to be a very interesting program.
- We expect to hear A380 news along the lines of the growing global urbanization driving airlines towards deploying VLAs. The logic is impeccable. But orders don't necessarily follow logical patterns. The A380 may be a decade too early – but Airbus had no choice to do the plane when they did. Boeing says the VLA market is only big enough for one vendor. Had Airbus not moved, Boeing would have kept its monopoly. Even if Airbus has to wait a decade for the A380 program to hit sales stride, it was worth it to hobble Boeing, in the view of some, and the 747-8 program appears dead in the water, with little customer interest even at bargain pricing.

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ATR -

- Last year ATR had a blockbuster show in Paris. ATR now talks about being the world's biggest turboprop company with great pride. It has managed to accumulate a global customer base.
- However, the ATR trades performance for operating costs when compared to Bombardier's Q400. Consequently its customers tend to be focused on its lower operational costs. For airlines that are not feeding a network with more distant smaller cities, the ATR is a compelling offering. Moreover, ATR has updated its cabin to make the aircraft provide a better level of passenger comfort.
- Being part of the Airbus family, ATR benefits from family connections. Although Airbus' CEO recently told us an Innovation Days they are happy being partners with Finmeccanica, it isn't always smooth sailing. A difference in views on a future 90-100 seat turboprop may yet see Airbus and Finmeccanica at loggerheads.
- In the meantime, ATR needs to focus on execution and delivering on their orders. We anticipate some orders at the show – for example, perennial show customer NAC may top up with under a dozen. India also offers good hunting grounds for ATR, particularly with ridiculously high fuel taxes on jets, but not turboprops. The Q400 has proven to be a good asset for Spicejet. India is likely to be a rich market for turboprops over the longer terms, as its airport development program continues.

Boeing –

- Focus will be on the 777-8 and -9 as well as the 787-9. Boeing's sales for wide bodies this year have been slow. Of the 444 orders to date, only eight were twin aisles. That's only 1.8% and not particularly exciting, causing analyst concerns that a slowdown in existing 777 models production may be required before the new models reach the market. Boeing needs to get its orders for the existing 777-300ER firmed up to fill a backlog gap. (By comparison, Airbus had 49 wide body orders through May).
- We do not expect much news around the 747-8, despite a flutter from the recent Dubai show. The program seems to be dead and waiting for the Air Force One replacement bid in 2017 before disappearing. It seems reasonable to assume the similar capacity, but much more efficient, 777-9 will be the Boeing VLA offering going forward. Boeing is likely to further outline the improvement in wings and engines planned for the 777X at the show.
- The as yet unannounced Monarch Airlines MAX order will also be highlighted because it is a switch from Airbus. We expect Boeing to push the message that the MAX builds on the 737's tremendous history combined with the superb CFM56 engine. Of course the MAX and LEAP are new and there is some leap of faith that this new combination will be as good as they say. The Monarch order came about, we are advised, because Boeing pulled out all the stops on price, and because they applied pre-delivery payments from a 787 on order to the 737MAX. Moreover Monarch follows the conversion at Air Canada, so Boeing is to be expected to stay hyper aggressive in the narrow-body market.

Bombardier –

- CSeries has gone through a tough time. But for the recent engine problem we were convinced the airplane would come to the show. We hope Bombardier and P&W can pull off a miracle, but it appears unlikely. The aircraft is impressive – airline people we have spoken with all say so. But

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like everyone in the business (i.e. Airbus & Boeing) flight test programs are designed to find problems. That is their purpose. Many seem to have forgotten the 787 teething troubles and the A380 and A400M difficulties. Of course the 787-9 test program went without a hitch, because of the 787-8 lessons learned. The Airbus A350 test program has been superb because of lessons learned. Both companies had to go through a nasty apprenticeship a few years ago to get there. Bombardier has not actually performed as poorly, but we would have liked to see them be much further down the flight test program by now. But our sense is that they are acting with abundant caution. They are not as big as Airbus and Boeing, so do not have the same resources and prefer to keep their risks minimal. This translates into looking slower and weaker. If Airbus or Boeing lost an aircraft in flight test, they could overcome it. If Bombardier had such a problem, it would be more difficult to overcome. So they take smaller steps to make sure they don't stumble.

- That said, we understand customers are getting closer to making decisions. The recent engine hiccup is, of course, not helpful. But if Bombardier could land an order from a big lessor, that would be a substantial boost for a program. First because it is an endorsement. Secondly because lessors create liquidity and a market for aircraft after airlines retire them.
- The CRJ program seems to be holding its own facing competition from the revised E-Jets. The regional jet market is bifurcating between the US and rest of the world. This presents a challenge for OEMs in this segment. The CRJ is being tweaked for better fuel burn. In fact, the fact the revised 777X engine losing its chevrons came after Bombardier already did this on the CRJ. Also, the tilted winglets now on the E-Jet were also seen on the CRJ first. Many observers do not credit Bombardier with being a leader. Moreover, the CRJ remains the lightest aircraft in its class. Given the thin margins for US regional carriers, the CRJ remains a compelling offering.
- The Q400 program has had a better year than it has seen for a while. Its tremendous power allow the aircraft to offer a replacement for smaller jets. Indeed airlines are increasingly seeing the benefits of high speed turboprops. In addition, Bombardier is seeing growing interest for the Q400 platform for SAR and maritime patrol. As with ATR, we watch with interest as the two turboprop makers eye the 90-100 seat markets, although the 84 seat high density Q400 comes closer to the 90 seat goal.

COMAC –

- With the first customer ARJ-21 at last headed for delivery, COMAC has to be pleased. But we do not expect to see much interest in the aircraft outside China and its area of influence.
- The C919 program is also rather quiet. We hear that when pilots look at the flight deck, they will notice that it looks exactly like that of the CSeries. This is a good thing. A lesson from the ARJ-21 is that COMAC needs a partner as it learns about the commercial aerospace business. Bombardier is a great partner and also a potential global customer support source. But even with such a partner, the C919 appears to be already outdated before it enters service. The aircraft is not a threat to A320 of 737 it was once thought. Just like the ARJ program, COMAC can learn a lot from the C919 – but it needs to accelerate this learning process by working closely (and openly) with a partner. Such cooperation will give the market much more confidence in COMAC.
- COMAC is without doubt a comer in the industry. But as COMAC evolves, it cannot assume Chinese airlines are natural customers which can be forced to buy their products. Even with very deep pockets and a talented and willing staff, COMAC has to go through an apprenticeship. It took Airbus 25 years to be able to compete with Boeing. COMAC can only shorten that time by working with a partner – and we suspect Bombardier is the partner of choice.

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- The talk about working with Russia on a wide body is a lot of talk for now. We suspect the SSJ deal for 100 to be built under license in China announced earlier this year is not a firm as it appears. Sukhoi has been burned by China before when it thought it had sold China 100 fighters, only to be shafted and have their design copied. COMAC has to tread carefully and build relationships that are respected. Failure to do this means apprenticeship costs stay high and longer.

Embraer –

- The E-jet program continues to execute well. Customers are pleased with the aircraft as we have seen good orders for the E-175 in the US. We could see orders for more E-175s from US airlines because the aircraft fits within the scope clause restrictions.
- The E-190/95 could see customers looking to refresh fleets. For example Brazilian airlines are natural customers as that economy grows. The early E-190/95 customers faced higher costs than expected. This was due to engine maintenance, but GE subsequently solved the problems.
- Embraer will be pushing for E2 orders from its global customer base. These should be forthcoming because the company has built a reputation of supporting its products. Embraer got the timing on the E-Jet perfectly as equivalent sized (Fokker, BAe) OEMs left the industry. Many of the early aircraft now could be replaced with the updated E-Jet and airlines could also get good pricing on the E2.

Mitsubishi –

- The program is now moving more quickly as Mitsubishi worked through their delay from the FAA paperwork falling behind production process. The engines are now installed on the first aircraft, and ground tests are underway.
- The MRJ is heavily dependent on two US regionals. However these airlines' patience is wearing thin. The swings in fuel prices combined with a much more difficult industry post US airline consolidation mean these airlines would like to have used these aircraft in service as originally scheduled.
- Mitsubishi has yet to prove their aircraft can find more than three customers after years of sales campaigns. Even with launch customer deals, they have no new sales in more than a year. We expect no surprises at FAS. But the pressure has to be on for the program to obtain orders.

UAC –

- The most successful commercial program for UAC is the SuperJet. The aircraft has apparently been doing much better than expected at Interjet in Mexico. In addition, launch customer Aeroflot has now taken delivery of its improved SSJs. The program still lacks an FAA certificate. This limits the US market for the aircraft. We understand from one US-based regional that if the aircraft had such certification, they would likely have considered it.
- The other program that offers great promise is the Yak-242 formerly known as MC-21. The naming seems to vary in news reports. The aircraft will offer both a Russian engine and the PW GTF. Based on a design by Sukhoi (like the SSJ) the aircraft has what appears to be a tremendous wing. It is rare to see a commercial jet without winglets. Yet the MC-21 does not have them because the wing is thought to be very efficient. (Boeing and Embraer disposed with winglets for their latest 777 and E2.) In many ways the range payload of the largest variant, the MC-21-400

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looks like a potential Tu-204 and Boeing 757 replacement. But the program appears to be running very slowly.
- UAC shares the same lack of transparency as COMAC. This is unfortunate because the greater the transparency the more program interest. This interest helps sell aircraft.

Pratt & Whitney

- PW will concentrate of the large number of orders it has received for the GTF program on 12 models of 5 aircraft types.
- While PW could upscale the GTF to 75,000 to 100,000 pounds, we do not foresee an appropriate wide-body program before 2020 for such an application.
- The GTF could be the ideal engine for a 757 replacement.

CFM International

- The LEAP engine is the focus of CFM, which is exclusive on the Boeing 737MAX. This provides a strong market share advantage over PW, given their shared position on the A320 family.
- We believe the limited growth potential of the LEAP versus GTF may hamper future growth in the 2020 time frame, when PW introduces its "second generation" GTF with performance improvements.
- Nonetheless, CFMs large customer base can be leveraged with commercial terms.

GE

- GE will be exclusive on the 777-X, and shares the Boeing 787 program with Rolls-Royce.
- The 777-X will be a key focus as GE touts its new technology on the GE-9X.

Rolls-Royce

- Despite years of critical commentary regarding PW's GTF, Rolls-Royce recently announced its own geared turbofan design. We expect this engine could even compete for a Boeing 757 replacement in the 2020 time frame.
- Rolls-Royce is exclusive on the A350XWB, which will soon enter service with Qatar Airways, and provide a strong market base.
- There is rampant speculation that Rolls-Royce will be the only engine for the A330neo, as GE has declined, and PW is currently busy with 5 different GTF applications.

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Premium #129 - Farnborough: Behind the Headlines

7/22/2014

The A330neo launch and its implications

The biggest headline from Farnborough 2014 was the launch of the A330neo, which will be a more effective direct competitor to the Boeing 787. The new competition will be a classic case of trading operating efficiency for lower capital costs, as the 787, with similar engine technology, advanced systems and composite construction, will be more fuel efficient than the A330neo. But Airbus has fully amortized A330 program costs, and can provide an A330neo at a much lower price than Boeing 787.

Does the launch of the A330neo program kill the A350-800? We believe so. Airbus will likely formally drop the smallest version of the A350 family once orders are transitioned either to A330neo or A350-900 models. There are only a handful of orders remaining for the poor-selling -800 model, despite the success of the A350-900 and -1000 in what appears to be the "sweet spot" of the twin aisle market.

The introduction of the A330neo introduces pricing pressure into the market for Boeing, which needs to recover the large cost overruns on the 787-8 program to bring the program into profitability. We expect that the competition from A330neo could negatively impact Boeing margins on future 787 sales, and that airlines will be the beneficiary of renewed competition between the airframe manufacturers. This could push the break-even point for the 787 program further out to the right. However, we don't expect Boeing to price 787s at a loss to gain market share against the less expensive A330neo. Besides Boeing has a very big 787 backlog.

How do the economics stack-up? Our independent assessment of operating economics indicates that that A330neo will be somewhat competitive with the 787 on a 4,000nm segment, with the 787 holding a slight advantage. When capital costs are included, the A330neo is quite competitive, depending on pricing assumptions.

We have not yet completed analysis of the A330neo on all routes, and there are some indications that performance improvements may degrade for shorter stage lengths. As we obtain additional data from Airbus and other industry sources, we will incorporate that data into future analyses. The following chart shows our comparative analysis of Cash Operating Costs for a 4,000NM segment for competing aircraft.

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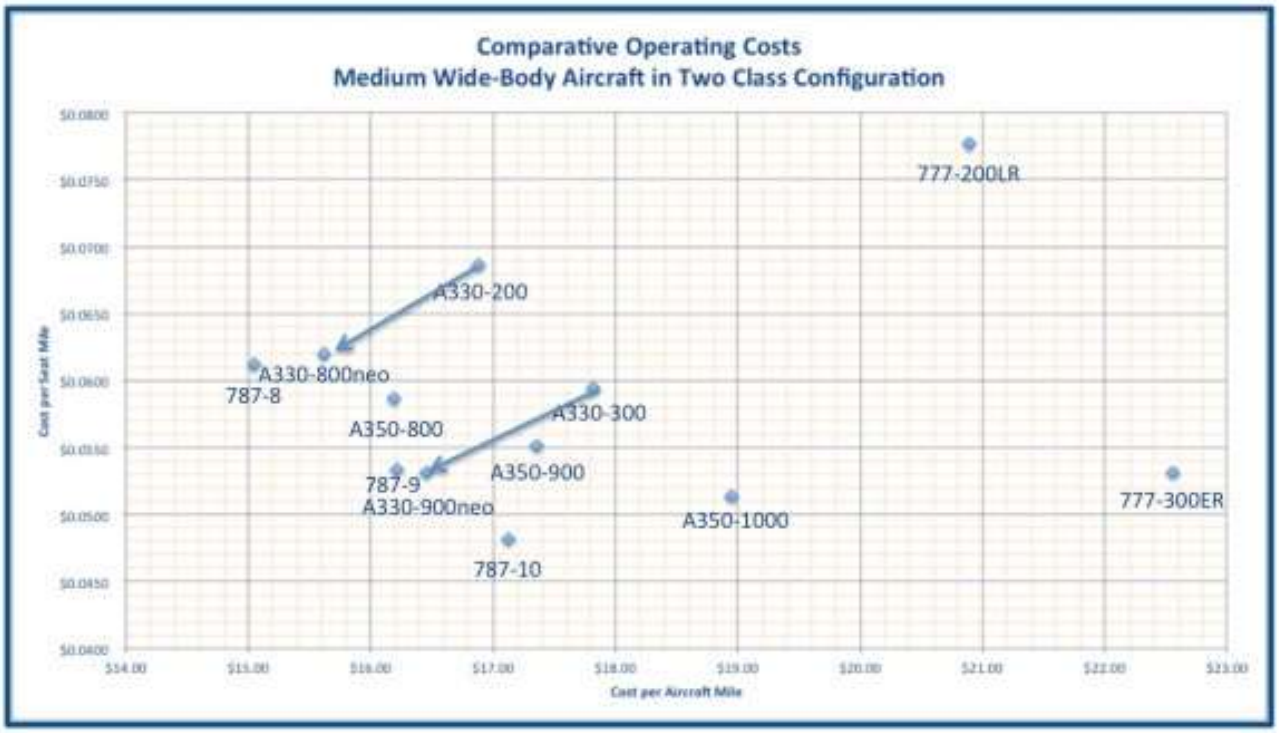

Data underlying the chart are shown in the following table:

COMPARATIVE OPERATING ECONOMICS				4,000 nm mission, $3.50 fuel						
Aircraft	Configuration	Seats	Fuel Burn	Fuel Cost	Crew Cost	Maintenance	Nav. & Ldg.	TOTAL	Cost/Mile	Cost/Seat Mile
777-200LR	2 Class -9Y	269	18,700	$ 65,450	$ 14,146	$ 14,800	$ 10,075	$ 104,471	$ 20.89	$ 0.0777
777-300ER	2 Class-10Y	425	20,800	$ 72,800	$ 15,227	$ 14,640	$ 10,130	$ 112,797	$ 22.56	$ 0.0531
787-8	2 Class	246	12,800	$ 44,800	$ 13,606	$ 8,500	$ 8,320	$ 75,226	$ 15.05	$ 0.0612
787-9	2 Class	304	13,900	$ 48,650	$ 14,146	$ 9,600	$ 8,675	$ 81,071	$ 16.21	$ 0.0533
787-10	2 Class	356	14,850	$ 51,975	$ 14,686	$ 10,300	$ 8,675	$ 85,636	$ 17.13	$ 0.0481
A330-200	2 Class	246	14,825	$ 51,888	$ 13,606	$ 10,370	$ 8,540	$ 84,403	$ 16.88	$ 0.0686
A330-300	2 Class	300	15,975	$ 55,913	$ 14,146	$ 10,515	$ 8,540	$ 89,113	$ 17.82	$ 0.0594
A350-800	2 Class	276	13,925	$ 48,738	$ 13,606	$ 9,800	$ 8,799	$ 80,942	$ 16.19	$ 0.0587
A350-900	2 Class	315	15,140	$ 52,990	$ 14,686	$ 10,150	$ 8,934	$ 86,760	$ 17.35	$ 0.0551
A350-1000	2 Class	369	16,900	$ 59,150	$ 14,686	$ 11,385	$ 9,519	$ 94,740	$ 18.95	$ 0.0513
A330-800neo	2 Class	252	13,046	$ 45,661	$ 13,606	$ 10,266	$ 8,540	$ 78,073	$ 15.61	$ 0.0620
A330-900neo	2 Class	310	14,058	$ 49,203	$ 14,146	$ 10,410	$ 8,540	$ 82,299	$ 16.46	$ 0.0531

Our assumptions for the A330neo include an additional six seats for the -800 over the -200, and ten for the -900 over the -300. The seating increases will be gained through relocation of lavatories and more compact galleys, and we will more closely examine the Airbus LOPA (Layout of Passenger Accommodations) as we refine our analysis to reflect typical airline configurations.

The cost per seat mile for the A330-900neo are close to those for the 787-9, but cannot catch the 787-10, which competes with the A350-1000 in size.

A total cost comparison, including capital costs represented by a typical lease rate, shows how the lower pricing for the A330neo versus Boeing 787 narrows the economic gap. The following chart incorporates estimated lease rates for each model based on data on current market pricing, and our assumptions regarding A330neo pricing.

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MONTHLY TOTAL ECONOMICS *Two 4,000nm flights per day*								
Aircraft	Daily Cost	Monthly Cost	Lease Rate	Total Cost	Miles Flown	Seat Count	Cost/AC Mile	Cost/Seat Mile
787-8	$ 150,451	$ 4,573,715	$ 1,100,000	$ 5,673,715	243,200	246	$ 23.33	$ 0.09484
787-9	$ 162,142	$ 4,929,104	$ 1,250,000	$ 6,179,104	243,200	304	$ 25.41	$ 0.08358
A330-800neo	$ 156,146	$ 4,746,829	$ 975,000	$ 5,721,829	243,200	252	$ 23.53	$ 0.09336
A330-900neo	$ 164,597	$ 5,003,762	$ 1,050,000	$ 6,053,762	243,200	310	$ 24.89	$ 0.08030

The key question for Airbus and its suppliers is will the A330neo cannibalize the A350 program, or are these separate markets?

The following table compares the maximum range of each model, with a full passenger load.

Airbus Wide Body Family	Seating	Range NM
A330-200	246	7250
A330-300	300	6100
A330-800neo	252	7450
A330-900neo	310	6200
A350-800	276	8250
A350-900	315	7750
A350-1000	369	8000
A380-800	525	8500

The A350-1000 remains a unique offering in terms of size and range, but the A330-900neo is quite close to the A350-900 in seating, with a difference of only 10 seats. The range differential of 1,550NM is significant for airlines requiring long-range, but flights utilizing that much range are limited. The A330neo looks like an ideal trans-Atlantic replacement for 767s and A330ceos, and could be an effective aircraft on Middle-East and India routes to Europe, as well as inter-Asian routes. Airbus cannot discount the A330 to the point that it threatens the A350 in the marketplace, as it would like to continue to increase the sales of its new aircraft. Thus, despite the threat of excessive discounting against Boeing, Airbus must also worry about protecting its own pricing for A350.

The key for Airbus is to maintain demand for both its A330 and A350 in the same size range, one with shorter-range and one with longer range. We believe this will be a difficult task, resulting in some potential A350-900 sales being cannibalized by the A330neo in the near term. However we are confident that Boeing will find the arrival of the A330neo disruptive. Already after announcement, the A330neo has more orders than the A350-800 ever had. Many airlines are wary of the long range, high-tech 787 or A350 and for them the cheaper A330neo is likely to be irresistible.

The CSeries Gains Momentum

Bombardier, after goose-eggs at the last two major air shows, finally began to gain momentum for the CSeries, which because of recent engine difficulties was not able to fly to Farnborough. Despite that, Bombardier received 5 firm orders plus 66 LOIs for 71 CSeries aircraft at the show.

Bombardier set out two market goals for CSeries prior to entry into service -- 300 firm orders and 20 customers. It achieved the latter at Farnborough, and moved the total firm orders to 203 and program

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commitments to 513 at the air show. Because most LOIs will convert into firm orders, a couple of additional orders in 2014 could push the program above its 300 goal.

Flight Global published a story that Australian leasing company Macquarie may soon place an order for 50 CSeries. While neither Macquarie or Bombardier would comment, such an order would provide an additional program boost to ensure momentum as the program moves closer to its EIS.

Bombardier also passed a milestone for the Q400 of 500 orders, while introducing a new Combi model with 50 seats and 1,153 cubic feet of cargo space. This model could be very successful in developing countries, particularly in Africa, where airfreight is an important element of airline operations. This provides an interesting alternative to the ATR-42 for some customers that have significant demand for air cargo in the 50 seat turboprop category. There were commitments for 10 Q400s, with five firm.

Bombardier brought an American Airlines CRJ900 to the show. This aircraft has also seen a spate of orders. The CRJ now boats 5.5% better fuel burn than the original model. It is also being made lighter and therefore provides compelling competition for Embraer. However Bombardier appears almost shy about some of its improvements; the outward sloping winglets now being used on the enhanced EJets and the "conical" fix on the engine that means no more chevrons but better fuel burn. GE and Boeing made a big fuss about doing this for the 777X with the GE9X. Yet Bombardier did it first.

Pratt & Whitney's Engine Troubles Overshadow Announcements

The recent engine failures on CSeries and F-35, both produced by Pratt & Whitney, couldn't have come at a worse time, just prior to the aircraft expected to be stars of the air show. With neither engine flying, the media focus was on problems, rather than news.

P&W announced an improved version of the GTF engine for the A320neo, offering an extra 2% improvement in fuel burn beginning in 2019. This brings the fuel burn advantage over today's engines to 18%, and provides the PW-1110G-JM Advantage a 3% margin over the competing LEAP 1-A from CFM, which has not yet announced a competing performance improvement package. This GTF performance improvement was largely overshadowed by engine failure news, which attracted much more press. P&W, albeit suffering from unfortunate timing, raised its order book from 3,500 GTF engines at Paris last year to more than 6,000 after Farnborough. While most press seemed to ignore the GTF Improvement news, airline customers did not.

Embraer Continues Momentum

Embraer received commitments for 85 EJets and E2Jets at the show. The E2 orders included 30 firm +20 options from Azul and 50+50 from Trans States.

The interior for the E2 Jet was shown at the show, with positive reviews, particularly for its new overhead bins providing capacity for one small roller-bag per passenger. Embraer also showed a novel staggered premium seating layout.

The largest E2Jet order came from TransStates, which also has orders with Mitsubishi for the same sized MRJ. Moreover, at 92,000 pounds the E2-175 ordered is way outside the scope clause and this would have to change substantially to allow for the E2-175 to be deployed. The TransStates orders, however,

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are conditional and can be easily cancelled. We understand that Embraer has not added the TransStates order for 50 plus 50 E2Jets into its official backlog as a result of the "cancel-able" nature of the contract. Nonetheless, the E2 had a positive show with the major order from Azul.

Boeing Stabilizes 787 Program with 787-9

After a tumultuous start with the 787-8, Boeing has introduced the 787-9 without a hitch, indicating that the program has now reached maturity. Boeing can now focus on improving dispatch reliability for the 787 series and continue improvements to its production operations and lower costs.

Boeing entered the air show with a large lead in orders over Airbus, and while Airbus outsold Boeing during the show, Boeing retained its overall lead in 2014 orders when all was said and done.

The show was relatively uneventful for Boeing, indicating that things are back on track in Seattle.

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Premium #130 - What if there was a 767MAX?

7/29/2014

The recent moves by Airbus and Boeing away from all-new programs signify a distinct trend – new airplane designs are very expensive and complicated. They are high-risk projects that are better avoided until technologies offer much greater deltas between the current and potential economics. The A380, 787, and CSeries delay experiences created a perception of increased risk, the reality is that engine technology drives aircraft economics, and that capital costs are increasingly important to airlines in today's environment.

That is why we see the A330neo, the A320neo from Airbus, the E2 from Embraer, the 737MAX and the 747-8 and 777X (that are really 747MAX and 777MAX) from Boeing. Tweaking basic designs offers much lower risk and the potential to still significantly improve economics. Airlines clamored for winglets and these only provided between 3-5% better economics. The re-engined and re-winged aircraft (neo & MAX) offer double digit improvements. Orders have flowed in as airlines endorse the low risk solutions.

New designs like the 787 and A350 are doing fine, and will prove to be good, and perhaps excellent, airplanes. But the risk factor is something many airlines would rather stay back from until the aircraft are proven. Delta Air Lines is the most glaring example; the airline refuses to buy aircraft that are, by its definition, "not mature". Moreover, by offering the 767 as the base for the USAF tanker, Boeing clearly sees how effective the basic design is. Boeing will be building and supporting 767 tankers for the next fifty years.

Airbus and Boeing had a great competition going with the A330 and 767 some years back. The A330 outlasted the 767, only to have to face off against the 787. Airbus points out it sold more A330s since the 787's arrival than before. Boeing points out its 787 eclipses the A330. Both statements are true. For Boeing to build a better airplane it has spent well over $20 billion. Airbus reckons $2 billion will bring its A330neo within striking distance of the 787 at much lower cost. On the face of it, did Boeing make the right choice?

As of now that question is not unreasonable. Two decades from now we will have a much clearer picture and the bet is that it was a good decision. But what if Boeing had ruminated more on the 787 and instead offered a 767MAX in the interim? For example, the 787 era engines could have been fitted to 767, and Boeing could also have deployed winglets (or used the 767-400ER wing) and a drag cleanup.

For the sake of this exercise let's say Boeing could improve the 767-300ER's fuel efficiency and range by 12%, similar to what Airbus achieved with A330neo. We estimate the 767MAX program would have cost Boeing under $2 billion.

The following chart from Boeing lists the longest routes current flown by the 787.

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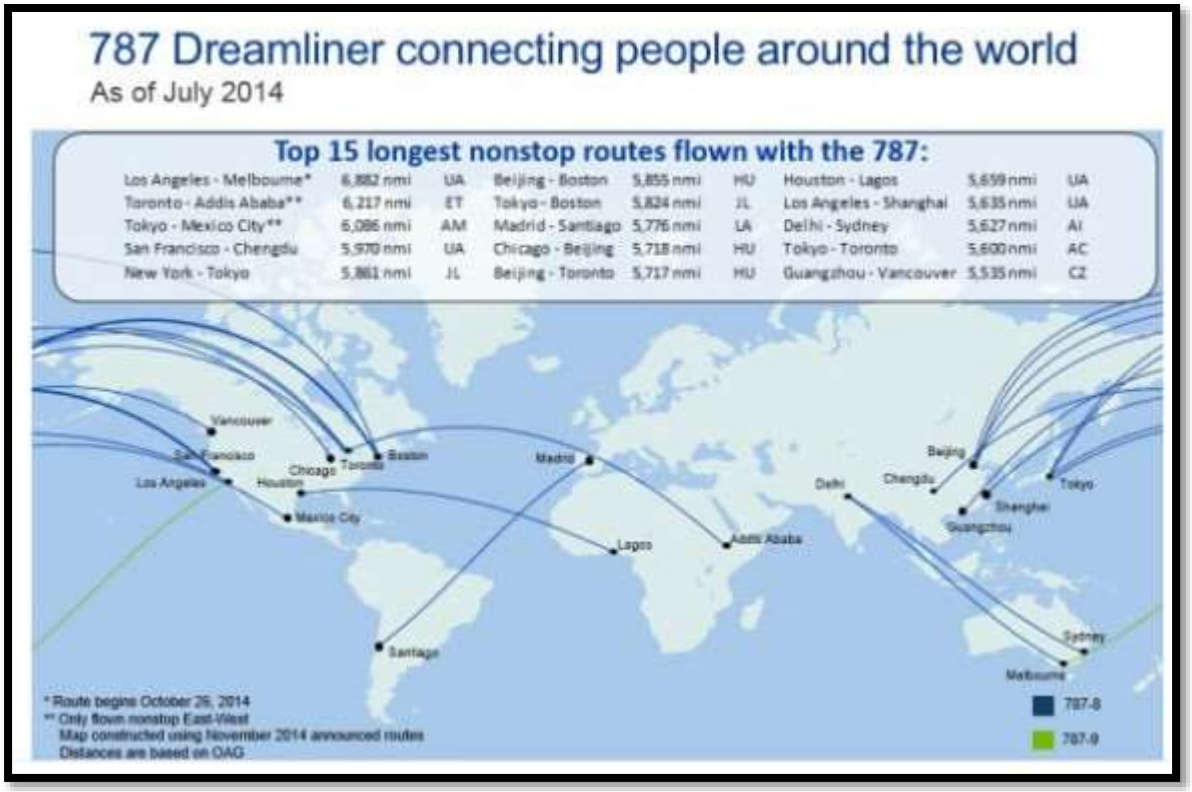

When we look at the ranges 787's are flying now, it is clear the aircraft has a significant range improvement over the 767-300ER. The 767-300ERs range of 5,990 NM improved by 12% would give it 6,700NM range. This is 14.6% less than the 787-8. But of the 252 routes currently or soon to be flown by the 787-8, there are only four with a range greater than 6,700 NM, or 2%.

Besides looking at the maximum range potential, the 767MAX could have filled in for the 757 in many markets. The 767 is one of Boeing's most successful programs with 1,110 aircraft sold. Of these 53% were 767-300ERs. In fact the -300 and -300ER models account for 74% of all 767s sold. The fact that the 787-8 was almost the same size goes to prove the inherent value of the 767-300ER. It was the right size with the right numbers for so many airlines. Replacing it with the 787-8 offered a lot more range and some passenger pleasing features. But it is essential the same size airplane.

Of course the 787-8 is a much more capable airplane than the 767-300MAX we envision. But the price Boeing could have charged for the 767MAX would have given Airbus' A330 a much tougher time. As the 787 went through its long gestation, Boeing could have pumped out a lot of 767MAXs. This would almost certainly have crimped the A330s sales success. Boeing would have kept a lot more customers "on side". Customers that defect are tough to bring back. Boeing had to offer a "screaming deal" for Air Canada to move from A320s to 737MAX. Consequently it behooves an OEM to offer existing customers a solution to keep them on side. It is a well-known strategy that it is cheaper to keep a customer than to win one.

Take a look at the economics of the 767-300ER, the 787-8 and what might have been a 767MAX. Our analysis shows that a re-engined 767, with a 12% reduction in fuel burn (similar to A330neo over A330ceo) would result in an aircraft very competitive with the 787-8 for a 4,000nm mission.

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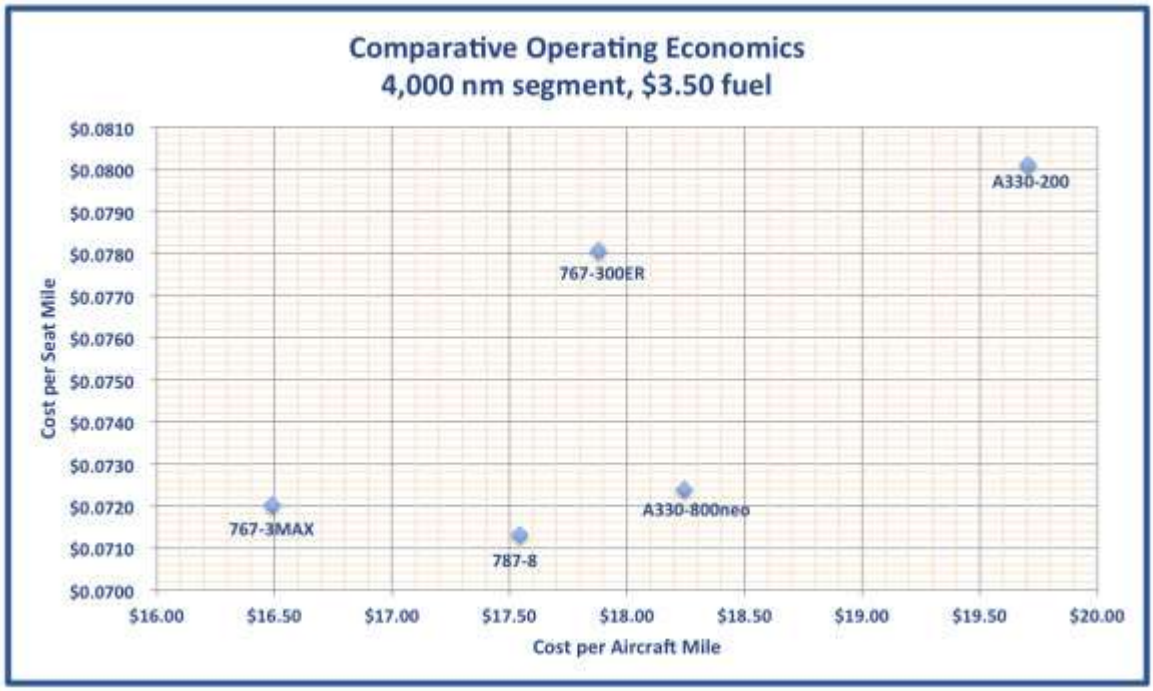
Our estimated costs are shown in the following table and chart, along with the A330-200 and A330-800neo.

COMPARATIVE OPERATING COSTS								
4,000 nm segment	$3.50 per US gallon							
	Fuel Cost	Crew	Maintenance	Nav & Ldg	TOTAL	Seats 2 class	Cost/AC Mile	Cost/Seat Mile
767-300ER	$ 46,200	$ 10,715	$ 8,150	$ 6,450	$ 71,515	229	$ 17.88	$ 0.0781
787-8	$ 44,800	$ 11,150	$ 7,175	$ 7,050	$ 70,175	246	$ 17.54	$ 0.0713
767-3MAX	$ 40,656	$ 10,715	$ 8,150	$ 6,450	$ 65,971	229	$ 16.49	$ 0.0720
A330-200	$ 51,675	$ 11,150	$ 8,750	$ 7,250	$ 78,825	246	$ 19.71	$ 0.0801
A330-800neo	$ 45,474	$ 11,550	$ 8,700	$ 7,250	$ 72,974	252	$ 18.24	$ 0.0724



A 767-3MAX would have been a very effective competitor to the A330 (and even the 787-8) today when capital costs are included. This is particularly true since Boeing optimized the production facility for 767s recently, leading to more cost-effective production. Of course, competing with the Dreamliner is probably why Boeing decided against a re-engined 767. On the other hand, once Boeing decided to drop the 787-3, there was another opportunity to look for a solution that better fit that requirement. ANA, as part of compensation for delayed 787s took delivery of some 767s. Clearly the 767-300ER was not past its prime even without the MAX options.

Perhaps this is why Airbus and Boeing are focusing on derivative aircraft in the near term. Is the incremental performance improvement worth the additional risks in costs, transition to exotic materials, complexity, and higher cost per aircraft?

Hindsight is always 20-20. In hindsight, in our view, a 767-3MAX could have made sense for much of the market. The positive reaction the A330neo serves as evidence. Besides, we would bet Delta would have ordered 50 or more 767-3MAXs.

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Premium #131 - The Super Twin Line Up

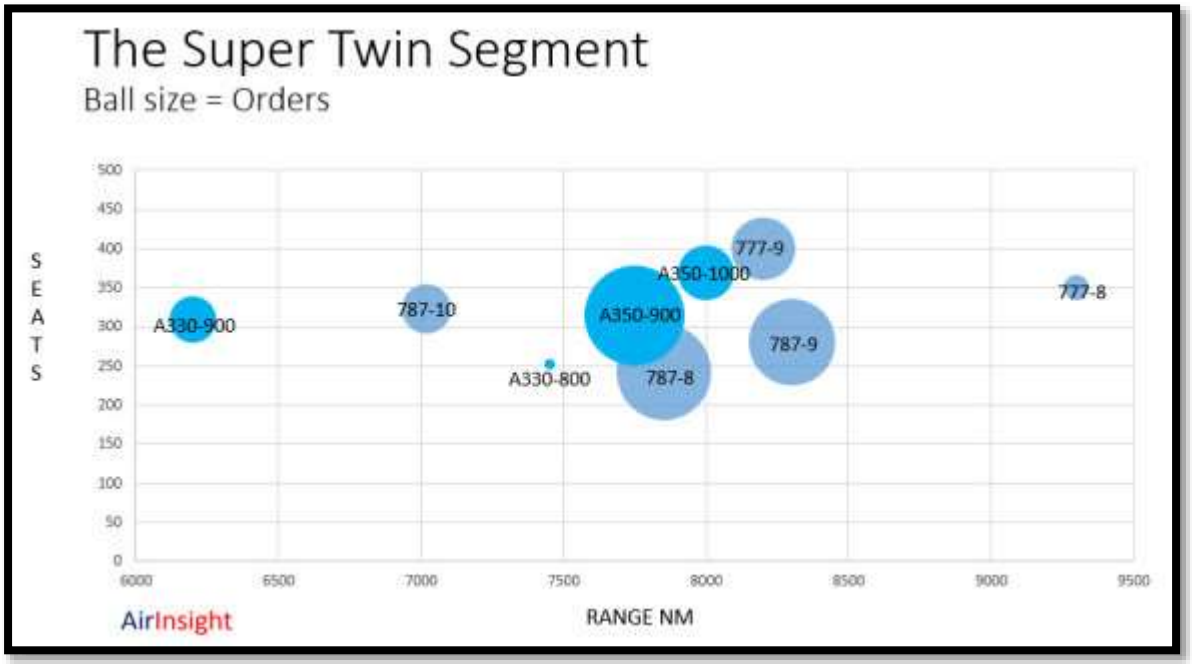
8/5/2014

As the dust settles from Farnborough, the two big OEMs continue to jostle for advantage in the twin-aisle market. For them the show never ends - campaigns continue until the next big event.

We decided to take a look at where the Super Twin market is now. Assembling the data requires some creativity. For example, not all the 777X orders are yet defined by model, and the same applies to some of the A330neo orders. In putting the data together, we have placed the undefined orders with the larger models. The primary reason is because that's where the momentum seems to lie, with a trend towards larger aircraft with better seat-mile economics. We also dropped the A350-800 from the data, as this program is down to 26 orders that Airbus is trying to switch, and essentially now cancelled in favor of the A330-800neo.

Here's what the Super Twin segment looks like today. The size of the balls indicates orders to date. The segment sweet spot is between 7,500-8,500 NM range and around 300-350 seats (averages at 316 seats and 7,785 NM range). The Super Twin segment has 2,117 orders. About 87% of these orders fall into the sweet spot.

The segment has two interesting undercurrent competitions. The first one, now emerging, is between the A330neo (less technology, more mature, much cheaper) against the 787-8 and -10 (more technology, longer range, maturing fast). The second one is the A350 against the 787-9 and 777-9.



Boeing has five models in the race. This provides an advantage because customers like choice. More options in terms of deciding what fits market expectations and plans is attractive. But one of the Boeing options, the 777-8 is clearly the odd man based on orders. This is somewhat a surprise, since the

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aircraft is the same size as today's best-selling 777-300ER. Boeing has three models in the segment sweet spot.

Aircraft Type	Typical Seating	Maximum Range	Program to Date Orders
787-8	242	7,850	490
787-9	280	8,300	409
787-10	323	7,020	132
777-8	350	9,300	35
777-9	400	8,200	220
Total Boeing			1,286
A330-800neo	252	7,450	6
A330-900neo	315	6,200	117
A350-900	315	7,750	539
A350-1000	368	8,000	169
Total Airbus			831

Airbus will continue to quietly transfer A350-800 orders to the A330neo program, as it recently did for Hawaiian and Transaero. The A330-900 is the shortest range of the Super Twins but is right in the sweet spot for capacity. Airbus is likely to garner a lot more sales for this model. The popularity of the A330-300 is the basis of this statement. Moreover, most long haul flights are at under 6,000NM and the aircraft's range fits well inside that. This aircraft is likely to battle mainly against the 787-10. The tradeoff airlines will face here is technology against price. Both OEMs will talk the tradeoff down, but in the end that's where the gap will be. Some airlines will prefer less technology and a mature airplane and others will prefer more technology and extra range.

The A330-800 has a lot of range, probably more than many target customers need. It competes with the 787-8, which has a big order backlog. Likely to sell at 50% of the current price of the 787-8, the A330-800 has the potential to be highly disruptive. The view among senior Airbus management is that this exactly the goal of the A330-800. If an airline needs longer range with about 250 seats, the A330-800 is a compelling option with a relatively low price along with perceived less technology risk. Aircraft with more capacity at a lower capital cost and competitive economics makes the A330neo models potentially disruptive to competing 787s.

The center of the sweet spot pitches the new technology aircraft against each other. We would argue the 777X is really a MAX. Therefore what works for the A330neo also works for the 777X. Also, the 787-9 seems to be headed for great success. Stretches work well, and the 787-9 economics are compelling. Airlines like Air New Zealand need long range with under 300 seats. The 787-10 and 777-8 look to be ideal replacements for the 777-300ER, which is today's benchmark. Airbus' A350-900 is clearly the most popular model of its family. The aircraft has sold well, and enabled Airbus to break into Japan Airlines.

In the sweet spot Boeing's two families have 53% of the market compared to Airbus' one family with 33%. But when looking at specific models, the A350-900 has sold the best in the sweet spot, with 26% of the segment. The 777-9 has outsold the A350-1000, but only by 51 according to our estimate. The

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race between them to replace 747s as they retire will be brutal. An early 747 customer, United Airlines has selected the A350-1000. Lufthansa will be replacing its 747s with the 777-9. The 747 replacement market is flagship territory. This makes every competition very tough. Airbus, of course, also has the A380 available at an even greater seating capacity.

In summary the state of play for now seems close. With arrival of the A330neo, the segment is once again in flux. It is too early to tell how the airlines are going to be won over. The OEMs are rolling out their best product offerings in this segment. Sales are not as prolific as in the single aisle market, so every sale counts even more in this segment. Each victory will be something to be savored.

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Premium #132 - The US Airlines, the Ex-Im Bank and Boeing

8/12/2014

There has been a lot written about the possible defunding of the US Export-Import Bank. Let's start with some history. The Ex-Im Bank has been in business for 80 years. Its primary role is to help US exports and thereby create or protect jobs. The bank is proud to say that in 2013, 90% of its transactions were for small business. Clearly the controversy around the possible defunding of the bank is not driven by problems with small business. The problem is big business, specifically Boeing. Some perceive the EX-IM Bank as "corporate welfare" for Boeing in the politically charged atmosphere in DC.

For a useful summary of the role the EX-Im Bank plays in the US economy, and aerospace in particular, John Lewis Managing Director of Bank of America produced this article.

The Ex-Im Bank numbers are big. In 2013 the bank authorized $27.3Bn to support $37.4Bn in U.S. exports worldwide. This was done through 3,842 transactions. But when looking at these transactions, the bank's efforts are focused in certain sectors.

The chart to the right illustrates where the bank did business last year. It appears that manufacturers eked out a slim lead over the aerospace sector for the first time in 15 years.

In addition take a look here, to see information about long term loans and guarantees. Of the deals listed, 34 are tied to Boeing.

It gets better. The table below lists the guarantees Boeing's customers were able to secure. The table shows the deals from 2013 and Boeing is involved with 62.8% of them, but for a total of 72% of the dollar value.

The bank proudly reports for 2013 "*$7.9 BILLION in financing to support the export of 106 U.S.-manufactured commercial aircraft to a total of 21 airlines and eight aircraft-leasing companies in 24 different countries, including support for aircraft exports to Russia, Kazakhstan, Poland and Slovakia*."

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Country	Guarantees	Value	Boeing	Value	Percent
Australia	1	$284,114,107	1	$284,114,107	100%
Brazil	5	$175,186,003	1	$32,787,000	19%
Canada	1	$190,488,570	1	$190,488,570	100%
Chile	1	$311,241,112	1	$311,241,112	100%
China	3	$613,931,497	1	$558,350,949	91%
Ethiopia	1	$124,604,901	1	$124,604,901	100%
Indonesia	1	$1,125,757,956	1	$1,125,757,956	100%
Ireland	2	$335,293,381	1	$147,899,381	44%
Israel	3	$235,062,320	2	$184,219,800	78%
Kazakhstan	1	$226,778,638	1	$226,778,638	100%
S Korea	2	$625,045,000	2	$625,045,000	100%
Kuwait	1	$323,382,500	1	$323,382,500	100%
Luxembourg	3	$463,386,699	3	$463,386,699	100%
Mexico	7	$1,769,463,594	1	$117,395,421	7%
Morocco	1	$93,267,887	1	$93,267,887	100%
Norway	2	$245,521,395	2	$245,521,395	100%
Philippines	1	$299,680,197	1	$299,680,197	100%
Poland	1	$479,234,469	1	$479,234,469	100%
Russia	3	$581,710,854	1	$469,934,008	81%
Singapore	2	$561,728,974	1	$99,450,000	18%
South Africa	2	$144,862,684	1	$36,836,854	25%
Turkey	1	$169,873,174	1	$169,873,174	100%
UAE	3	$900,631,581	2	$593,373,581	66%
Misc.	3	$620,817,540	3	$620,817,540	100%
	51	$10,901,065,033	32	$7,823,441,139	72%

The bank states in its 2013 Management Analysis Discussion that "*Ex-Im Bank supports U.S. exports by providing export financing through its loan, guarantee, and insurance programs in cases where the private sector is unable or unwilling to provide financing or where such support is necessary to level the playing field due to financing provided by foreign governments to their exporters that are in competition for export sales with U.S.exporters*." From what we can see here, the bank is doing its job and doing it well. The bank proudly points out that it generated $2 billion more than the cost of its operations. Moreover the Ex-Im Bank competes with 60 other credit agencies based in overseas countries.

So why is there this issue of defunding or re-authorization of this bank?

The most vocal opponent to the bank's activities in the aerospace arena is Delta Air Lines. Their position is pretty clearly stated: "*Delta's concerns are specific to the Bank's continued financing at better-than-market rates of widebody aircraft to airlines that are creditworthy or receive subsidies from their home country*."

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Delta provides this example. From this example one can see that the Ex-Im Bank's deal is attractive for Emirates.

EX-IM SUBSIDIES BENEFIT FOREIGN CARRIERS; HARM U.S. AIRLINES

In 2012, Emirates conducted both Ex-Im-backed and market-based (EETC) financings. The benefits of using Ex-Im support are highlighted in the chart below.

	Emirates Ex-Im Financing (June 2012)	Emirates Market Financing* (June 2012)
Type and Number	2 Boeing 777s	4 Airbus A380s
Coupon	2.00%[1]	5.48%[2]
Loan-to-Value	80%[3]	66%
Loan-to-Value Price Adjustment	0%	.69%[4]
Annualized Ex-Im Fees	1.41%[5]	0%
Total Annual Rate	3.41%	6.17%

EMIRATES WILL SEE SAVINGS OF $20.3M PER PLANE BY USING EX-IM AT THESE RATES.

*EETC through a lessor to fund four A380 aircraft. See Emirates's May 8, 2014 earnings release.

1. 2.00% is actual rate from 6/18/12 Ex-Im bond. Average life was 6.12 years, similar to the EETC of 5.7. In July 2012 Emirates issued another Ex-Im bond at 1.55% coupon, but with a shorter average life of 4.93 years (which based on yield curve would be expected to be lower rate).
2. 5.48% is blended average coupon of the A/B tranches as priced on 6/21/12. The issuer of the EETC was "Doric Nimrod Air Finance Alpha" but the credit was Emirates's. Avg. life 5.7 years.
3. Assumes 80% LTV, maximum allowed for a Risk Category 1 credit.
4. The adjustment to the total annual rate to reflect the loan-to-value ratio is an estimate derived from a regression analysis (using information about other public transactions) of the rate that would have been required to obtain market financing with an 80% ratio.
5. 141 bps is average quarterly MPR for Risk Category 1 credit from the beginning of the 2011 ASU up to and including the July 2012 quarter.

Delta's CEO made a speech (video) in Washington DC in late June that explains his position with the context of the US airline industry's history. The airline is not alone in this stand. ALPA, the pilot union, also does not like the bank's help for foreign competitor airlines. Here is a letter written by ALPA (Moak) to Congress.

Seeking comment from the other two big US airlines with international service, we got this from American: "*American doesn't care to comment. For additional perspective, I recommend reaching out to Airlines for America (http://www.airlines.org)*." As of this writing, United has not responded with any comment. Bear in mind American has been focused on its merger with US Airways post Chapter 11 and United is digesting its own merger. For both airlines the Ex-Im Bank fracas has been conveniently handled by Delta.

Recently the bank came under a cloud regarding an allegation of fraud.

Feeling are running high. The bank's re-authorization is coming up in September. The hard opposition may be softening. Perhaps it is no accident that Boeing announced it will build the 787-10 in Charleston.

Meanwhile Boeing's view on re-authorization was summed up this way. "*Boeing is a firm supporter of Ex-Im re-authorization. The bank provides loan guarantees to airlines that need them to line up commercial loans. If those guarantees are no longer available from Ex-Im, some of our customers may*

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have no choice but to purchase airplanes from Airbus rather than from Boeing. Airbus has the support of three export credit agencies, in France, Germany and the UK, so this is a significant competitive issue for us.

That will especially be true during periods of tight credit, when many airlines require government guarantees to secure a loan. Even when credit is readily available, as is the case now, there still are airlines that need a government guarantee to get a loan, such as those in developing regions. Boeing finances some purchases but there are limits to how much of that we can do. The more money we put in reserve for airline loans, the less we have to invest in new technologies and products. Without Ex-Im we will be at risk of losing sales and market share, initially to Airbus and eventually to emerging competitors in China, Canada and other nations. There are 60 countries that have export credit agencies, including all of the world's major exporting nations. "

Then we were sent a more lengthy note from Boeing: "First, there is no credible information supporting Delta's claim that Ex-Im financing is putting them at a competitive disadvantage. U.S. airlines are getting the lowest-cost financing available through the U.S. bond market, specifically by issuing enhanced equipment trust certificates that are backed by the underlying asset – the airplane. Foreign carriers utilizing Ex-Im, moreover, are paying more for USG credit guarantees than ever before. That is because of the agreement reached in 2011 through the OECD that doubled the cost of government export credit. The goal was to bring the all-in cost of financing with government export credit guarantees in line with pure commercial financing, and all of the data we've seen since then indicates that the goal has been achieved. It is as costly, and in many cases more costly, for airlines to finance airplane purchases using government export credit. I've attached some charts that illustrate these points.

Second, there are 60 countries that have export credit agencies, including all of the countries where commercial airplanes are produced. Airbus has the support of three export credit agencies (in France, Germany and the UK). So even if one were to believe Delta's claim that export credit disadvantages US airlines, then eliminating Ex-Im support for Boeing airplane exports would not address their concern. Customers who need export credit guarantees to secure commercial loans would simply buy from Airbus, and in the future from COMAC and others. Delta claims that Airbus would "give up" export credit support for its customers if Boeing did the same, but there's been no indication that they would do so. What we've seen in the market this past year is Airbus whispering to customers that they should buy from them rather than Boeing because Ex-Im may not be there in the future to help finance their purchases. Airbus clearly would use the demise of Ex-Im support for Boeing sales to their own competitive advantage, just as they have done with launch aid and the other illegal subsidies they have gotten from European governments from their inception.

Third, we have not put out any numbers on potential lost sales or market share if Ex-Im goes away or is restricted from financing airplane sales. Credit markets are very dynamic, and therefore the need for government loan guarantees is dynamic too. Right now, credit is readily available, and that fact, combined with the higher cost of government export credit, means that fewer airlines are choosing to go that route. When credit tightens, however, many more airlines find they need a government loan guarantee to financing their purchases. In the wake of the global financial crisis, for example, both Boeing and Airbus saw about 30% of their deliveries financed with government export credit. So this is a serious competitive issue for us. If we lose Ex-Im support for our customers, we risk losing both sales and market share, and it is not just Boeing that is affected. Last year we cut checks totaling $48 billion to 15,600 other U.S. companies that support our business. When Ex-Im supports Boeing, therefore, it

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supports a while sector of the US economy – and one of the few sectors with a positive balance of trade. Commercial airplanes are America's number one manufactured export. How many jobs would be lost if Ex-Im goes away? I can't be precise about that, but it would be significant. Delta employment, meanwhile, is on the rise. As you know, it is one of the world's biggest airlines, and it is making very good profits. It is hard to see where it is getting hurt by export credit financing.

Fourth, while Delta says United and American support its position on Ex-Im, it is only Delta that is active on the issue and speaking out about it publicly. Neither AA nor UAL are lobbying the issue on the Hill, which certainly would be the case if this were truly an issue that put US airlines at a competitive disadvantage.

Fifth, Boeing has not been countering US airline complaints about competitive disadvantage on international routes (other than DL's specific claims about Ex-Im). We support open skies, but as I'm sure you know, so do the US airlines, at least in concept. The main issues I've heard them raise relate to government ownership of airlines and various freedoms negotiated as part of Open Skies. We have not taken a position on government ownership, and while we are a champion of open skies, we recognize that issues can arise in international agreements that may need to be addressed through further negotiation. We certainly agree that there should be a level playing field, which is why any changes in export credit rates and practices MUST be governed by international agreement. "

So Delta claims better than market rates and Boeing says this not the case. Boeing offered the following table as evidence. Based on these numbers it appears the US carriers have not suffered any high capital costs for equipment.

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All recent capital market deals by U.S. airlines have been cheaper than government export credit

	Date	Aircraft	Cheaper than export credit?	Total savings
Continental Airlines	March 2012	New 737-900ER & 787-8	✓	$89.5 million
U.S. Airways	April 2012	New & used A321	✓	$4.9 million
Delta Air Lines	June 2012	Used A319, A320, 757 & 767	✓	$57.5 million
Continental Airlines	October 2012	New 737-900ER & 787-8	✓	$89.2 million
U.S. Airways	November 2012	New A321 & A330-200	✓	$40.9 million
U.S. Airways	April 2013	New A321 & A330-200	✓	$97.5 million
Hawaiian Airlines	May 2013	New A330-200	✓	$50.0 million
United Airlines	August 2013	New 737-900ER & 787-8	✓	$150.6 million
United Airlines	March 2014	New 737-900ER, 787-8, 787-9, & EMB-175	✓	$132 million

Sources: Airlines' SEC filings; Boeing Capital analysis

The story is more complex though. The charts provided by Delta above and the Boeing chart on financing tell quite a different story. Delta points out that the Ex-Im financing seems to generally be given to airlines with good credit or airlines with sovereign ownership, where the chances of a default are low.

Goldman Sachs recently had this to say about the Ex-Im bank's business in aerospace: "...*US Ex-Im, in our view, is not quite the risk it appears to be in news headlines. Sources of capital are diverse in geography, type, and the lenders/investors offering capital (including global banks, the capital markets, business development corporations, pension and hedge funds, and an ever growing leasing community)*."

Delta also wrote an interesting letter (AFN Chairman Hensarling ExIm 080614) to Congress.

Another insightful chart put out by Goldman Sachs points to the breadth of financing Boeing's sales utilize. Note the decline in Export credits, which supports the lack of concern about Ex-Im impact. However also note that OEM financing is zero, and even with markets filling in the gaps any Ex-Im bank absence creates, will likely also drag Boeing back into the financing business. No wonder Boeing wants the Ex-Im bank to stay in business.

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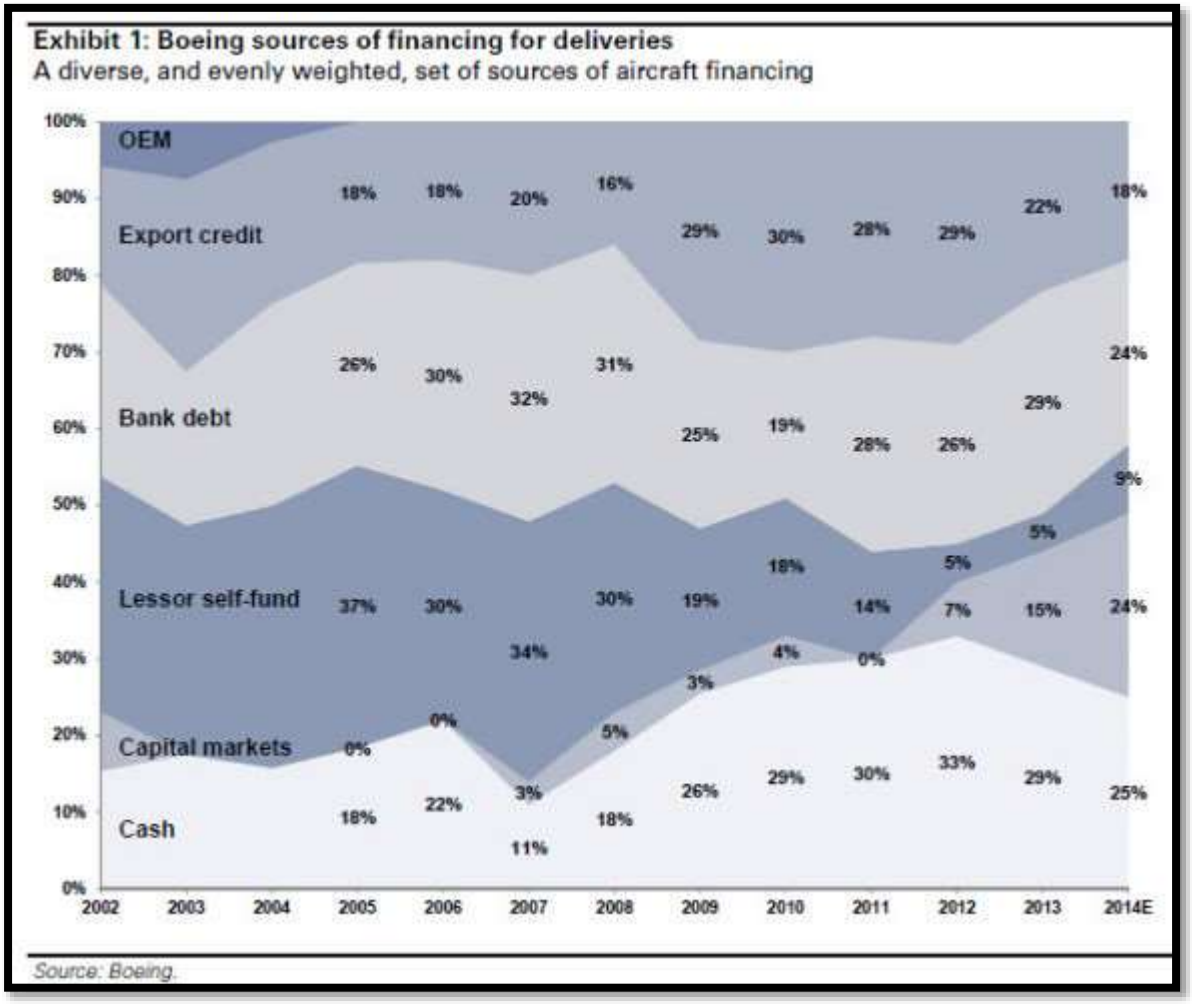

One can go back and forth on the matter, without end. What seems clear is that non-US airlines do seek Ex-Im bank financing. Logic says this has to be because it offers real benefits. Undoubtedly these benefits include lower costs. Bear in mind that when an airline places an order, financing is not being dealt with. Typically an airline has to arrange finance 18-24 months before delivery. With many of today's deliveries years out, financing is not under pressure for many orders.

If we come down on a side, it would be that governments should not be picking winners and losers. Government interventions in markets almost always causes distortions and is less efficient than free markets. And this being where we find our sympathies, we also believe that all governments need to exit the export credit business. It is likely not the best use of tax payers money. The problem is of course, once a government creates an agency, it is almost impossible to close. Throw in the fact that getting other nations to close their own export credit support and you can see where is likely to end up.

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Premium #133 - Can Etihad Really Turn Around Alitalia?

8/19/2014

Last week, the long-negotiated agreement for Abu Dhabi based Etihad Airlines to purchase a 49% minority stake in Italy's beleaguered Alitalia airlines was finalized. The transaction includes several elements:

- €387.5M in cash for 49% of Alitalia
- €112.5M for a 75% interest in Alitalia's frequent flyer program
- €60M for 5 pairs of slots at London Heathrow airport
- €300M authorized capital increase from current investors
- €300M in new loans
- €598M in debt restructuring of existing short-to-medium loans

In total, the package is worth €1.8 billion, or about $2.4 billion US.

This should help provide the carrier with stability during a restructuring that will attempt to bring Alitalia back to prosperity. As James Hogan, Etihad's CEO noted at the press conference, "there is no quick fix."

Alitalia has lost upwards of €1.1 billion since its reorganization in 2009. Etihad is forecasting a €100 million operating profit by the end of 2017. Is it an overly optimistic outlook? Many believe so. Alitalia is currently inefficient, with an over-reliance on short-haul flights, lacking the draw for premium business traffic in comparison to other carriers for long-haul service. While Etihad can help change that over the next five years, it can't take place quickly.

One cartoonist summarized the skepticism in the market, with the thesis that Alitalia will negatively taint Etihad.

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While we don't believe either supposition represented to be the case, Alitalia's reputation has slipped in recent years from what it once was. Nonetheless, it remains an iconic brand, and with the help of Etihad could recover in areas such as customer service and image. At the announcement, Etihad's CEO James Hogan indicated that the Alitalia brand should convey Italy's reputation for food, fashion, luxury, culture, history, creativity, innovation, and that "the sexiest airline in Europe should be Alitalia."

Rebranding is scheduled to begin in the first quarter of 2015. It is expected that, like with Air Berlin, Etihad may purchase, and lease-back seats to Alitalia to reduce the investment for a product upgrade.

The Strategy

The key element will be labor. Fortunately, accords were reached with the major unions that include job cuts as an element of the agreement. It is clear that staff cuts and productivity gains will be needed, and the attitude that Alitalia, as a flag carrier, could never disappear, has to change. LCCs have made major inroads in Italy. Alitalia employees have seen examples such as Malev and Olympic folding because of low fare competition, and these examples are helping to change attitudes that Alitalia is not invincible. Alitalia is better off today than it was in 2009, but has a way to go. If Etihad can turn its projected 2017 profitability by 2019, it will still have accomplished a major turnaround.

The new strategy for Alitalia is a renewed focus on long-haul, eliminating some unprofitable short-haul flights. The new business plan calls for Alitalia to grow its wide-body fleet by 32% from 22 to 29 aircraft, and to shrink its narrow-body fleet from 90 to 78 aircraft. Alitalia's current fleet is comprised of the following:

Alitalia Fleet	As of 15 August 2014		
Aircraft Type	***Number in Service***	***In Storage***	***Total***
Airbus A319	22	0	22
Airbus A320	47	1	48
Airbus A321	21	0	21
Airbus A330-200	12	0	12
Boeing 767-300ER	0	1	1
Boeing 777-200ER	10	0	10
McDonnell-Douglas MD82	0	14	14
TOTAL	**112**	**16**	**128**

Alitalia currently has no aircraft on order, so growth in the wide body fleet will likely come from existing Etihad orders. Etihad placed orders for 50 Airbus A350s, 71 Boeing 787s, and 25 Boeing 777X s last fall, and can supply Alitalia with new aircraft from its order book. Etihad plans to take delivery of 14 wide-bodies in 2014, and 9 in the first half of 2015.

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While plans for new routes have yet to be been announced, an increased focus on northern Italy is likely. Alitalia trails Ryanair, Meridiana, Lufthansa, and British Airways in the number of seats offered at Bologna, trails easyJet, Emirates, Meridiana, and Lufthansa at Milan Malpensa, and trails easyJet, Volotea, Air One, Air France, and Lufthansa in Venice.

Clearly, low cost carriers have had an impact domestically, and Alitalia will scale back routes in which it cannot effectively compete with commodity service, or high speed rail. But the opportunity for additional international operations certainly makes sense for Alitalia, particularly from Milan's Malpensa, a major business center. Alitalia has routes to the US that Etihad currently does not have rights to. As a result, expansion in Milan, and potentially Venice, may make sense. Alitalia also has a small footprint in Asia. Whether additional non-stop service makes sense, or service connecting via Abu Dhabi, opportunities for growth exist.

We expect Alitalia to offer additional flights to Abu Dhabi from Italy, which should bring the Etihad/Alitalia combination close to Emirates current frequencies in the Italy-Gulf market, and double that of Qatar. This should help both Etihad and Alitalia via connecting traffic.

Running the Show

Despite an ownership of only 49%, Etihad tends to run the show at the airlines it invests in. With Alitalia, Etihad has investments in eight airline partnerships:

Alitalia will remain in the SkyTeam alliance, and will continue to have close relations with Air France and KLM. Delta has complained about unfair competition from Gulf Carriers (see our ExIm bank story from last week), so it remains to be seen whether relations with Delta will cool. With AirBerlin also in the Etihad alliance being a member of the oneworld alliance, Alitalia could also code-share with its own and rival alliances.

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In many of airline investments, Etihad has placed key executives in senior management positions, and is, in effect, running the show. Will the same thing happen at Alitalia, and has Gabriele Del Torchio just eliminated his own job as CEO? This remains to be seen, but is a possibility as Alitalia joins the Etihad equity alliance.

Can Etihad do what no one has been able to accomplish - bring Alitalia into profitability? It will take a massive investment in both talent and money to do so, and this represents the largest challenge for Etihad's alliance to date. Despite all odds, there is a chance that it could work, and bring "sexiness" back to Italian skies. Time will tell.

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Premium #134 - Was the A380 introduced ten years before its time?

8/26/2014

The A380 has recently been in the news, with the question being asked of whether it will become profitable and gain additional sales in today's airline environment. Our view of the aircraft is that it was introduced a decade before the market was ready for it, and may yet come into its own during the coming decade.

There are several trends that will influence the market for the A380, some positive for the aircraft, and some negative:

- *Traffic growth is continuing at a strong pace.* Boeing's Commercial Market Outlook (2014-2033) forecasts global traffic growth of 5% per year, meaning traffic would double every 15 years. Airbus agrees that traffic doubles every 15 years, and notes that traffic has risen 67% since 9/11 and SARS.

- *Airport capacity has not grown at the same rate as air travel.* While we've seen new airports open in the UAE and China, many airports in key business centers remain congested and slot controlled. London Heathrow is the poster child for such an airport. Take-off and landing slot pairs at LHR routinely trade for $10-30 million, depending on time of day. While newer airports have opened in Dubai, Doha, Abu Dhabi, Inchon, Beijing Daxing and Bao'an serving Shenzen and Hong Kong, older airports in the west are playing catch-up with traffic growth, primarily with new terminals and expansion projects. But growth in runway capacity, the most constraining airport element, is inadequate apart from the all-new airports. Even in developing countries, like India, it is difficult to obtain the land for a new airport.

- *Route dispersion and the use of smaller wide-body aircraft have increased non-stop options for travelers.* This enables travelers to avoid the hub cities for connecting flights between secondary cities. However, small cities lack the volume for dedicated international travel, so connections will still be required, either through a small hub or a major hub. Moreover as Airbus points out, there are currently 42 cities with 10,000 long haul passengers per day now, and this will grow to 90 by 2032. For hub-to-hub traffic, the VLA is efficient in terms of slot constraint and cost per seat mile. Bear in mind that traffic between the mega cities accounts for over 90% of long haul traffic.

- *Capacity is being constrained by risk averse airlines.* Airlines, particularly in the United States, have discovered that constraining capacity increases yields and profitability, leading to some CEOs belief that very large aircraft are economical. Boeing's Current Market Outlook projects a near doubling of the commercial airplane fleet by 2032. This requires many constrained airports to increase capacity. Therefore among the US airlines in particular, the policy of capacity constraint almost guarantees they will not benefit from traffic growth since they lack the capacity. Load factors are routinely over 85% on US carriers. In addition airlines like Delta are retiring older 747-400s prior to their next big MRO visit. The airline is drawing down service to Asia out of Detroit but growing it out of Seattle where it's smaller A330s and 767s can reach

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Asian cities. It appears this is a Band Aid solution to optimize Delta's current fleet and does not provide the airline with capacity for traffic growth.

- *Twin-engine aircraft are replacing four engine aircraft; engine maintenance is a key element of cost.* Of course, the ratio of cost isn't one-to-one because the engines on a twin tend to be larger, and more expensive to maintain on a per engine basis. But the next generation of Super Twins certainly seems to have caught on with airlines and have large order backlogs. Even so, Super Twins do not have the carrying capacity of a VLA. Which means for intra mega-city markets, airlines must buy more Super Twins than they would VLAs. Two Super Twins costs more to buy and operate than one VLA. Consequently replacing VLAs with Super Twins is not the optimal solution in every case. The tradeoffs are complex.

- *The average aircraft size is going up in the narrow-body market, and down in the wide-body market, as 747s are retired and 787s enter service.* The VLA market, once ubiquitous as fleet flagships, has become a niche market. Boeing notes that in 2012, the single-aisle category comprised 64% of the worlds' fleet and will reach 70% by 2032. Boeing also foresees a modest increase in the average size of airplanes in operation. Airlines are replacing small regional jets with larger regional jets. In the wide body segment Boeing states 91% of orders are for small and medium sized aircraft. Of course Boeing is focused on the 777-9 as a 747 replacement and therefore chooses to shrink its VLA forecast. Airbus, with the A380, sees a much brighter future with 1,711 needed by 2032. We believe the truth lies somewhere between these two visions.

If the A380 serves a niche market, how much potential does that niche have? Several issues impact that potential:

<u>Is a four engine aircraft economically competitive?</u> The answer is yes, particularly for routes that have adequate traffic to utilize a VLA. Clearly, the A380 won't be economical if an airline can't fill it. But in certain markets, with strong demand and operational constraints, it could be a natural fit. Next time you are at London Heathrow in the morning, take a look at the number of A380s arriving.

Emirates is the case study for building routes with smaller aircraft, and sustaining them when mature with the A380, capitalizing on the aircraft's growing passenger preference. Manchester-Dubai is prime example of their route development strategy. The route began with an A330, graduated to a 777, and then an A380, which has been profitable, with strong load factors for Emirates.

BA is utilizing the A380 to consolidate flights and create slots for market expansion at LHR. Their consolidation of three 747-400 flights between LHR and LAX into two A380s is an example of how the economics of the A380 can be leveraged in high capacity markets into slot constrained airports. BA now offers the same number of seats between LHR and LAX at 19% lower cost. On a mega city to mega city basis, the VLA is tough to beat.

<u>As slot constrained airports become even more congested, will the VLA emerge as the logical answer?</u> We believe the answer is yes.

The A380, for example, has several advantages. First, passenger preference for the aircraft is high - airlines operating it report that it is preferred over other aircraft. For high traffic markets, it is the most economical solution, as one can replace two smaller aircraft with one A380 and reduce costs for a given

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revenue base. For high-density airports like LHR, the VLAs are the obvious low cost solution to growing congestion. Moreover, many airlines remain sensitive to the concept of a "flagship" aircraft and a VLA fulfills this better than any other aircraft. Nothing says your airline is a major player than a VLA.

But the VLA also has disadvantages. Newer Super Twins (A350XWB & 777X) offer competitive seat-mile economics to VLAs with lower capacity - meaning lower risk. It can be difficult to fill a VLA to profitable load factors consistently in seasonal markets. In addition, VLAs are a major capital expense. VLAs have four engines rather than two, and managing a small sub-fleet is difficult. Even with these challenges, Emirates shows that airlines using VLAs can consistently overcome these issues and remain profitable. In terms of overall cost per passenger, VLAs are compelling when full.

Timing is everything.

The A380 was delayed, and introduced in the midst of a global recession. It had an early engine issue with a well-publicized Rolls-Royce engine failure. That was followed by a problem with cracking in the wing rib attachment brackets, requiring additional maintenance. The A380 did not have a smooth market introduction.

Were the A380 to be introduced today, it might be hailed as the answer to the growing congestion problem, particularly if it had the latest engine technology, which would provide additional economic advantages over competing aircraft. Moreover Airbus had to introduce the A380 when it did, in order to forestall Boeing's 747 driven profitability. Had Airbus had a smooth A380 introduction there might be many more in service and the VLA segment would be larger than it is now. The stumbling entry into service for the A380 in no way reflects on the reality that a VLA could be profitable for many airlines.

Airbus just completed a successful re-launch of the A330 with new technology engines. A potential A380neo may make sense for the market, and the time for this aircraft may be around the 2020-2021 timeframe.

Do we expect thousands of A380s to be sold? Of course not, as the VLA market has become a niche. But demand for the aircraft should pick-up, as alternative solutions to traffic congestion won't come fast enough for the airports that are currently, or are becoming, slot controlled. The A380 may come into its own a decade after its entry into service.

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Premium #135 - The Norwegian Air International Debate

9/9/2014

This week, the US Secretary of Transportation rejected a request from Norwegian Air International (NAI) to be granted expedited approval to begin scheduled flights to the United States on an expedited basis. The dismissal order can be seen here. NAI is a subsidiary of Norwegian Air Shuttle, the European discount carrier, which is among the first low cost carriers to undertake transatlantic operations. According to Politico, "several aviation insiders with knowledge of the situation have said that DOT won't rule on Norwegian's desired foreign air carrier permit until after the elections."

This decision is clearly political, with more than 100 members of the House of Representatives and 40 members of the US Senate sending letters against the application to DOT, and the House even passing an amendment to an appropriate bill to block the airline from serving the US. As those of us in the US already know, politicians in Washington, with an approval rating in the teens, appear quite easily bought and sold, especially during an election year.

Norwegian stated that it was disappointed in the ruling, but still expected to ultimately win approval, indicating that the DOT has already had six months to examine the application. NAI believes that opposition stems from protectionism for the major airlines, and indicated that tickets on its existing operations are often more than $100 cheaper than its closest competitors

Norwegian Air already operates flights to the US using new Boeing 787s and offering low fares from New York, Orlando, Ft. Lauderdale, Los Angeles and San Francisco to Europe. Their service launched last May between the US and Scandinavia with fares as low as $99 each way. That's a really cheap transatlantic fare. But the 787 is an efficient, state of the art airplane.

The crux of the matter is location, and the ability to utilize "open skies" traffic rights to fly to destinations without the need for a bi-lateral route award. Norway is not a member of the EU, so Norwegian Air opened a new subsidiary in Ireland, Norwegian Air International, to fly transatlantic while enjoying the benefits of Irish incorporation, which gains them EU traffic rights. In addition, Ireland has fully adopted the Cape Town Convention, which provides better aircraft financing conditions, and is the reason Ireland is the home to many large aircraft leasing firms. Norwegian indicates that it examined the UK and other EU countries before deciding upon Ireland. Ireland is also the home to low cost carrier Ryanair for similar reasons, as it is the best place to finance aircraft. Their subsidiary is legally registered as an Irish-based airline, but with majority Norwegian ownership. That technicality is at the root of this dispute.

The authority for NAI to operate into the US has been opposed by both the incumbent US carriers and their labor unions, which argue that Norwegian can hire Asian crew members at lower cost than in Ireland. Norwegian counters that they offer competitive wages and follow all applicable local labor laws for every country in which they operate, and could hire Asian and American crew members from any

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country. They already employ more than 300 American cabin crew members, and received over 6,000 applications for 300 advertised positions. Norwegian claims that their wages and benefits are superior to those offered by US airlines, which post-bankruptcies and forced wage reductions for US carrier employees, is likely true.

The application was to expedite the approval process for NAI, a carrier based in Ireland with Norwegian ownership, to begin service. The carrier requested the ability to conduct scheduled and charter transportation of persons, property and mail under the US-EU-Norway-Iceland Air Transport Agreement of 2011, as amended, as is normally granted to other EU carriers. Our view is that like any other carrier operating from those countries, permission should be granted, as it normally is, for expedited introduction into service. The Open Skies arrangement applies to Norway and Iceland as well as the EU, but flights from the EUROPE to most destinations in South America, Africa and Asia can currently only be operated by an EU-based carrier. The subsidiary in Ireland provides that basis.

This is similar to the opposition that Virgin America faced before it could start service in the United States, with claims that it was under the control of Sir Richard Branson, despite Virgin Group only holding a minority share. While that was settled, after complaints from US airlines not wanting additional competition, it took more time than it should have. We have a similar situation here.

A number of parties objected to NAI's application, including Delta, United, American, USAirways, Lufthansa, SAS, Air France, KLM, and Austrian Airlines. All of these airlines have existing transatlantic operations and the international carriers have code-sharing agreements with the big three US carriers as well. Labor unions also opposed the application, including ALPA, APA, SWAPA, TTD of AFL-CIO, AFA, IAM and TWU domestically, and the European Cockpit Association (ECA), European Transport Federation (ETF) and Norway's Parat trade union.

Supporting the application were FedEx, Atlas Air, the Travel Technology Association, the European Low Fare Airlines Association, the Washington Airports Task Force, the American Society of Travel Agents, the Broward County Aviation Department and Ft. Lauderdale Airport, and the Greater Orlando Airport Authority.

It is somewhat surprising to us that labor unions opposed this effort, since a majority of Norwegian's staff in Scandinavia, including pilots, cabin crew, technicians, and administrative staff, are union members. We would expect, as with most airlines, that union organizers would penetrate any new crew bases or opportunities in Ireland rather quickly, and likely be successful given union presence in other parts of the organization.

So why is everyone afraid of additional transatlantic competition from a low fare carrier? Norwegian asks "Why should a flight between New York and Europe cost three times as much as a flight between New York and Los Angeles? The flight to Europe is only about an hour longer, sometimes even less."

Ryanair and Southwest encountered resistance from the established carriers when they began low fare service. By introducing low fares transatlantic, Norwegian is pushing the frontier to long-haul international low fare service, thereby threatening the ability for incumbent carriers to continue to generate their current yields.

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Norwegian has chosen the Boeing 787 for these routes, which creates jobs in the United States in addition to planned hiring of additional crews at their US bases. From a consumer standpoint, we applaud their efforts.

Innovation must often overcome inertia and entrenched interests to move forward. We believe Norwegian has an innovative idea, has legally established an Irish-based subsidiary, and should be allowed to fly under the open-skies bilateral between the US and Europe.

Politicians have larger issues to focus on than whether a small European low cost carrier should be allowed to fly to the United States because it found a loophole that regulators hadn't considered in the agreement between the US and EU. A few daily flights by a European LCC, on new US built aircraft, won't change the face of the industry overnight; and isn't competition and capitalism the hallmark of the United States? Between an economy that is growing too slowly and ill-considered foreign policies, there are bigger fish to fry. In our opinion, the do-nothing Congress, which controls the purse strings, has once again intimidated the DOT and its Secretary, Anthony R. Foxx, from doing his job. This is sad for American consumers, and stifles innovation that could create increased demand, increased tourism, increased trade, and the benefits they bring.

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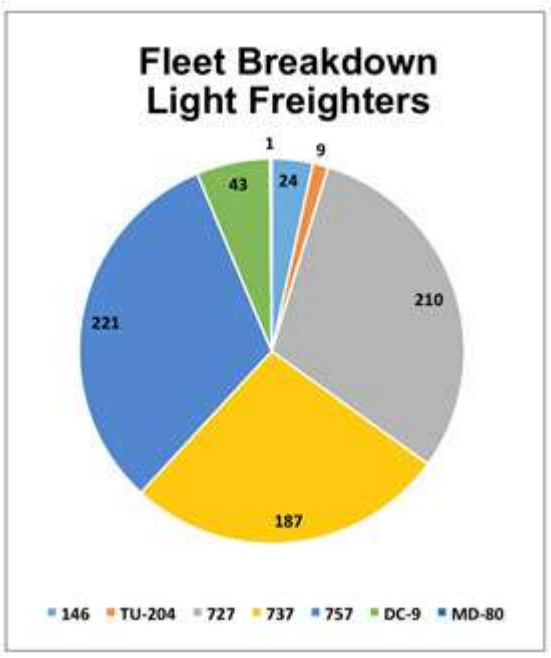
Premium #137: Will Airbus Join the Narrow-Body Passenger to Freight Conversion Market?

9/16/2014

While the airfreight industry and the market for large freighters has been in a recession over the last few years, a bright spot for the air cargo sector has been the surge in order for passenger to freight (P2F) conversions for narrow-body aircraft, in particular the Boeing 737 Classics. We expect nearly 50 conversions to be delivered this year, a level not seen since FedEx converted a large fleet of Boeing 727s two decades ago. The P2F conversion market is currently in an upswing, the opposite of the moribund market for long-haul freight.

Today, the narrow-body freighter market is dominated by Boeing products, including the 727, 737 Classics and the 757. 737 Classics are being converted to replace aging 727s in the cargo fleet. The following chart shows the fleet breakdown of light freighters at year-end 2013. With the exception of a few BAe 146 and Russian-built aircraft, the light freighter market is virtually all Boeing. There is currently no P2F conversion program for the A320 family with a certified STC.



Conversions for the Boeing 737 Classic

Three cargo converters perform P2F conversions on the Boeing 737 Classic.

- PEMCO is the market share leader among 737 Classic converters, and has a backlog of 40 orders through 2015. PEMCO also converts the Boeing 757-200 into freighters.

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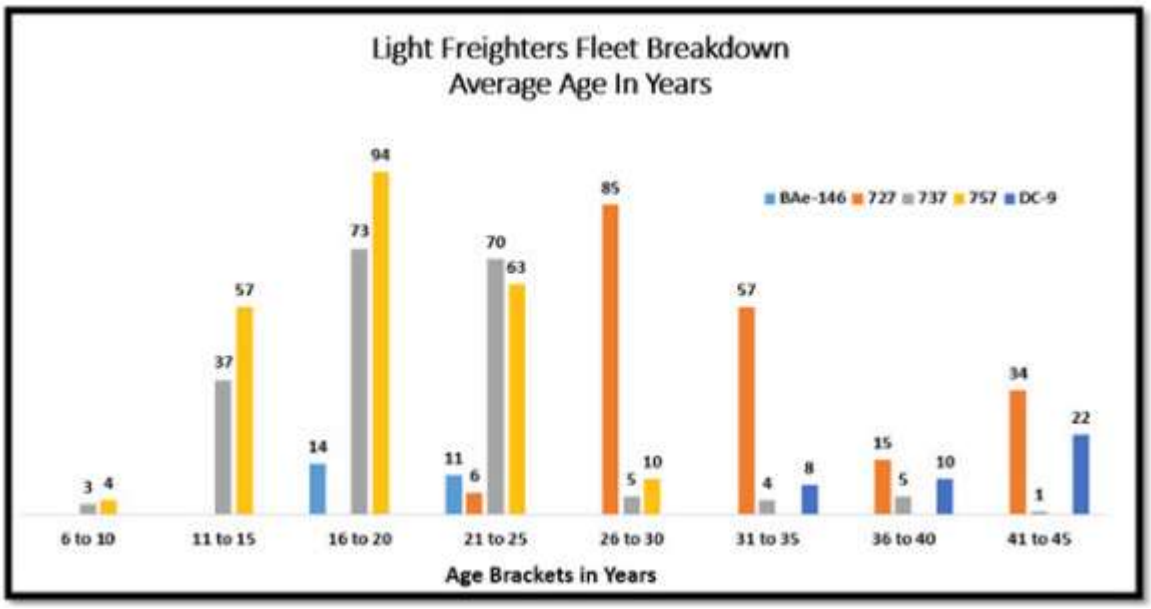
- Aeronautical Engineers Inc. (AEI) offers cargo conversion programs for the 737-300, 737-400, MD-80, and has announced the first conversion program for the 737-800NG, to be available in beginning in 2017.
- Israeli Aircraft Industries-Bedek Division (IAI-Bedek) has been converting Boeing aircraft from passenger to freight since the 707, and currently converts 737-300, 737-400, 767-200, 767-300, and 747-400 models. Their conversions have logged more than 2 million flight hours.

Conversions for the Boeing 757

The Boeing 757 is also converted by three major players.

- PEMCO focuses on combi conversions after acquiring a 757 STC.
- ST Aerospace converts the Boeing 757-200, with a 14.5 pallet capacity, won a major contract with FedEx, converted 5 aircraft in 2013, and has delivered more than 60 conversions.
- Precision Converters has a 15 pallet version of the 757 of and has converted 41 Boeing 757s.

Once a cargo aircraft begins to age beyond 25-30 years, replacement demand increases for that type. Today we are seeing a replacement bubble for 727s, which are predominately over 26 years of age. The following chart illustrates the average age of the light freighter fleet as of year-end 2013. It is notable that within the next 5 years, a significant number of 737 and 757 aircraft in freighter service will reach the age at which replacement often occurs, potentially beginning another replacement cycle.



AEI has already announced a program for the 737-800NG, which could be a replacement for the oldest early 737 models in freighter service. But to date, there is no viable replacement for the 757, nor any competition from Airbus in this space.

We spoke with Airbus and Boeing regarding their perspectives on the market and their respective strategies in the P2F marketplace.

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The Boeing Perspective

Boeing believes that the market between 2014-2033 will be for 960 narrow-body freighters, all through P2F conversions. This is an average of 48 per year, as projected in their 2014 Current Market Outlook. While currently enjoying a unique position, they anticipate that there is room for another competitor in the P2F segment, which will be driven by both market demand and whether their competitor chooses to enter the market.

Currently Boeing has a licensing agreement with third party narrow-body passenger to freight converters for the 737 Classics, 757-200, and MD-80s. "While Boeing currently does not own any STC for narrow body P2F, we are talking with customers and studying the business case for a 737-800 Boeing Converted Freighter. The 737-800 is the first Next-Generation 737 to be studied in detail because of the large quantity of existing feedstock candidates and the airplane's superior payload/range performance relative to the other Next-Generation 737 models." While this might come as news to AEI, who already announced intentions for a 737-800 STC, it indicates that the next generation of conversions has not yet been settled, by any means.

The Airbus Perspective

Airbus is not currently in the P2F market, but is examining current market trends and residual values for its aircraft to determine whether it is time to enter that market. Airbus had a joint venture project for an A320 P2F conversion several years ago with Irkut, but that project was cancelled due to both market and technical issues. At that time, there simply wasn't enough feedstock at a reasonable price to move forward with the program and the economic equation didn't add up. The pricing delta at the on-ramp price between A320 and its 737 Classic competition was too big to make a good value proposition. In addition, a cargo door behind the wing on the A320 was not viewed as optimal by several industry observers.

There is a good news/bad news proposition for Airbus in looking at the market. The good news is that A320 residuals are higher than those for 737 Classics of similar vintage. The bad news is those higher values mean higher feedstock prices, which result in higher prices for a segment that is driven by low capital investment. Airbus would prefer sustained residual values for its passenger aircraft rather than having attractive candidates for P2F conversion, even if it leaves them absent from the P2F conversion market. After all, the volume in the P2F segment is dwarfed by sales to airlines of new and pre-owned A320s.

While the freighter business has never been core for Airbus, they believe that an STC solution for A320 and especially A321 could emerge. With 221 Boeing 757 freighters in service but aging, the A321 is an area of interest for Airbus, as it is the only aircraft offering similar capacity. But such a conversion program is likely several years away.

P2F Lead Times for STC Development

Historically, P2F conversions require a 3-4 year time frame to reach the market, with conversion of a prototype requiring 12-14 months. While that time frame can be shortened, the focus of most conversion houses is on feedstock cost. Accelerating the time frame can be expensive, and could negatively impact the price to be charged for a conversion, which would likely limit conversions in a

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competitive market. Given a 3-4 year lead time, it is likely that an A320 conversion would compete against the 737-800, and the A321 against a potential 737-900ER conversion. The -900ER does not look like a strong P2F option according to industry feedback, given its runway performance limitations.

The A321 has recently experienced a market spike in popularity, with the result that there are few aircraft available to provide affordable feedstock today. The high residual values for the airplane is representative of its value proposition, and current unique position in the market. Perhaps indicative of that unique value is that the US Airways A321 fleet has been moved into to American's fleet before any other type. Operators of the 757 like the A321s operating economics, especially after being fitted with sharklets.

Currently, one Boeing converter, AEI, has announced intentions for a 737-800 P2F program. At Airbus, the major converters and a new entrant have approached the company to discuss an A320 STC program, but none have yet signed with Airbus for the data required to complete an STC. Airbus expects that A320 or A321 P2F STCs will be pursued in the next round of development by the major players, in the same 3 to 4 year time frame that 737NG models begin to be converted.

The Bottom Line

Could Airbus be competitive in the P2F market today? With some very early A320 models being parted out, there would be an opportunity for A320 freighters to compete with the 737 Classic today. But by the time a program could be developed, in 3 to 4 years, the replacement bubble for 727s with 737 Classics will be nearly complete. While the A320 has better operating economics than the 737 Classic, it also has higher residuals for aircraft of comparable vintage, reflecting that advantage.

But the heart of the market will be the opportunity for the A321, likely in 5-8 years when residuals fall and candidates for freighter conversion begin to come off leases. As 757 freighters begin to be retired, A321 is the logical replacement candidate. But having missed the current replacement wave, there's no reason to rush into production as long as residual values remain high.

The decision for Airbus is whether to pursue a factory-engineered STC conversion and license it, or provide data licensing for conversion firms to develop their own STCs. We believe the former might provide the most cost-effective approach for Airbus, and eliminate the disappointment left when the A320 joint venture conversion with Irkut was curtailed.

Airframe manufacturers have been increasing their participation in the aftermarket. Were Airbus to sponsor an A320/A321 conversion, it is likely that Boeing would sponsor a 737NG conversion program of its own, and begin to change the nature of the conversion aftermarket. It will be interesting to watch this space over the next couple of years as key decisions are made in Toulouse and Seattle.

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Premium #138 - WILL ALLIANCES TAKE THE NEXT STEP - OR WILL THE ETIHAD MODEL PROVE MORE PRODUCTIVE?

9/23/2014

Airline alliances, including the Star Alliance, oneworld, and SkyTeam, have generated substantial benefits for their members. Those benefits, however, have primarily been on the marketing side of the business, as code-shares and connecting traffic increase revenues for alliance members, particularly when flying into partner hubs for traffic feed. Alliances have also taken the first steps at joint purchasing. To date, however, those purchases have focused primarily on disposable items -- such as napkins or blankets for use inside the cabin, but not focused on larger items, such as aircraft, engines, and maintenance.

Equity alliances, such as Etihad's investments in a number of airlines, have already seen aircraft transition between one member and another (Jet to Etihad) and appears ready to move more aggressively into joint purchasing and leveraging of purchasing power. IAG, which owns British Airways and Iberia, has already negotiated orders for the A350 on behalf of both airlines, and is likely achieving significant volume-based discounts.

The problem for a global alliance, such as Star, oneworld or SkyTeam, is the broad range of fleet types operated. With each alliance, there will be operators of Airbus and Boeing narrow-bodies and Airbus and Boeing wide-bodies. An example of that is the oneworld alliance, whose fleet is shown below:

	airBerlin	American	British	Cathay	Finnair	Iberia	JAL	Jordanian	LAN	Malaysia	TAM	Qantas	Qatar	S7	Sri Lankan	oneWorld	
787			8				15	2	7				14			46	2.1%
777-300		10	12	55			20				10		26			133	6.1%
777-200		47	46	5			26			13			15			152	6.9%
767-300		58	21				47		31		9	9		2		177	8.1%
767-200		10														10	0.5%
757-200		93														93	4.2%
747-400			55	8						1						64	2.9%
737-800	38	226					9			56		73		10		410	18.7%
737-700	9															9	0.4%
737-400			19							2		13				34	1.6%
MD-80		163														163	7.4%
A380			7									12	1			20	0.9%
A340				11	7	22		4	3	6			4		6	63	2.9%
A330	14			38	8	8		3		19	13	26	32		7	168	7.7%
A321	13	5	18		11	18		4			19		10	4		102	4.7%
A320	30		56		10	11		7	77		99		31	18	8	342	15.6%
A319	9	15	44		9	13		4	26		26		2	20		168	7.7%
A318			2													2	0.1%
E-190/5					12			5								17	0.8%
E-170/5					2			3								5	0.2%
Q400	13															13	0.6%
Total	124	627	288	117	59	72	117	32	139	97	176	133	135	54	21	2,191	
	5.7%	28.6%	13.1%	5.3%	2.7%	3.3%	5.3%	1.5%	6.3%	4.4%	8.0%	6.1%	6.2%	2.5%	1.0%		

But what would happen if the alliance decided to take things to the next level, and make fleet decisions together?

Imagine an aircraft procurement with 15 airlines aggregating fleet needs and negotiating with Airbus and Boeing over massive orders or 300-400, rather than 40-50 aircraft? That type of negotiating leverage would significantly impact pricing. One order could potentially "make or break" a program.

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Is there a reason the carriers can't get together, combine fleet needs, and negotiate as a block, with the subtle differences in BFE taken care of by each carrier?

With respect to buyer furnished equipment (BFE) and interiors, standards should exist among alliance members that are acceptable to all of the operators. There are currently a myriad of interior options available to an airline, with only minor differences, yet these small differences impact costs by a lot. At one point there were more than 100 different galley carts available for the Boeing 747. Do we really need more than 2 or 3 different designs, as they serve the same function and are quite similar? Northwest and KLM collaborated on a World Business Class in their alliance, offering the same seats and comfort level to ensure that business traveler expectations were met in their alliance. But that was just two carriers collaborating, and not 15 as we see in current alliances.

Airlines need initial provisioning when they order aircraft, and this means maintaining separate spares inventories, typically at hubs and major destinations. But with 15 carriers operating larger fleets, statistical analysis tells us that too many spares are currently purchased, and that with pooling, an optimal arrangement can be made. Shouldn't BA handle all the oneworld spares at LHR, American at JFK, and have spares replenished as they are used? There are operational savings that are not being taken advantage of. Clearly commonly fleet types drive huge economies of scale. The savings would be significant.

Maintenance is another area in which economic synergies should occur. While each carrier may have its own maintenance facilities and wish to maintain them (as in some countries it isn't easy to reduce staff levels), opportunities exist to specialize in certain types of repairs and leverage the volume of the entire alliance to enhance the efficiency of operations. In the oneworld example, American could specialize in 777s while BA could specialize in the A320 family.

Engine power by the hour contracts would be negotiated with better rates for a fleet of 400 than a fleet of 25. MRO contracts for component repair and overhaul would be significant better with the guarantee of more volume. We believe the answer is self-evident.

Etihad, and its equity alliance partners, are moving in that direction, and will be leveraging the combined purchasing power of its carriers in purchasing for key operational components, including aircraft and maintenance. By combining purchasing power, the alliance can take advantage of volume discounts, economies of scale, and pooling of spares inventories. Those benefits sink directly to the bottom line, but require agreement on standards, vendors, and joint negotiations. That's much easier to do as an equity shareholder than as a member of a loose federation. Moreover, the industry is familiar with standards - the FAA, EASA and JAA all honor each other's certifications. Maintenance undertaken by Japan Airlines will be to the same standards as American or BA.

Of course, equity doesn't guarantee an alliance will succeed. Delta, Singapore, and Swissair once had 5% equity cross-holding stakes in the Qualiflyer alliance, which disintegrated as the carriers moved in different directions. This may yet happen to some members of the Etihad alliance.

Pundits have long predicted the "virtual airline" in which marketing and operational aspects would be separated, with the latter being optimized by third parties. Should alliances delve more deeply into operational issues, an element of that strategy could come into play. But getting airlines to agree on

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anything is like herding cats, and more likely to happen in an equity sharing arrangement than via a marketing confederation.

It will be interesting, now that Etihad has invested in perennially bankrupt Alitalia, to see the degree to which operational synergies can be added to the marketing synergies created by the alliance. Italy's unions have to swallow a lot of humble pie for this to work. If the alliance proves successful, and helps lower the costs through economies of scale, we could see a new direction for the three alliances in the future. The OEMs will not be happy.

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Premium #139 - COMPETITION AT THE HIGH END OF THE NARROW-BODY MARKET

Boeing's recent introduction of the 737MAX8-200 with an order from Ryanair is changing the dynamics of the high end of the narrow-body market. It appears that the MAX8-200 may cannibalize potential orders from the 737 MAX9, which has been a much slower seller than the competing A321neo.

The Lion Air MAX order for 201 aircraft is questionable as to model breakdown. Boeing has publicly indicated that Lion Air will either be the launch customer for the MAX9 or the first customer in Asia for the MAX8 – but no split has been announced. Based on the order, dollar wise, they can't all be MAX9s. We split the order as 100 MAX9 and 101 MAX8.

	A321neo	737 MAX9
Orders	724	217
Customers	28	10
2 Cl Seating	185	172
MTOW (lbs)	206,100	194,700
Range (NM)	3,650	3,595

Boeing recently announced a 737MAX9 order from Irish lessor Avolon, and in the process released a data point which is eye catching. According to Boeing "*the 737 MAX 9, the largest in the 737 MAX family, offers the best fuel-efficiency per seat and will be 7 percent per trip less expensive to operate than its competitor, the A321neo*." As one can imagine this piece of information is viewed skeptically in Toulouse.

As a third party, we have gathered data from each manufacturer, airlines, and leasing companies. Since neither airplane is in production, performance numbers are likely to change slightly before EIS, as the OEM and engine manufacturers will continue to tweak and refine designs. Airbus has frozen its A320neo design and the aircraft has just undertaken its first flight.

Based on the best currently available data, our independent analysis shows slightly different results, as shown in the table below:

Independent Comparative Economics				
Range (NM)	500	1000	1500	2000
737 MAX9	14.03	11.23	10.42	10.00
A321neo PW	14.65	11.78	10.90	10.50
MAX Advantage	4.38%	4.89%	4.59%	4.96%
Cost/Seat Mile				
737 MAX9	0.0816	0.0653	0.0606	0.0582
A321neo PW	0.0807	0.0613	0.0566	0.0545
NEO Advantage	1.08%	6.09%	6.51%	6.27%

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We show the 737MAX9 to be between 4-5% better in trip costs than the A321neo, but the A321neo is between 1-6% better in terms of seat-mile costs, using a layout with equivalent seating comfort. Boeing's explanation of the cost differential doesn't seem to hold water.

Boeing told us the basis of their claim is as follows: "*Based on our analysis the 737 MAX 9 will retain the efficiency advantage between the 737-900ER versus the A321 over the A321neo and be around 6 percent lighter. This lighter airframe combined with the overall efficiency gained from the engines and aerodynamic improvements and lower maintenance costs add up to make the 737 MAX 9 cost less per trip to operate at any distance. The assumption in our 7 percent calculation is based on a standard dual-class comparison at 800nmi.*"

Airbus's view is, unsurprisingly, quite different: "*While the more complex structural changes to the MAX9 have resulted in around 3.2 tonnes more weight addition vs the 737-900NG, the more capable A321neo with significantly higher bypass ratio engines, is only 1.6 tonnes heavier than the A321ceo. Moreover, coupled with the A321neo's recent passenger capacity boost potential to 240 seats, versus only 215 seats for the MAX9, the net result is that the A321neo is around five percent lighter per seat than the MAX9, which also relates to the advantage for the A321neo of around 14% better fuel burn per passenger vs the MAX9. Those are some examples of the A321neo advantages, which drives a double-digit cost-per-seat advantage of 13% compared to the MAX9 on a typical 800nm sector. The gap is increasing, and we now see a very high demand for A321s, and are ramping-up production so that soon half of our single-aisle production will be A321s*."

With 7.5% more seats at the same pitch, the A321neo has a capacity advantage, and also offers better range and runway performance. A key question for Boeing is whether the MAX9 will improve on the performance of the 737-900ERW, which often cannot complete flights without a tech stop from the US West Coast to Atlanta from short runway airports, like San Diego, and is range limited with full loads. That may be a factor holding sales back in the marketplace.

The customer base for each aircraft is interesting. Airbus has a wider customer spread. Based on our order assumption, Boeing has nearly half (46%) of its MAX9 orders tied up with Lion Air. This is not unusual these days as illustrated by Emirates at the A380. But Lion Air is not Emirates either in terms of fiscal strength or stature. Airbus is also exposed to Lion Air (11.5%) but it has four customers that account for just under half its orders. People within the industry advise us that the MAX order has yet to be divided into the various models.

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	A321neo	737 MAX9
ACG		10
Air Canada		28
Alaska		17
ALC	34	15
American	130	
ANA	23	
Arkia	4	
Avianca	4	
Avolon		10
BOC	23	
Cebu	30	
CIT	3	
Hawaiian	16	
Icelandair		7
ILFC	25	
Indigo	20	
jetBlue	30	
Lion Air	65	100*
Lufthansa	40	
MEA	5	
Pegasus	17	
Philippines	10	
Qatar	14	
TAM	6	
TransAsia	12	
TUI		20
Turkish	53	10
United		100
	564	217

* Lion Air order assumed spilt between /MAX8 & MAX9

Here's the status of total NEO and MAX orders as of September 22nd, based on our split of the Lion Air MAX order. For this analysis, we have split the 201 Lion Air order between the MAX8 and MAX9.

Firm Orders for NEO and MAX				
Airbus	A319neo	A320neo	A321neo	Total
	49	2484	724	3257
Boeing	737MAX7	737MAX8	737MAX9	Total
	55	1852	312	2219

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The Bottom Line: The A321neo and 737 MAX9 are very close in terms of economics, but not to the degree Boeing claims once seating capacity is adjusted to utilize equivalent seat pitch for the two aircraft. A key to the differential in sales between the aircraft is likely not economics, but the runway capability of the 737 MAX9, which is expected to be similar to that of the 737-900ERW.

If runway restrictions reduce loads, or fuel uptake, as has been experienced on some routes, so the MAX9 could be less profitable to operators. Let's hope the MAX9 is better than its predecessor in that regard. But the MAX9's runway performance has become a "wait and see" development with customers who are deciding how to split their MAX orders. Today, the overall market advantage, in our view, belongs to the A321neo.

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Premium #140 - There are three kinds of lies: lies, damned lies, and statistics.

10/7/2014

Benjamin Disraeli made these words famous while aerospace keeps them current. Industry forecasts are difficult work. The major OEMs and independent firms have teams of highly educated people working on annual forecasts, with access to every imaginable input, and spend considerable time putting them together. As with any forecast, the question is not whether you will be right or wrong, but how close you come to reality.

So why do forecasts vary as much as they do? If everyone has access to or uses the same inputs, why are forecasts, in many instances, not even close to each other? Take a look at this table, which covers the narrow-body segment up to 200 seats. While we could also have included the wide-body sector and focused on the differences in Boeing and Airbus forecasts (which seem to favor the segments in which they have products), the narrow-body and regional markets are interesting because of the number of participants and disparity between forecasts.

Twenty Year Forecast Comparisons					
Seats	20-59	60-99	100-149		Total
Bombardier	400	5600	7100		13100
Seats		60-90	91-120	121-199	Total
Superjet		1680	3520	20260	25460
Seats	TP >70	70-130	90-130	130-200	Total
Embraer	2050	6250	3950	18500	30750
Seats					Total
Airbus				20242	20242
Seats		61-100			Total
Mitsubishi		5360			5360
Seats			<90	91-200	Total
Boeing			2490	25680	28170
Seats		<90	91-120	>121	Total
Pratt & Whitney		2558	3309	20143	26010
Seats	30-80	90-100	110-130	150-200	Total
Rolls-Royce*	1850	920	1550	8200	12520

Seats	40-100	70-110		120-200	Total
Teal Group*	1182	1836		9930	12948

* 10 year forecast

The first thing one might notice is that seating categories aren't compatible among the OEMs and independent analysts. Why would that be? The industry sells to the same customers and their products are nearly perfectly substitutes. So having widely varying seat breakdowns is, to say the least, odd.

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We got a forecast from Teal Group as a benchmark to see how an independent source sees the market. Like Rolls-Royce, Teal's numbers are for ten years. Teal's Richard Aboulafia thinks forecasts more than ten years out are less useful – paraphrasing Keynes with "in the long run we're all dead". But even the independent Teal Group has an overlap and gaps – with 40-100, 70-110, and 120-200 seat ranges in their forecasts.

Totaling forecasts should give one some sort of broad agreement. Teal and Rolls-Royce are close on a global level which is reassuring. But among the rest we see wide disparity. Bombardier does not even forecast anything above 149 seats. Even though they have a forecast on under 60 seats where they offer no products. While their CS300 can seat up to 160 passengers, there's no forecast of sales in that category, indicating that they consider the aircraft to fall within the 100-149 seats range. Is it an apple, or an orange?

Superjet is in the ~100 seat market but forecasts the 130-200 seat market. Is this because they have their eye set on it? The larger market is four times the market they produce for, so it might well be.

Embraer forecasts the turboprop market even though they do not serve it. There are rumors about reentering the market, but we have our doubts.

Airbus does not even breakdown the single aisle segment in its GMF. We requested a detailed breakdown but, at this writing, we have no response. Given Airbus produces their best-selling aircraft in this segment, one would expect them to have an exquisitely detailed idea of that market segments.

Boeing breaks the segment into two sections. Its best-selling 737 is in the larger of the two and its robust forecast is also, no doubt, also built on exquisite details not shared with the outside world.

Rolls-Royce offers a ten year, rather than twenty year forecast. Doubling their numbers for comparison would be an approximation of a forecast and too fluffy for any meaningful comparison.

So What?

Why this interest in forecasts? At the recent ISTAT Europe event in Istanbul the first serious whiff of uncertainty crept in about the massive order books. If Airbus' John Leahy says "What worries me is this whole 'Field of Dreams' concept: 'Build it and they will come", then mortals should fear. Airbus and Boeing are both considering production rate increases and these increases are coming at the single aisle segment.

The OEM blue sky forecasts has also raised concerns from UBS, Bank of America Merrill Lynch and Citi. Avitas' Adam Pilarski has been, consistently, talking about a bubble for some time. The slide below is from Pilarski's March 2014 ISTAT Americas presentation. Speaking with him post Istanbul, Pilarski says he has no reason to change his mind.

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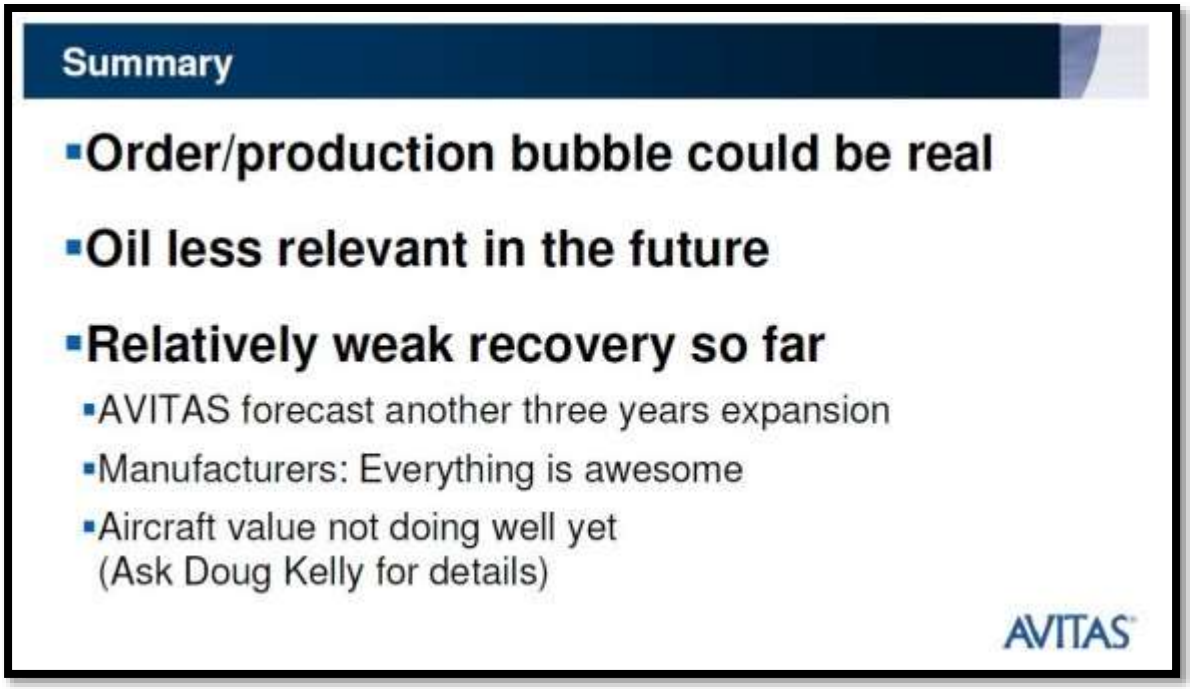

High fuel costs and cheap finance have fed the demand for new aircraft. Throw in new technology engines that are nearly 20% more fuel efficient and you have the volatile mix to drive orders. In addition it seems that "over ordering" or "double counting" is the new normal. Not every airline can expect to achieve its traffic targets – the market is growing, but is relatively finite in the short term. Traffic doubles every 15 years, and the current single aisle backlog is 5-7 years long.

Consequently if three airlines order planes, as John Leahy said, "… someone is going to be very successful, someone very unsuccessful and someone in the middle. So two or three don't need all the planes they ordered." This problem exists across the industry; LCCs vs Network carriers, many new leasing companies and of course, the perennial huge orders from the three Gulf carriers. Markets are not growing fast enough to absorb all of the orders – so it looks more and more like a bubble is forming.

We are currently in an unusual situation – high oil prices combined with cheap finance are fueling the order boom and, of course, those forecasts. The industry needs massive retirements to allow these orders to be delivered. The recent airBerlin cancellation was a reminder of what can happen. But it's only one blip. Are there more to come? What if oil prices drop sharply? What happens if interest rates have to rise sharply to offset rising inflation (current zero interest rate regimes across much of the developed world are unprecedented). Pilarski calls this the "reverse perfect storm". Funny, yet serious at the same time.

The industry is also subject to periodic economic shocks and events, from terrorism to SARS. Could Ebola be the next threat and reduce demand for international travel? What if someone with the disease was on your airplane, and you are quarantined for 21 days. Business travel would drop because of the risk, while desktop video conferencing would skyrocket. Periodic shocks cannot be accurately forecast, but as we review history, we know that they exist, and are likely to happen again.

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Our regular readers know that we have also been warning of a potential bubble in the narrow-body market, as we do not believe the production rates increases contemplated at Boeing and Airbus are sustainable, given the current demand scenario, without major aircraft retirements. Should fuel prices fall, which the oil industry supply-demand balance indicates that they should, the benefits of the new airplanes don't outweigh the additional capital costs, and this will cause airlines to re-think fleet orders.

The rosy forecasts look great but people in this industry know, better than most, that just when things look their best an unexpected hit is coming. Oil price declines (who expected to the USA become a net energy exporter even five years ago?) and higher interest rates are well within a realistic scenario. Airlines almost always mistime aircraft deliveries. Many of the new entrants into aircraft finance (and their investors) are almost certainly going to get burned.

Some classic advice springs to mind: "Bulls make money, bears make money, pigs get slaughtered".

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Premium #142 - Will Lower Oil Prices Burst the Bubble?

10/13/2014

Oil prices have dropped below $90 per barrel last week, amidst the US becoming the largest producer of energy in the world and Saudi Arabia breaking ranks with its OPEC colleagues. As the fuel efficiency of vehicles continues to increase, the supply-demand balance for oil is moving further towards excess supply, indicating a strong likelihood of further price cuts.

At what point does it make sense to keep older aircraft rather than purchase new aircraft? Airlines have been ordering new re-engined narrow bodies at record rates in recent times as fuel prices shot to more than $110 per barrel. With those prices dropping about 20% from their peak, and no end to pricing instability in sight, things are beginning to change.

Where is the inflection point at which an airline would be indifferent between an existing aircraft, with higher fuel burn but lower capital costs, and a new but more expensive aircraft with lower fuel burn?

We've modeled the operating economics for a number of aircraft, and by varying the price of fuel, can calculate the projected cash operating costs and capital costs for existing and the forthcoming aircraft. Let's take a look at the sensitivity to changes in fuel prices on the most popular aircraft in the world, the Airbus A320ceo and A320neo, and the Boeing 737-800W and 737-MAX8.

We've chosen a 1,000nm mission for each aircraft as representative (an average flight is about 800nm) and have projected operating costs under the same assumptions for each aircraft. On a seat-mile basis, at $100 fuel - which equates to about $3.15 per gallon retail. We've added these to our estimates for other direct operating costs to compare the various aircraft.

Capital costs for the newer aircraft, with more expensive engines, are expected to be higher than for existing aircraft. Based on lease rates for new aircraft and higher list prices, we estimated projected lease rates for neo and MAX models. We compare those lease rates to those for a 2010 vintage aircraft that might be replaced by a new neo or MAX by an airline.

Utilization per month for a 1,000 nm mission would be approximately 150 missions per month with typical airline utilization and turn times. The following chart summarizes operating and capital costs for each type and compares the combined total savings for one A320neo over the A320ceo, and one 737MAX8 over one 737-800W.

At $100 fuel, the economic equation favors new aircraft over the existing aircraft, with a modest monthly savings.

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Overall Operating and Capital Cost Comparison - with fuel priced at	$100 per barrell			
1,000 nautical mile mission				
Aircraft Type	A320ceoCFM	737-800W	A320neoPW	737MAX8
Vintage	2010	2010	new	new
Number of Seats - 2 Class Standard Configuration	150	162	150	162
Block Fuel in Gallons	1,859	1,955	1,593	1,732
Fuel Price/Gallon	$3.15	$3.15	$3.15	$3.15
Fuel Cost	$ 5,855.12	$ 6,157.48	$ 5,017.83	$ 5,455.12
Crew Cost	$ 2,001.63	$ 2,001.63	$ 2,001.63	$ 2,001.63
Maintenance Cost	$ 1,601.08	$ 1,658.57	$ 1,501.97	$ 1,684.10
Landing Fees	$ 584.00	$ 585.20	$ 696.00	$ 621.20
Total DOCs	$ 10,041.83	$ 10,402.88	$ 9,217.43	$ 9,762.04
DOC/AC Mile	$ 10.04	$ 10.40	$ 9.22	$ 9.76
DOC/Seat Mile	$ 0.0669	$ 0.0642	$ 0.0614	$ 0.0603
Utilization - missions per Day	5	5	5	5
Monthly DOC - 30 days	$ 1,506,274.22	$ 1,560,431.43	$ 1,382,614.02	$ 1,464,306.60
List Price	$ 93.90	$ 93.30	$ 102.80	$ 106.90
Monthly Lease Rate - 2010 used vs. 2014 purchase	$ 275,000	$ 320,000	$ 365,000	$ 410,000
Total Monthly Cost	$ 1,781,274.22	$ 1,880,431.43	$ 1,747,614.02	$ 1,874,306.60
Total for Exising vs New Programs		$ 3,661,705.65		$ 3,621,920.62
Monthly Savings - New Programs vs. Existing			1.09%	$ 39,785.03

When we reduce fuel price to $90 per barrel, the new level reached last week, the economics begin to change slightly, as shown below, but still favor the new airplanes over their used 2010 counterparts by a very small margin, as shown below.

Overall Operating and Capital Cost Comparison - with fuel priced at	$90 per barrell			
1,000 nautical mile mission				
Aircraft Type	A320ceoCFM	737-800W	A320neoPW	737MAX8
Vintage	2010	2010	new	new
Number of Seats - 2 Class Standard Configuration	150	162	150	162
Block Fuel in Gallons	1,859	1,955	1,593	1,732
Fuel Price/Gallon	$2.83	$2.83	$2.83	$2.83
Fuel Cost	$ 5,269.61	$ 5,541.73	$ 4,516.04	$ 4,909.61
Crew Cost	$ 2,001.63	$ 2,001.63	$ 2,001.63	$ 2,001.63
Maintenance Cost	$ 1,601.08	$ 1,658.57	$ 1,501.97	$ 1,684.10
Landing Fees	$ 584.00	$ 585.20	$ 696.00	$ 621.20
Total DOCs	$ 9,456.32	$ 9,787.13	$ 8,715.64	$ 9,216.53
DOC/AC Mile	$ 9.46	$ 9.79	$ 8.72	$ 9.22
DOC/Seat Mile	$ 0.0630	$ 0.0604	$ 0.0581	$ 0.0569
Utilization - missions per Day	5	5	5	5
Monthly DOC - 30 days	$ 1,418,447.44	$ 1,468,069.23	$ 1,307,346.61	$ 1,382,479.83
List Price	$ 93.90	$ 93.30	$ 102.80	$ 106.90
Monthly Lease Rate - 2010 used vs. 2014 purchase	$ 275,000	$ 320,000.00	$ 365,000	$ 410,000
Total Monthly Cost	$ 1,693,447.44	$ 1,788,069.23	$ 1,672,346.61	$ 1,792,479.83
Total for Exising vs New Programs		$ 3,481,516.67		$ 3,464,826.44
Monthly Savings - New Programs vs. Existing			0.48%	$ 16,690.23

But when we reduce prices to $80 per barrel, the old aircraft economically beat the new aircraft, suggesting that the price differential for Boeing and Airbus will not hold-up in the marketplace, as shown below:

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Overall Operating and Capital Cost Comparison - with fuel priced at		$80 per barrell			
	1,000 nautical mile mission				
Aircraft Type		A320ceoCFM	737-800W	A320neoPW	737MAX8
Vintage		2010	2010	new	new
Number of Seats - 2 Class Standard Configuration		150	162	150	162
Block Fuel in Gallons		1,859	1,955	1,593	1,732
Fuel Price/Gallon		$2.52	$2.52	$2.52	$2.52
Fuel Cost		$ 4,684.09	$ 4,925.98	$ 4,014.26	$ 4,364.09
Crew Cost		$ 2,001.63	$ 2,001.63	$ 2,001.63	$ 2,001.63
Maintenance Cost		$ 1,601.08	$ 1,658.57	$ 1,501.97	$ 1,684.10
Landing Fees		$ 584.00	$ 585.20	$ 696.00	$ 621.20
Total DOCs		$ 8,870.80	$ 9,171.38	$ 8,213.86	$ 8,671.02
DOC/AC Mile		$ 8.87	$ 9.17	$ 8.21	$ 8.67
DOC/Seat Mile		$ 0.0591	$ 0.0566	$ 0.0548	$ 0.0535
Utilization - missions per Day		5	5	5	5
Monthly DOC - 30 days		$ 1,330,620.67	$ 1,375,707.02	$ 1,232,079.21	$ 1,300,653.06
List Price		$ 93.90	$ 93.30	$ 102.80	$ 106.90
Monthly Lease Rate - 2010 used vs. 2014 purchase		$ 275,000	$ 320,000.00	$ 365,000	$ 410,000
Total Monthly Cost		$ 1,605,620.67	$ 1,695,707.02	$ 1,597,079.21	$ 1,710,653.06
Total for Exising vs New Programs			$ 3,301,327.70		$ 3,307,732.27
Monthly Savings - New Programs vs. Existing				-0.19%	$ (6,404.57)

The Bottom Line:

The new re-engined aircraft make their economic case from lower fuel burn, with a trade-off of higher capital costs. As fuel prices drop, their economic advantage over used aircraft also falls, as shown in our analysis over late model current aircraft. Should fuel prices continue to fall to $80, or perhaps even $70 per barrel as some pundits believe, the new models will not be able to maintain a price premium over existing aircraft.

We would expect a spate of order cancellations or price re-negotiations should that occur, as demand for the new models would fall and the useful lives of existing aircraft be extended. While this does not mean that the new models will not be successful, it could burst the short-term order bubble that we've seen, resulting in fewer orders for the neo and MAX for the next couple of years - just when Boeing and Airbus raise production rates.

The one thing that can bring the "field of dreams" attitude of "If you build them, they will come" back down to earth quickly would be a significant drop in fuel prices. Recent events indicate that an adjustment is arriving, and could reduce demand just as the OEMs increase production rates. The old adage that airlines order new aircraft when times are good, and take deliveries when they aren't needed may be playing itself out again. It will be interesting to watch.

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Premium #143 - A340 Fleet Status

10/28/2014

There are 633 A340s in service today. The aircraft is no longer being built and its production life was short. The initial good idea of a lighter quad was eclipsed by the remarkable performance of the big fan engines, enabling the same range and payload to be delivered using a twin engine aircraft. The table below shows the four models of the A340 and the fleet age. On average, the fleet is under a decade old at this writing. While one might think Airbus might see the program as a failure - this is not the case because the same basic aircraft is sold very successfully as the A330, its production twin. Airbus has had a tremendous run on the A330 and is getting ready to build the neo version.

	-600	-500	-300	-200	Total
Avg Age	6.5	5.8	10.7	14.5	9.7

The next table lists the relative seating capacity of the models and the number in service. Airbus was able to grow capacity by 43% from the -200 to the -600. But the heart of the market was the -300, and at its capacity it came into conflict with the 777-200. The twin's economics were simply too good to ignore and airlines bought 510 compared to 398 A340-300s. Of the 510 777s, 83% were the -200ER variant with additional range. Boeing has also managed to sell 59 even longer range -200LRs which competed with the A340-500.The largest A340-600 competed with the 777-300ER, and the market spoke: 134 A340-600 sales vs. 816 (-300 plus -300ER). The numbers are crueler than they should be. The A340 was a good development project in that Airbus learned about building bigger aircraft and enabled the firm to ultimately develop the A380.

Seats	-600	-500	-300	-200	Total
260				51	51
300			398		398
313		50			50
372	134				134

The A340 is a relatively young airplane, and Rolls Royce, which powers the -500 and -600 models with the Trent 500, has developed a new by the hour maintenance plan that provides "four for the price of two" maintenance costs when compared to the competing 777. The aircraft are technically sound, but risk economic obsolescence given higher fuel burn and engine maintenance costs than their twin-engine competitors. The maintenance cost concessions, combined with lower fuel prices, should help the newer models remain in production. Unfortunately the -500, an ultra-long range model with more limited capacity, is being retired by several airlines and has become a successful head of state airplane. The -600, with high capacity, remains competitive.

The A340 fleet is somewhat concentrated in certain markets as the next chart illustrates. The blue indicates the relative impact of the top three users in a region. In Africa the concentration is over 80% with SAA accounting for over half. Airbus has been able to make the Asia/Pacific market much less concentrated. In Europe there is some concentration because of Lufthansa, Air France and Iberia. All three airlines remain loyal Airbus customers. In Middle East the concentration is due to (predictably) Emirates (33%), Etihad and Gulf. North America is essentially Air Canada and therefore also around 80% concentrated.

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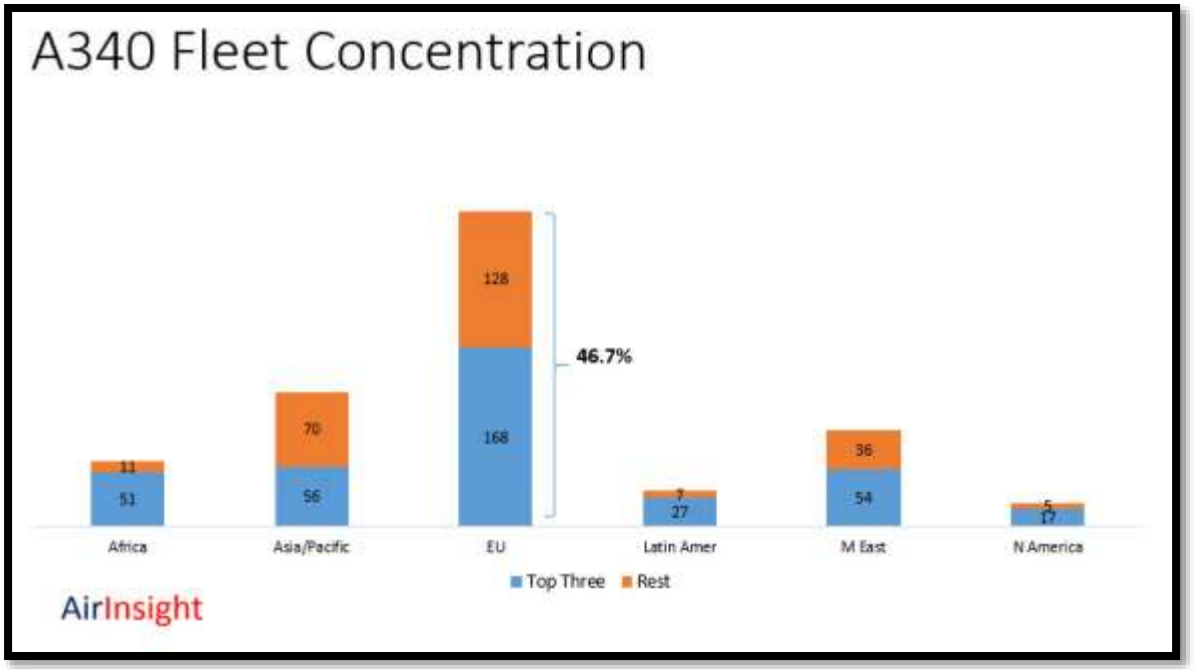

As one looks towards operators replacing aircraft in the seating capacities, the future looks like being as tough as selling the earlier competition. Airbus developed the A350 which is an order of magnitude more efficient than the A340 and even the 777. Arguments of seating capacity aside, there is no doubt the A350 is bringing the fight to the 777 and why Boeing developed the 777X. Airbus has brought an effective twin the the twin war - or the segment we refer to as Super Twins.

At the lower end, Boeing's 787 is done extremely well. So well that Airbus had to revise its strategy of believing the A330 could soldier on. The A350-800 turns out to have been still born as it was too heavy for the segment - shrinks don't do well. But the revised A330neo is more compelling and comes in at lower technology risk. Plus it will be a lot less pricey than the 787 both in purchase price and running costs. Given the industry's fear of risk, many airlines are likely to embrace the A330neo over the 787.

Which means that in markets where Airbus has concentration it will want to keep its market share. In North America that has fallen apart as Air Canada is the key customer and has defected to Boeing. In Africa, SAA and Air Mauritius are likely to call for competitive bids and then buy Airbus anyway. Asia/Pacific is more interesting because its airlines are so big that many buy from both OEMs. Of the 967 A350XWBs on order, one quarter are from this region. And of the 979 A330s on order, 47.5% are from this region. The Middle East accounts only 8% of the A330 orders but 32% of the A350XWB orders. The loss of the Emirates order stung and Airbus can be expected to pull out all the stops when that order is revisited in 2014. In Europe we find 17% of the A330 orders and 13% of the A350XWB orders. Airbus orders are surprising weak on its home turf, with Lufthansa buying 777X, Air France 777-300ERs, and British Airways also operating 777s.

Airbus needs to focus and win big orders in the Gulf and Asia. This is where the growth is. The A330neo is joined by the A330R and the A350XWB must win at least 50% of the orders. Airbus has been successful in Japan with JAL defecting from Boeing. But it is also cleverly working on the A330R to

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ensure Asian interest. Winning orders is increasingly about work share. Pricing remains key, but how the price is made up is of utmost importance.

This market remains highly competitive. Business has become more complex in line with the rising complexity of new aircraft. On that score, Airbus has done well to run the A350XWB flight test program as well as any that has been undertaken anywhere. It is in marked contrast to its own A380 and the first iteration of the 787. Airbus has done a lot to inspire confidence in the A350XWB as a result. We anticipate the A330neo going as well. Boeing needs to similarly run a flawless 777X development and flight test program to inspire confidence and overcome the 787 battering.

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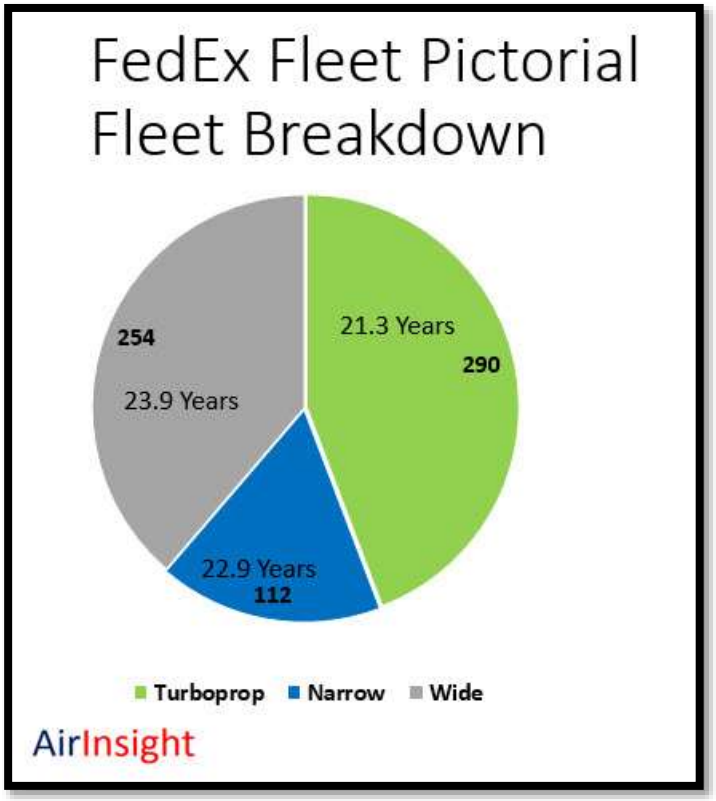
Premium #144 - The two big US freight airlines and fleet renewal

11/4/2014

Largely absent from industry news of late are two major US airlines that transport a lot freight, quietly and efficiently. Since much of their traffic occurs at night, people tend to overlook these companies. Yet these two operators, FedEx and UPS, are huge. In 2013 FedEx reported revenue of $45bn and $2bn in profit, while UPS had $54bn and profits of $807m.

The following pictorial charts illustrate the fleets at these companies.



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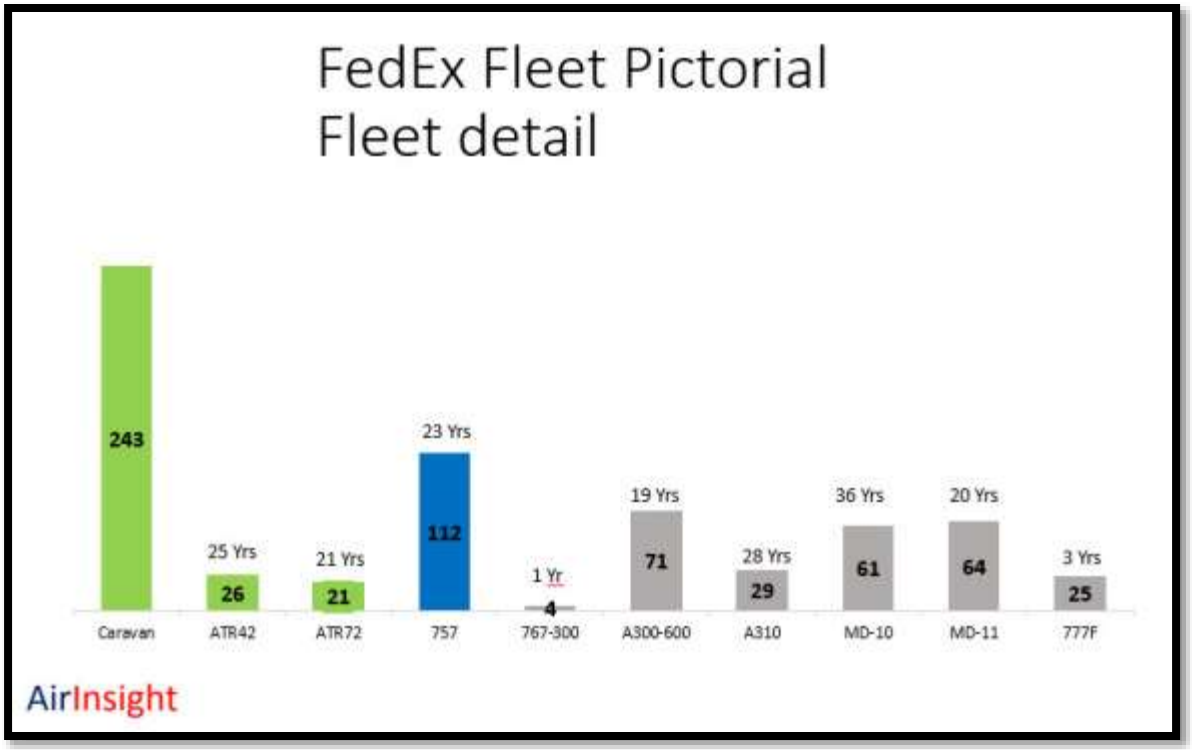

FedEx has 645 aircraft and the pie chart provides the breakdown by category and average age. About 45% of the fleet is turboprops, mainly Cessna Caravans, 17% narrow body Boeing 757s, and 38% wide bodies of various types that account for the rest of the fleet. Excluding turboprops, the split is roughly 30/70 narrow-body to wide body. The bar chart provides a guide to fleet breakdown by aircraft model and age. Unfortunately, we don't have an average age for the Caravan fleet.

Next let's look at UPS fleet. Wide body aircraft represent 68% of its fleet of 237 aircraft, and narrow body 32%. UPS differs from FedEx in its use of smaller aircraft for feeder routes, contracting those out rather than flying under their own certificate. As a result, UPS has a simpler fleet, but also with an age profile considerably younger than its key competitor.

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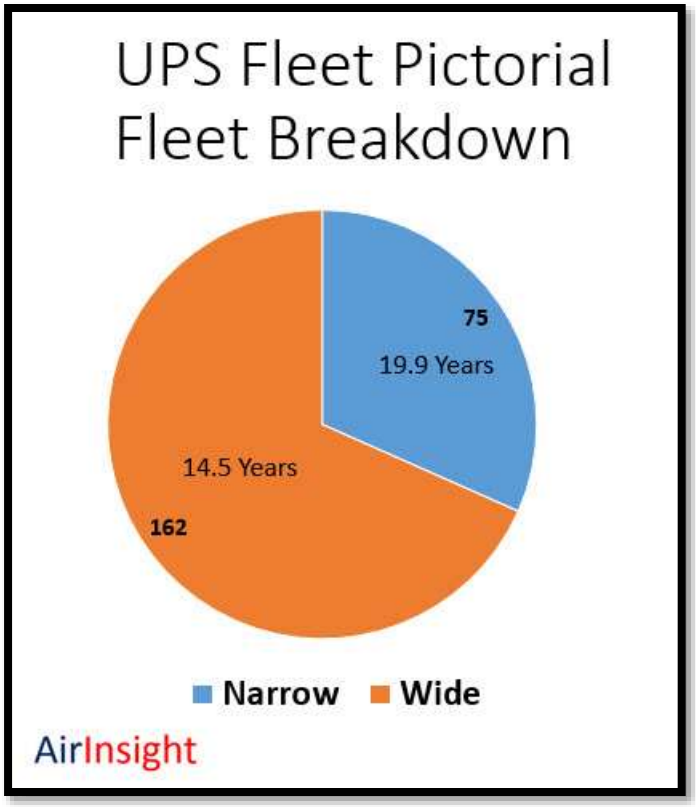

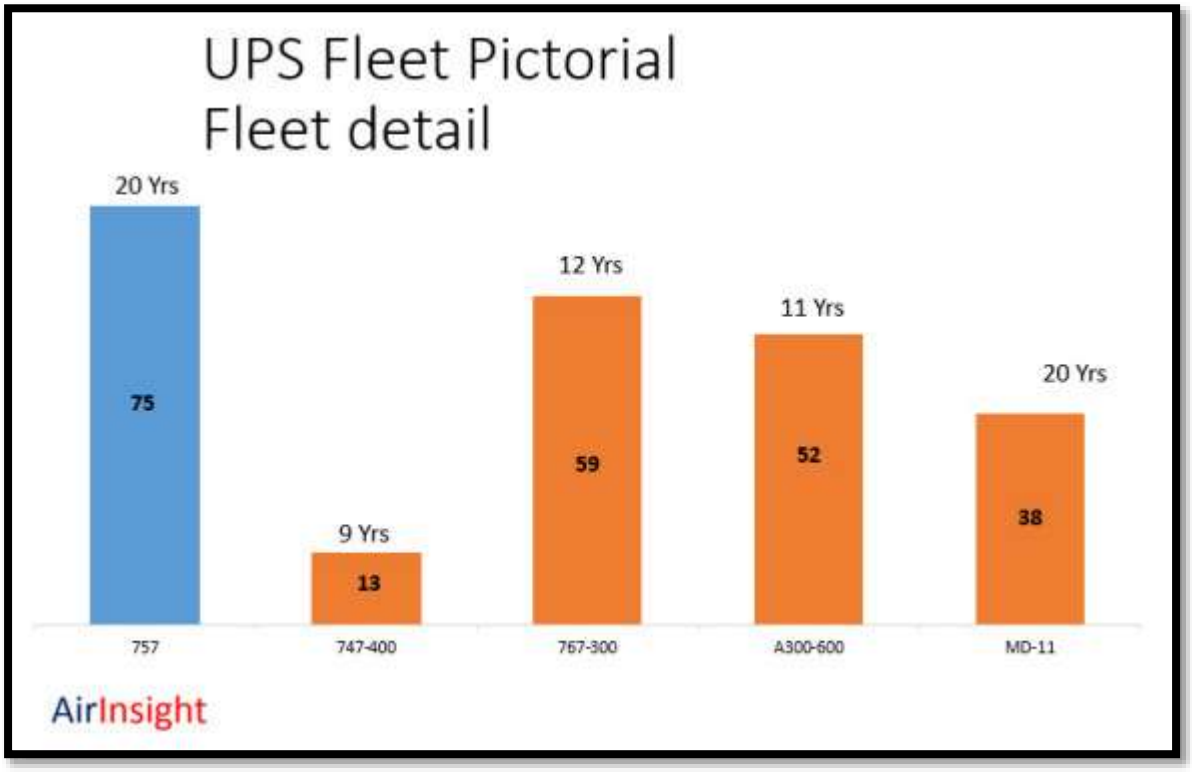

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With the fleet breakdowns and ages, it seems reasonable to assume that both companies will be moving towards younger aircraft, particularly FedEx. Looking at the widebodies, where UPS has acquired young 747-400s at bargain prices, FedEx has moved towards the 777F. Based on their fleet breakdowns, one would think that both firms could be serious contenders for the A330F. Between them they have 152 A300/310s that will require replacement in the not too distant future. While UPS has a newer Airbus fleet, FedEx aircraft are at or over the 20 year mark and might be expected to be replaced first. The handful of 767-300s, that are still new, are a puzzle - will FedEx order more while they are still listed for sale?

Then there is another aspect to these two fleets. The widebodies at FedEx are old - seriously old. Normally this would be a cause for some concern in terms of replacement. But FedEx is actually in a very good situation, timing wise. Given that Boeing is moving to the 777X, its current 777 line needs orders. Similarly, Airbus is moving from the A330 to A330neo, and needs to maintain the A330 line.

Based on the current production rate, Boeing needs to sell about 250 777s now to keep the 777 line busy. This number changes by reducing the rate - but doing that is likely to cause labor disruption, something Boeing would rather not have more of. Over the next six years, based on sales trends for the airplane, this is going to be difficult. The closer one gets to 2020, when the 777X starts to be built, the less likely it is that airlines will want the current model. Based on orders in June 2014, and if there are no new orders, the 777 program at current production rates runs dry in October 2017. With 35 -300ERs ordered since June, the line could stay busy through December. Of 255 777s ordered since June, 86% have been for the 777X.

Which brings us back to FedEx. It has already taken delivery of 25 777Fs. It needs to replace 125 aging DC-10s and MD-11s. Throw in UPS replacing 38 MD-11s and if both firm select the 777, Boeing's 777 production "gap" challenge drops off considerably. The freight firms don't care for the latest models and, for these two firms, moving to the 777F actually catches them up two aircraft generations, providing them "current" lift.

Airbus could also be motivated to weigh in with replacements for its A300 and A310 freighters, as it also needs to keep the A330 line moving. More modern A330 aircraft, at attractive prices, could also be attractive for both carriers.

Boeing and Airbus sales teams are no doubt paying visits to Memphis and Atlanta offering deals. The longer the freighter firms wait, the better the deal will get. As profitable companies they can call the shots. These two firms are likely to see A330F and 777F offerings at prices they won't see again. The way to monitor the relative negotiation strengths will be seen by what Airbus and Boeing do; if they slow production rates, the freighter companies aren't budging.

Boeing has a longer gap to fill in terms of time until the new models arrive. Current 777 production is for seven per month. In order to keep labor quiet and the line running, we don't foresee the rate dropping to below five per month. But that only pushes out the existing backlog to December 2018, while the 777X will not start deliveries until 2020 - leaving the line with a 2019 gap . Boeing would prefer to stay at a rate of seven per month and therefore is likely to be pushing its sales team to sign new orders - even at unprecedented lower pricing. The alternative is simply too expensive. Throw in similar motivation from Airbus, and it appears we have a potential "buyer's market" that the larger freight operators could exploit.

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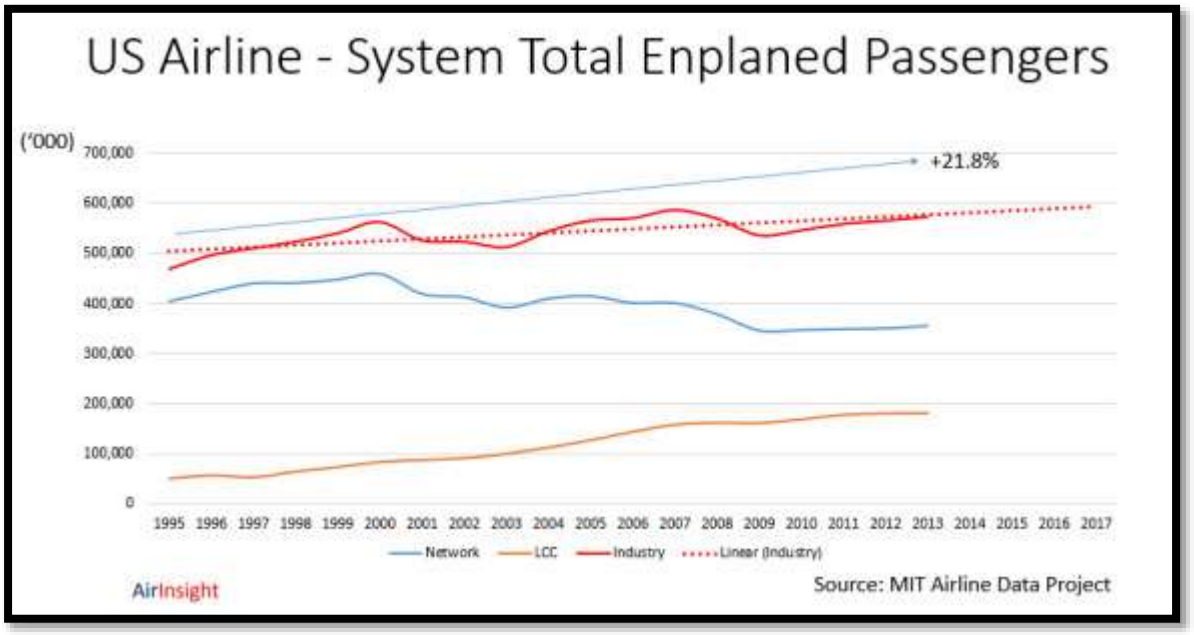
Premium #145 - Will Capacity Discipline Hold in the US Airline Market?

11/11/2014

The US airline industry has rebounded solidly, showing its best profit margins since 1999. With fuel prices dropping, the potential for even better airline financial performance appears on the horizon, positively impacting airline equities. Historically, there has always been either an exogenous factor, or competitive fare war, to bring high profits back to earth. Is today's surge in profitability different, and is it sustainable? Let's examine some trends, and examine some trends over the longer term.

We begin with traffic.



Although the US economic recovery has been slow, it has not been keeping people away from traveling by air. Traffic is remarkably resilient, up over 21% between 1995 and 2013. Air travel has a relatively inelastic demand, which is why Congress loves taxing it. LCCs kept growing market share up to 2009, but since have appeared to level off a bit. Travelers do not like to pay higher fares unless forced to, but since 2009, network carriers have held stemmed the decline in market share a bit better than before. Network carriers have managed to keep LCCs at bay.

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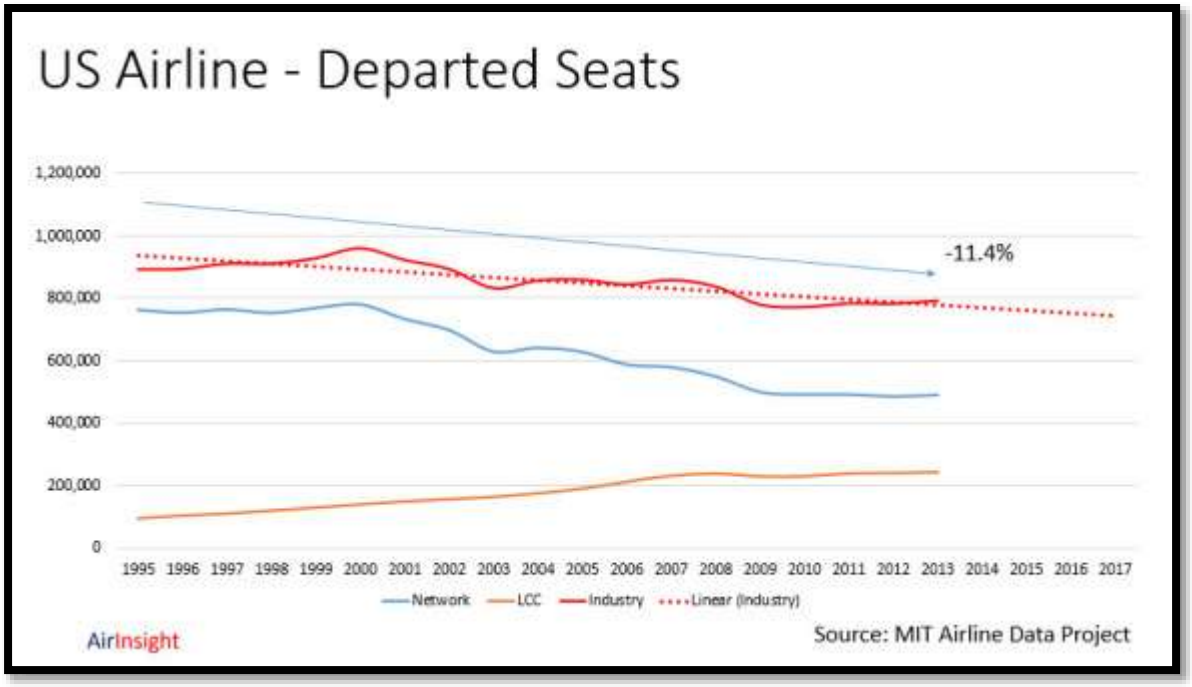

The US airline industry has consolidated and the impact is remarkable. There are over 11% fewer seats at year end 2013 compared to 1995. Capacity discipline has resulted in improved productivity - more seats are full at departure. The trend indicates we can expect further productivity gains, and full aircraft. One potential disruptor to that trend could be lower fuel prices. With lower fuel prices, older aircraft that were becoming economically, rather than technically, obsolete can remain in operation longer. Could this result in a breakdown in capacity discipline among the majors and Southwest? Time will tell. Delta Air Line's bet on older aircraft seems to be paying off handsomely though.

With three big airlines in the US, oligopolistic behavior is to be expected, and is likely to continue unless an opportunity to "steal market share" is perceived. The big LCCs like Southwest and jetBlue do want a fare war. Nor do smaller ones like Virgin America or even Frontier and Spirit.

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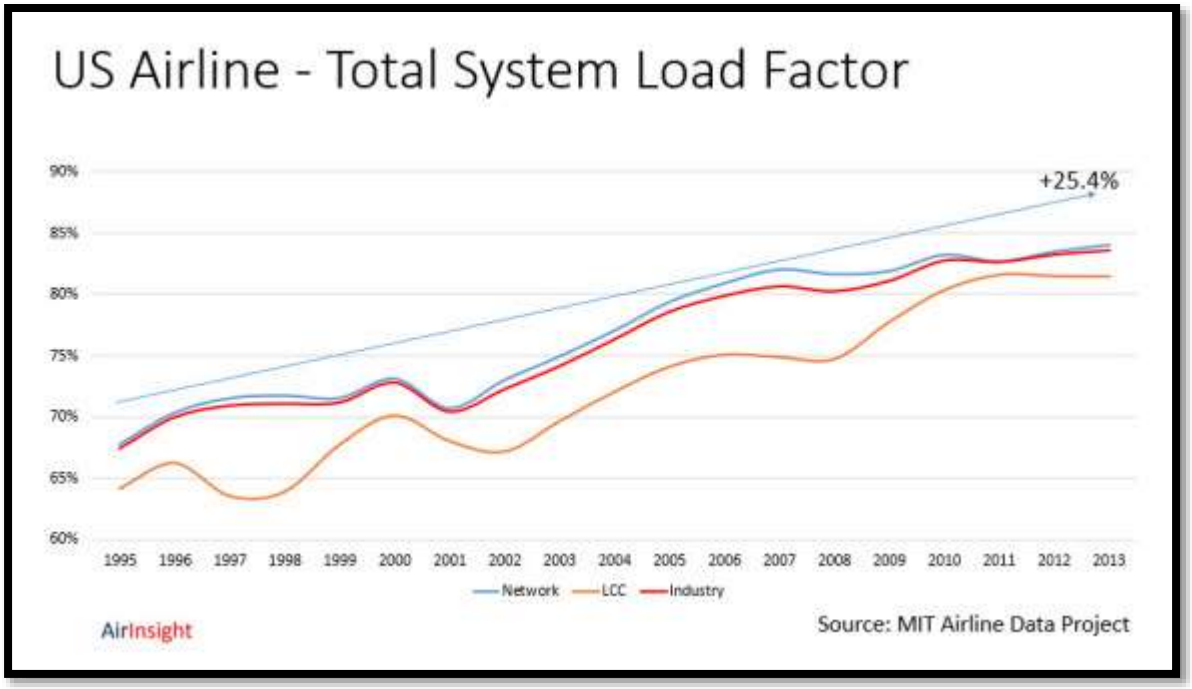

Which leads us to load factors - between 1995 and 2013, load factors rose over 25%. Anyone who has flown in the US during this period has a crowded flight horror story. That cramped feeling you thought was odd, wasn't odd at all. How high can load factors go? We do not think this trend is tapped out yet. Airlines are not growing capacity by more than 3% on average. Traffic is growing faster than this.

You know where this leads - eventually every seat being filled. But every week still has a Tuesday, and every day has off-peak flights. Dynamic pricing is enabling airlines to balance load factors with budget travelers to enable higher yields on popular flights and fill the empty seats on unpopular ones.

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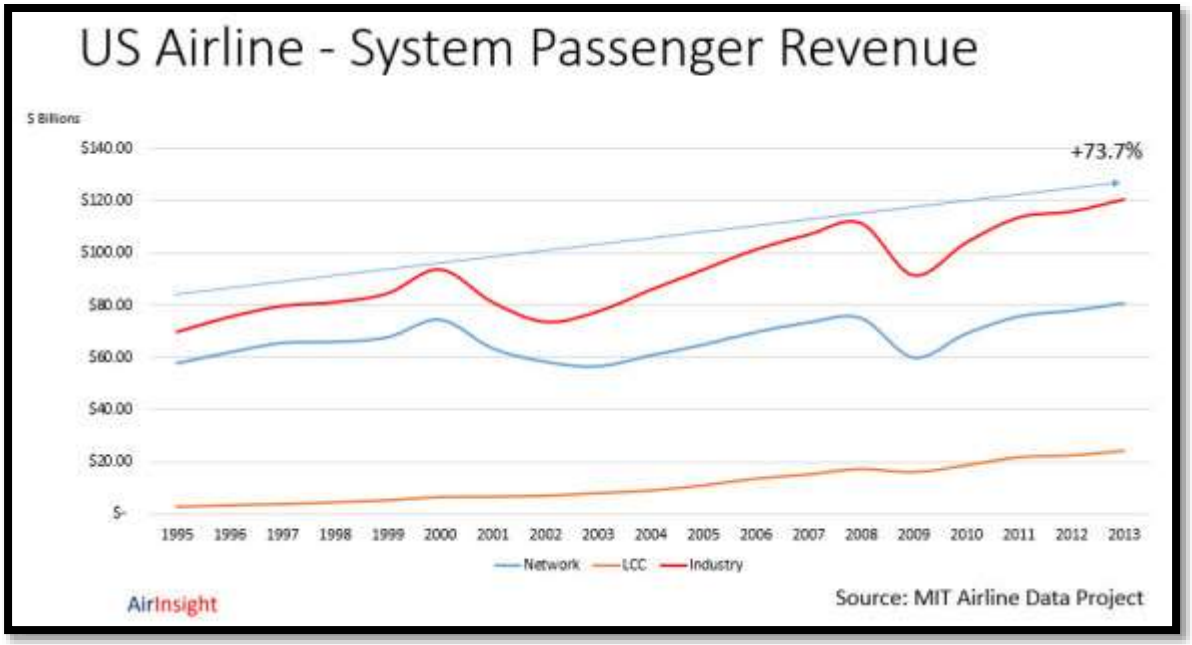
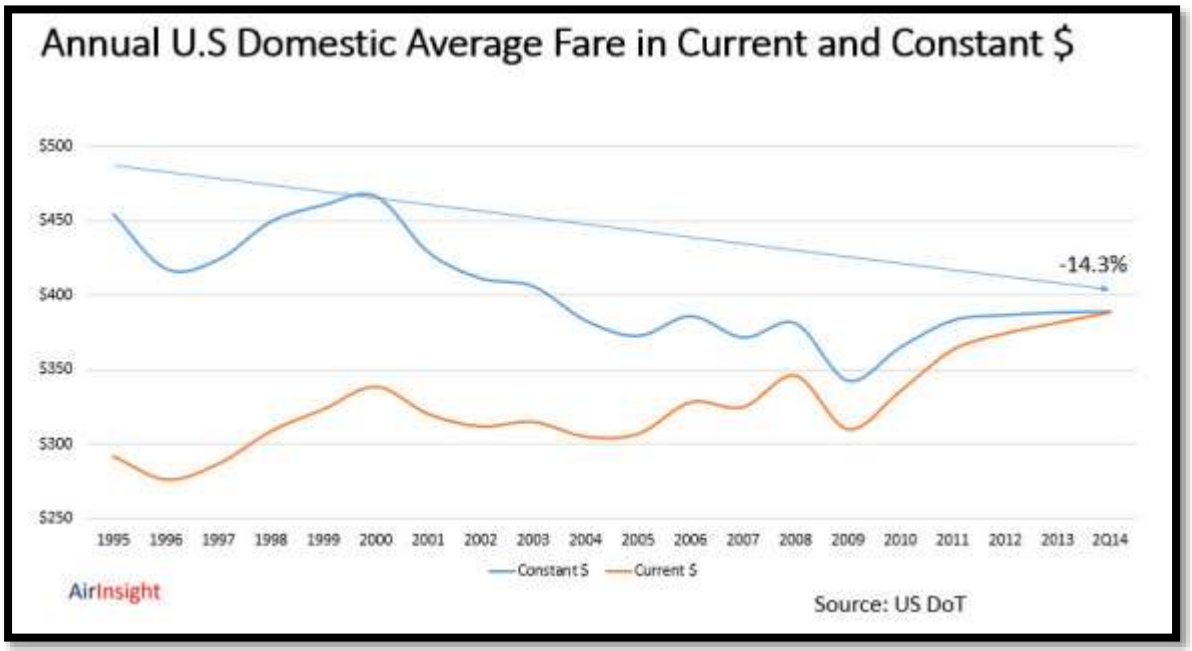


With growing traffic demand and shrinking seat supply, US airlines have brought in buckets of money. Revenues are up over 73% between 1995 and 2013. Network airlines have done better than LCCs at growing their revenues. Where did this come from? The answer, to a significant degree, is ancillary revenues, such as baggage fees - or from the customer perspective, nickel and dimeing the consumer. As the next chart shows, the buckets of money were made despite fares actually going down in constant dollars - meaning the increase was from non-fare revenues.



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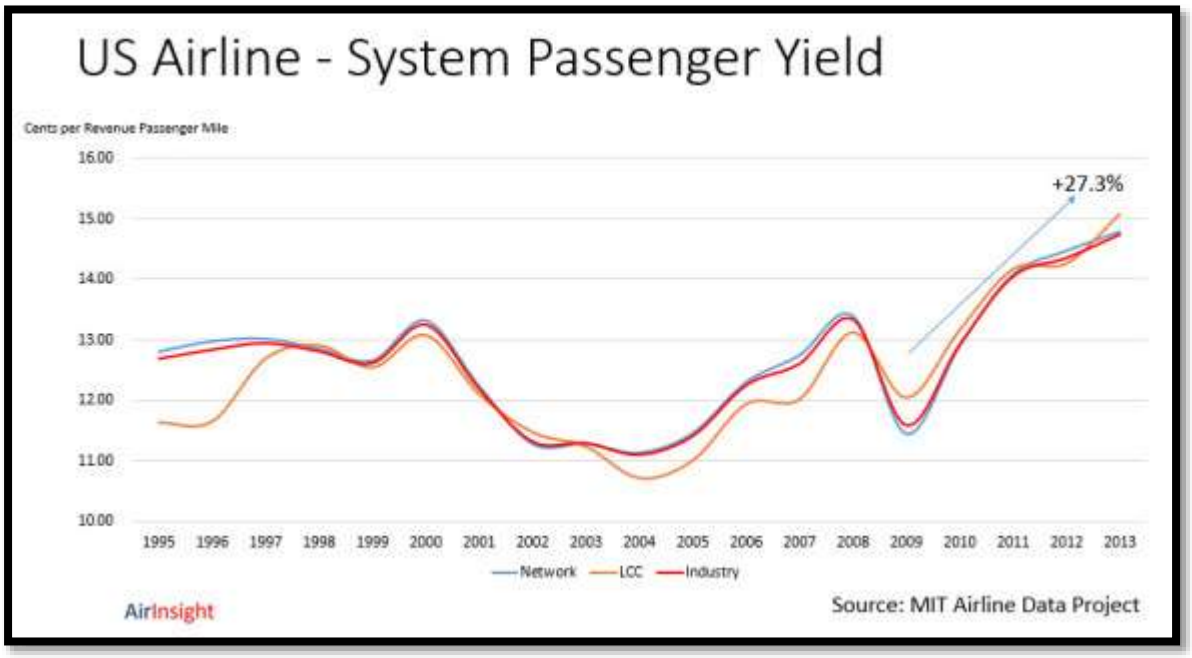
When one looks at the average fare charged, in constant dollars, the value is down 14.3%. However as the other charts illustrate, US airlines have more than made up for this by cutting capacity while demand grew. Note how fares started to rise after 2009. Delta and Northwest started the consolidation phase in April 2008, and by 2009 the industry (magically) started to control capacity and hold the line on fares.



Finally, combining the charts we can see why airlines are rolling in profits for 3Q14. Demand is resilient, capacity has been cut back and fares are creeping higher because the traditional supply and demand clearing spot has moved higher. Since 2009, post the start of consolidation, system revenues have grown over 27%. US airlines have a history of not making profits but now it appears this has fundamentally changed. The question is whether this can remain stable, or if another exogenous shock - whether a terrorist attack or fear of Ebola - could result in a downturn.

The airline industry performance has always been closely related to GDP growth - with a high correlation to traffic. What is different, this iteration, is that airlines have been disciplined about capacity, aren't as concerned about turning away passengers, and happy to earn money on ancillary charges that a few years ago didn't exist, and simply dropped straight to the bottom line. There has been no cost impact resulting from charging for baggage, but a tremendous impact on profitability.

The Bottom Line

Capacity discipline has been the key to ensure that every airline makes money, and the industry has done a good job in the last couple of years holding back from their former strategies of unbridled growth. Perhaps this is a final phase of deregulation, in which the carriers have been reduced those with the cost structures and scale economics to remain competitive, and are happy to share a larger pie. The question is what comes next. Will the current and likely extended decline in fuel prices serve to reinforce, or potentially break, that discipline? We believe the former is more likely, resulting in US

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airlines taking the lion's share of the unexpected profits, passing little onto consumers, and maintaining capacity discipline. We foresee a continuation of rational oligopoly economics at work.

Will the industry discipline hold? We are betting yes, because there so few players. The traveling public, however, will be forced to tough it out.

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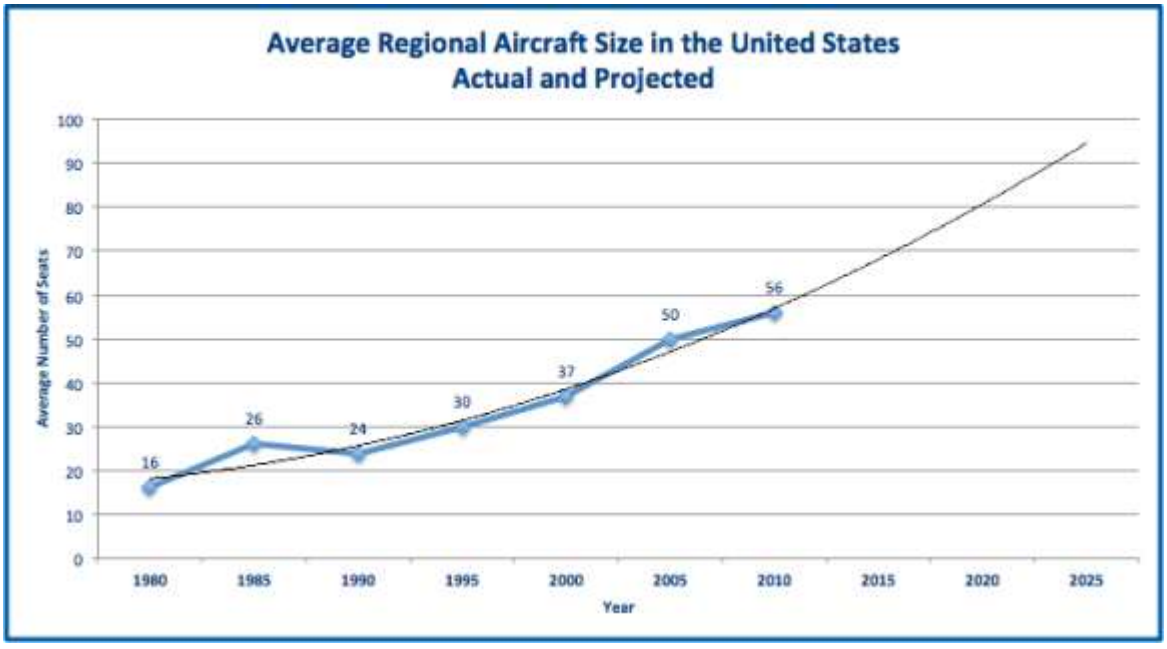
Premium #146 - Evolutionary Dynamics of the Regional Airline Marketplace

11/18/2014

The definition and size of a regional jet is shifting as new and larger models from regional manufacturers are entering the marketplace. The 100-149 seat market, once dominated by the major airframe OEMs, has been invaded by regional aircraft manufacturers, including Bombardier and Embraer. With Airbus and Boeing still participating, albeit relatively unsuccessfully of late, in the 100-149 seat arena, we consider this a "crossover" segment between the regionals and mainline aircraft in our discussions.

The size of regional aircraft has traditionally differed between the US market and international markets, primarily due to scope clauses in pilot contracts with major airlines. In the US, these restrictions govern the size of aircraft that regional affiliates can operate, and have historically restricted regional operations to smaller aircraft than those operated internationally. For example, the Fokker 100, while operated by regional airlines around the world, was operated by major airlines in the US.

The following chart illustrates the average seating for regional aircraft in the US historically since 1980, and includes a trend line illustrating what might happen if past is prologue. With the introduction of larger regional aircraft in recent years, scope clauses have crept up slightly, enabling jets with 70-75 seats to operate with US regionals. We expect the scope clauses to expand to allow 90-100 seat regionals as several new aircraft are introduced before the end of the decade.



The new aircraft are larger than the 50 seat regional jets they are replacing. The Sukhoi Superjet 100 is already in service with 98 seats, and a 130 seat version is under discussion. Bombardier is introducing the CSeries with 110 and 130 seat models, the latter capable of 160 seats in ultra-high density operations. Embraer is re-engining its popular E-Jets, and the E2-175 and E2-195 each gaining seats to

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88 and 132, respectively, with the E2-190 remaining at 106 seats. Mitsubishi will introduce its 92 seat MRJ-90 and plans a 78 seat MRJ-70 models. All current MRJ orders are for the larger version, which will enter service first. Based on the size of new aircraft from regional manufacturers, it appears that the upward trend in aircraft size will continue.

The new 100-130 seat regional jets are generating orders outside the United States, but not within the US due to concerns over scope clauses. At the same time, Boeing and Airbus are moving their mainline customers upward in size, de-emphasizing the 100-149 seat market.

Comparing historical orders for the current generation of narrow-bodies versus the next generation re-engined narrow-bodies from Airbus and Boeing, the trend away from the smaller versions of those aircraft is quite clear. With only 1.8% of the orders for the next generation of narrow-bodies coming from the smallest models, will the 737-7MAX and A319neo follow the 737-600 and A318 out of production as uneconomic aircraft with little or no market demand?

Comparison of Airbus and Boeing Narrowbody Aircraft by Size Total Program Orders					
Existing Generation			Next Generation		
737-700	1,368		737-7MAX	55	
A318+A319	1,544		A319neo	49	
Total 100-149	2,912	20.11%		104	1.8%
737-800	4,822		737-8MAX	2134	
A320ceo	4,640		A320neo	2514	
Total 150-175	9,462	65.35%		4648	81.9%
737-900ER	570		737-9MAX	217	
A321ceo	1,535		A321neo	709	
Total 175-200	2,105	14.54%		926	16.3%

One of the reasons for that transition is aircraft economics, as the forthcoming aircraft from Bombardier (CS300) and Embraer (E2-195) perform more cost-effectively. The following chart shows seat-mile and aircraft-mile costs for jets in the 120-149 seat class, and also includes the larger 150 seat A320ceo/neo and 162 seat 737-800/8MAX models for comparison. The new models from Bombardier and Embraer beat their similar sized competition, and are only slightly higher in seat-mile costs than the larger models (>150 seats) from Airbus and Boeing.

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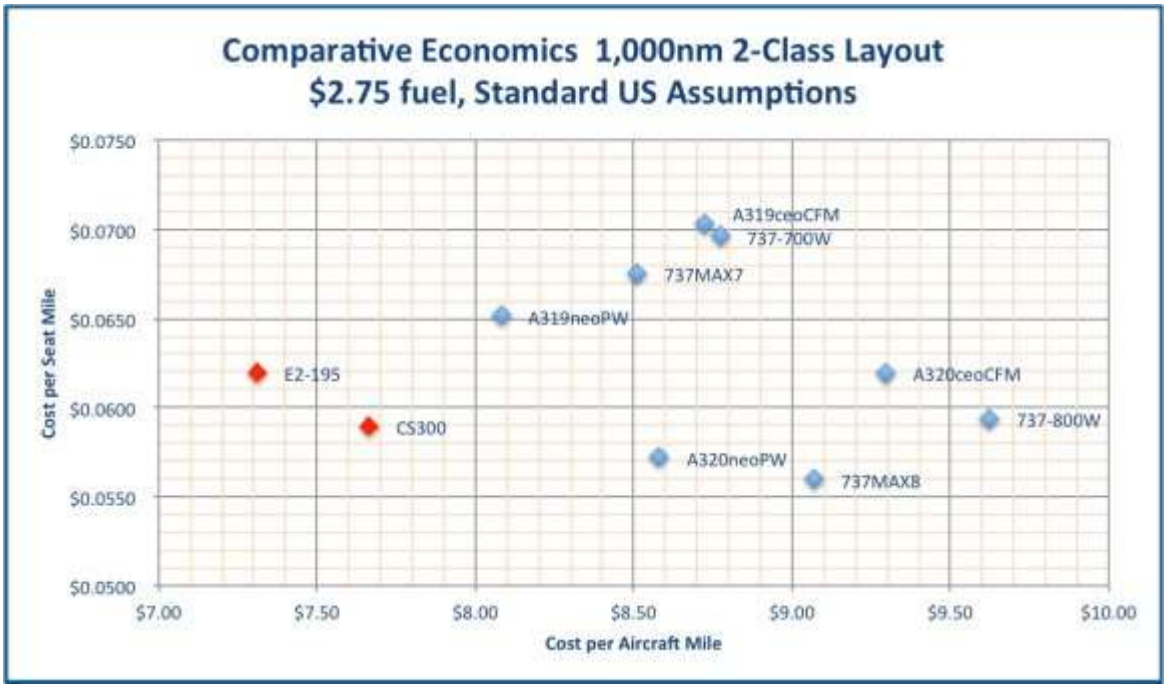
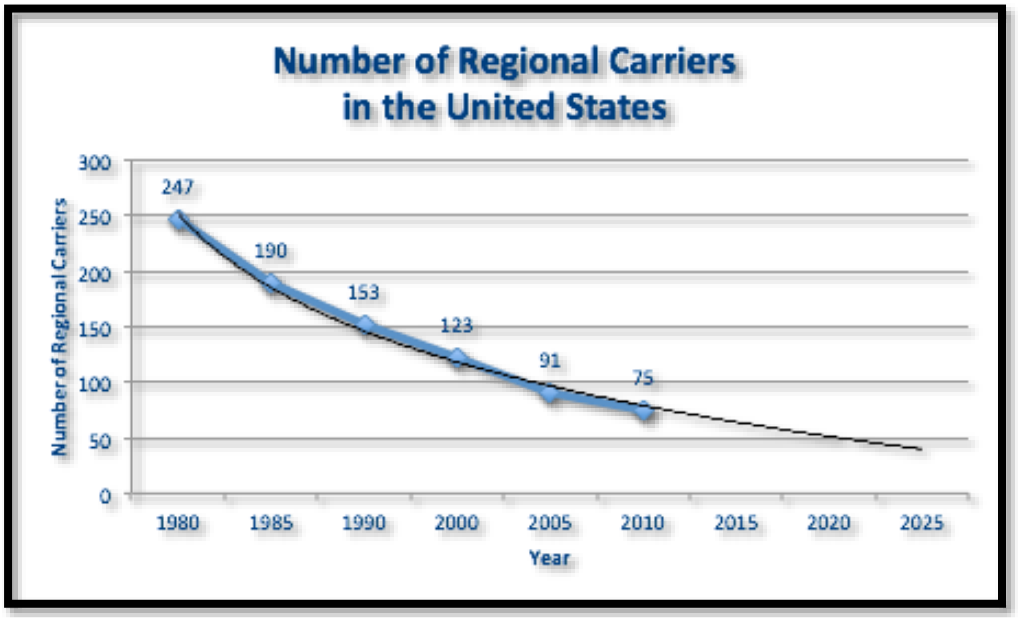


Delta came up with an innovative solution for its 717 operations, negotiating a third wage level between the mainline and regional aircraft in its pilot contract. Could we see a creative bi-level Scope Clause for CSeries or E-2 jets? A workable precedent has been established at Delta that might enable more cost-effective operation of these “crossover” aircraft domestically.

Consolidation is also rapidly increasing the regional airline market in the US. The following chart illustrates the number of regional carriers in the US since 1980. As of 2014, there are 51 regional carriers, falling slightly below the historic trend line and indicating an increase in concentration.



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Will we reach the point of oligopoly, like the major airlines, with only 3 major regional operators? We are currently seeing re-alignment at many operations, consolidation of multiple operating certificates into single certificates to reduce administrative costs, and activities that point to that direction.

Today, in the US market, eight major groups operate the vast majority of the regional fleet. SkyWest, which operates 753 aircraft, is considered a major airline by the Department of Transportation, with more than $1 billion in annual revenues. Concentration will likely continue as these groups move towards single operating certificates and rationalize administrative costs.

If you have an interest in more details about this market, we are publishing our 2014 Regional Jet Report next week. Email us from here with any questions.

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Premium #147 - A closer look at the impact of last week's aircraft orders

11/25/2014

There were two large aircraft orders last week, one for 50 aircraft at Delta and another for 10 aircraft at Kuwait Airlines. Their economics, implications, and contribution to the bottom line of the aircraft OEM, however, appear to be quite different. Airbus won a hard fought order with Delta, but at a deep discount likely to result in low margins. Boeing won a smaller battle, but with a lower discount, and will

likely earn a substantially higher margin per aircraft from its order.

The Delta Order

The long awaited wide-body order from Delta selected Airbus as the big winner. The order for 25 Airbus A350-900s and 25 Airbus A330-900neos is worth $14.2bn at list prices. According to Avitas, however, the size of the deal is closer to $6.2bn. Delta may have secured a 57% discount, on average, from list prices. That is excellent news for Delta shareholders, but not as good news to Airbus shareholders and their bottom line. If Avitas is correct accurate, there has been a big transfer of value from Airbus shareholders to Delta shareholders.

The industry rumor mill indicates that Boeing lost the Delta order because of its inability to offer a 787 delivery slot that suited Delta. The implication is that Boeing's 787 sales are doing rather well with a backlog that hasn't much flexibility. If Boeing could have, they certainly would have shuffled deliveries

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to be able to slot in aircraft for Delta. No OEM would want to say no to the second biggest airline in the world. Clearly, both companies wanted this order.

Airbus, with the introduction of the A330neo, created a pricing weapon to be used against the 787-8 and -9. Because their aircraft is a low-cost derivative of an existing aircraft, they have much lower development costs to amortize per aircraft, and can offer these aircraft at much lower prices than Boeing could offer a 787, particularly after the extended development program dramatically increased program costs.

Our analysis of "pricing to economic equivalency" indicates that Airbus would need to price the A330neo about $25 million lower than the 787 with fuel prices at $100 to make up for the higher fuel burn. However, at $80 fuel, that differential shrinks to between $15 and $20 million.

Of course, the OEMs quote list prices, which in recent years have deviated significantly from actual prices than in the past, with discounts of 55% plus for key orders now seen often. Almost any airline is able to achieve 30% off. While not quite in the day after Thanksgiving "Black Friday" retail sales territory, the OEMs today are close. List prices appear meaningless guidelines.

If we look at historical list prices, they have risen much faster than inflation, reflecting the desire of aircraft OEMs to better obfuscate their economic realities when they report transactions. Hence list prices for aircraft involved in transactions this week that seem astronomical when compared with the reality of what airlines pay.

Aircraft	List Price in $MM
A330-800	241.7
A330-900	275.6
A350-900	295.2
B787-8	218.3
B787-9	257.1
B777-300ER	330.0

It is likely that Boeing would have offered Delta a typical 45-50% discount on the 787-9 for this order, pricing aircraft at around $140 million. Based on the Avitas deal estimate, Airbus sold their planes at an average of about $124 million. We would expect that the A350 would be priced higher than the A330 neo – with the A350 in the $140 million range and the A330-900 around or just under $100 million.

The Delta order has been characterized as having been won through the availability of earlier delivery slots. Airbus and Boeing are pretty well sold out until 2020 for their new technology 787 and A350 models. Could it have been the low pricing on the A330neo that made the difference? Airbus' strategic pricing weapon against the 787 – the A330neo – has won its first competitive battle.

But does this mean Boeing is in trouble? Of course it doesn't, despite what one reads in the media. Boeing is well positioned, particularly in the large twin segment with 777 and 777-X, and has the fully amortized and highly profitable 777-300ERs that are still selling.

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The Kuwait Airways Order

The second major deal this week was the announcement that Kuwait Airways intends to purchase ten 777-300ERs. This order has a list price of $3.3bn, which pales in comparison to the $14.2bn Airbus/Delta deal. Boeing may at some point be forced to offer deeper discounts the 777-300ER to ensure that it's production line stays busy until the new 777X enters service. However, we do not believe that Boeing provided discounts anywhere near the level of 57%. And even if Boeing did discount that heavily, it might still end up with a more profitable deal than Airbus, as the Boeing 777 program, unlike A350 and A330neo, requires no further development, is way down the cost curve, and remains highly profitable.

After the Delta order, the Airbus A350 program is still 25 orders behind from where it was in January (after the Emirates cancellation of an order for 70 A350s). Boeing on the other hand is sitting on 53 additional 777 orders year-to-date and a backlog about 270 aircraft through October. While this backlog won't last through the 777X EIS, Boeing is under less pressure than Airbus.

The Bottom Line:

A win at Delta would have been good for Boeing. But a loss is not as painful as it appears. Airbus needed this order more than Boeing did, and priced accordingly. It may turn out that after all the discounts and accounting clouds are cleared, that Boeing could have made more profit on the ten 777s sold to Kuwait than Airbus will make on its 50 aircraft sold to Delta. Volume is only one factor in the equation – margin is another. Selling airplanes is one thing – cash flow and profitability is another.

As an example of what the deal might look like we collaborated with Collateral Verifications (CV) in creating the following table. CV has conservative valuations on discounts; they believe Airbus does not need to discount the A330 too much given its popularity - they mention recent sales at $130m, then throw in escalations for the next four years and even with big a "Delta discount", the A330-900neo is around $130m. Using our own estimates on amortization and production costs we estimate the assumed profit.

Prices in US$m

Airbus	List	Discount	Estimated Real Price*	Number	Real Sale	Assumed profit		Total Profit
A350-900	295.2	48%	155.0	25	3874.5	18%	27.1	678.0
A330-900neo	275.6	53%	130.9	25	3272.8	16%	20.9	523.6
				50	7147.3			1201.7
Boeing								
777-300ER	330	49%	170.0	10	1699.5	22%	36.5	365.4

* Source: Collateral Verifications

In summary, Airbus may have had a big win, but they may be averaging a profit of $24m per aircraft sold compared to nearly $40m in profit per Boeing aircraft sold. It is clear that Airbus regards the Delta deal as strategic; with hopes of influencing American next. Which is perhaps why Avitas has a much lower (13%) valuation on the Delta sale than CV. Indeed Avitas may have factored more items and reduced its estimate of the real price for the Delta deal.

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Premium #148 - 787 Fuel burn performance and the limitations of public data

12/2/2014

There is much good to be discovered in the US DoT's Form 41 data. But it is important to understand the limits of this source. As an example we are going to take a look at the data this source has on the 787.

Recently FlightGlobal published (Nov 18-24) an excellent article on a series of interviews they undertook with airlines operating the 787. The overall feedback from airlines is positive. No doubt this gives Boeing a lot of comfort. Airlines report the 787 is a fuel efficient aircraft – with 20% savings over what the 767-300ER achieved apparently quite common. This is the number Boeing promised their customers.

However when one looks at data from the DoT Form 41 there is a very different story to be told. Take a look at the table below. The DoT only has data being reported by United Airlines, since it is the sole US-based 787 operator. Fortunately United flies the 767-300ER also, allowing for an even comparison. The columns in blue are the actual data from Form 41. Definitions of each column are shown below the table. In order to try to even the comparison as much as possible we calculated the fuel use by fight hour and then by seat.

Clearly the 787, according to this data, is nowhere near 20% more fuel efficient than the 767. United claims they were not contacted to be part of FlightGlobal's 787 story.

United Air Lines

767-300	Sum of FUEL_FLY_OPS	Sum of AIR_FUELS_ISSUED	Sum of TOTAL_AIR_HOURS	Fuel Fly Ops/Air Hr	Fuel Fly Ops/Hr/Seat	Air Fuel Issued/Air Hr	Air Fuel Issued/Air Hr/Seat
2010	555855.9	239932.77	155.27	$3,580	$16.73	1545	7.22
2011	667548.38	231513.6	149.88	$4,454	$20.81	1545	7.22
2012	710494.41	217115.92	136.37	$5,210	$24.35	1592	7.44
2013	678588.97	220689.46	138.6	$4,896	$22.88	1592	7.44
1H14	308719	101524.98	64.79	$4,765	$22.27	1567	7.32

787-8	Sum of FUEL_FLY_OPS	Sum of AIR_FUELS_ISSUED	Sum of TOTAL_AIR_HOURS	Fuel Fly Ops/Air Hr	Fuel Fly Ops/Hr/Seat	Air Fuel Issued/Air Hr	Air Fuel Issued/Air Hr/Seat
2012	5698.84	1850.49	1.21	$4,710	$21.51	1529	6.98
2013	92673.43	30583.57	18.76	$4,940	$22.56	1630	7.44
1H14	107411.2	35255.17	21.89	$4,907	$22.41	1611	7.35

Source: US DoT Form 41 P5.2

Fuel_Fly-Ops	Flying Operations - Aircraft Fuel And Oil (000)
Air_Fuels_Issued	Aircraft Fuel Issued in gallons (000)
Air_Hours	Total Aircraft Airborne Hours (000)
787-8 seats (2 class)	219
767-300 seats (2 class)	214

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So now what? Did airlines lie to FlightGlobal? We sent our table to Boeing and United, asking for help understanding what this might mean. Boeing provided the following response: "*On average, 787 customers are seeing a 20 percent fuel advantage over their similarly-sized airplanes without efficiency upgrades. The variance in percentages is due to several factors including route structure and engine type. The longer the flight, the better the fuel efficiency. For example, a shorter-range mission won't see much benefit, but a 6,000nm flight can grow to more than 20 percent. We won't go into detail on specific customers, although ANA has been public about their greater than 20 percent fuel advantage.*" As of this writing United has not responded.

Meanwhile, given the obvious discrepancy in the data we also turned to masFlight, the leading source of airline operational data. They also took a look at our chart and then went off to do some digging. This is what masFlight came up with.

Diffrence in Enroute Burn Per Flight Hour between 767-300ER PW4060 and 787-8 GENX-1B70

Month	ORDFRA	SEANRT	MELPER
JAN	15.2%	17.1%	13.5%
FEB	15.2%	17.0%	13.4%
MAR	15.3%	17.0%	13.4%
APR	15.4%	16.9%	13.4%
MAY	15.3%	16.9%	13.4%
JUN	15.4%	16.7%	13.9%
JUL	15.6%	16.7%	13.4%
AUG	15.5%	16.9%	13.5%
SEP	15.3%	17.2%	13.2%
OCT	15.1%	17.5%	13.4%
NOV	15.2%	17.4%	13.6%
DEC	15.3%	17.3%	13.3%
Average	15.3%	17.1%	13.5%
Median	15.3%	17.0%	13.4%
Distance (nm)	3,980	4,368	1,560

The table shows data for a twelve month period on three routes using aircraft performance data, allowing for a fair competitive comparison carrying the same payload. The table shows that, in fact, the 787 is regularly producing a better fuel burn than the 767-300ER.

masFlight estimates that, on average, for the routes shown in the table, the 787 operates with a fuel burn improvement of 15.3%. Given the stage lengths and taking Boeing's statement about 6,000nm above, the numbers are plausible.

This is not a 20% saving as stated by airlines in the FlightGlobal story. Though the differences are much smaller than we see from Form 41; 5% is still significant. How to explain this difference?

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As with all data sources there are variances that are not obvious. For the Form 41 a reasonable suggestion might be that the data filed by United does not allow for a fair and equal comparison when we group all the data. The Form 41 remains a useful tool for all sorts of analysis. But one must understand that it does have limits.

What we need to do there is ensure the comparisons are done on a per route basis, normalizing payload or Zero Fuel Weight and air miles flown to ensure comparable mission profile for both aircraft. Indeed this is what we accomplish with the masFlight data.

How then to explain the difference between masFlight data and what airlines told FlightGlobal? We believe the differences can be explained by, again, understanding data sources and inputs. For an airline, like LAN, flying relatively new 767-300ERs the improvements from the 787 are going to be smaller than 20%. On United's routes, we may be comparing older 767-300ERs with new 787s where fuel burn savings will be higher. In addition if the 767-300ER has winglets, then its fuel burn delta with the 787 will be less than 20%. Nuances are not insignificant; rather they can add up to show big differences.

When Boeing first spoke about the 20% savings, no winglets were being considered on the 767, so the number was a reasonable target.

In conclusion what we learn from this is that when comparisons need to be made it is important to ensure that data sources are as clean as possible. Fair comparisons require exactly even playing fields. This is an industry that does not have a shortage of data. But when data is pulled for analysis, if it doesn't pass the initial smell test, it's not necessarily wrong. It most likely means that one has to seek out another view and try again.

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Premium #149 - Evolution of wing aspect ratio

12/9/2014

The commercial aerospace industry has seen tremendous changes in technologies. Generally the focus has been on things like materials and engines. But there is another item that often gets overlooked in the evolution of aircraft, and that is evolving wing design. We know the new wings look different, but there is magic going on that is unseen.

Aviation Week's Guy Norris points out that when one looks at the wing of the 737 there has been tremendous change. Using the 737-200ADV as a baseline, Boeing improved the aerodynamic efficiency of the wing by 2-3% up to the 737 Classic in 1984. Then in 1997 when Boeing introduced the 737NG, it was able to improve wing aerodynamic efficiency by some 22% over the -200ADV. The NG wing is supercritical with a higher aspect ratio. Shortly after the NG introduction Boeing added winglets and the aerodynamic efficiency rose again to some 27% better than the baseline -200 ADV. The NG wing had greater surface area yet weighed 200 pounds less because they could make the skin thinner. Without these advances in wing design, the 737 could not make transcon flights as it does routinely today.

Boeing started to use composites in their wings on the 787, offering the same "stiffness" but with a higher aspect ratio providing a more aerodynamic efficient airfoil. This allows a more "sail plane" like airfoil for the same structural weight. In effect getting the performance of a larger conventional wing but with less weight and drag. The 777X is an example of where this leads – an aircraft longer than the 747, with wider wingspan yet requiring less thrust than the current 777. The 777X wing will flex more and have increased aspect ratio.

Airbus has been going down the same path. Using cutting edge design the A350 wing has different aspect ratios along its length. The A350, for example, has a higher overall aspect ratio than any previous Airbus big twin. We expect that the A330neo will see its wing optimized and end up with a higher aspect ratio than the A330ceo. A clue to this is the fact that the A330neo wing is four meters longer than that of the A330ceo.

Wings are the part of the aircraft that generate lift and are heavy. For example the metal panels on a wing may be ten or more times thicker than the panels covering the fuselage. A general rule of thumb is that an aircraft's wing weighs about one-third of the total weight. In an extreme case, we understand that the A380 wings weigh as much as the fuselage. This underscores how much stress wings handle, and why they need to be among the most robust parts of the aircraft.

Many design elements play an important role in wing design; for example airfoil shape/efficiency, laminar flow, winglet technology, span load distribution and nacelle integration. Also, a vertical winglet has zero impact on span and aspect ratio, but would impact efficiency. For this story we are focusing on only two aspects – wingspan and aspect ratio. This post cannot discuss all aspects of wing design. We want to simply point out how wingspan and AR are changing.

The Aspect Ratio (AR) of a wing is defined as the square of the span divided by the wing area. Generally newer aircraft in commercial service are seeing a rise in wing AR. The rule is wings with higher ARs generate lift with less drag and provide better flight efficiency. Essentially, a high AR wing is more efficient because it reduces vortex formation and associated drag. A higher AR for a given span means a

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smaller chord distance, lower area and thus higher wing loading. Wing design is mission related and so when looking at the charts below one should bear these tradeoffs in mind.

For efficient economic cruise a higher AR is preferred. Which is why we see commercial aircraft tending towards higher AR. For an aircraft that spends a lot of time climbing and descending, like a regional airliner, a high AR may not be optimal. But for a long range aircraft, cruising at altitude for many hours per segment, almost certainly a higher AR is optimal.

Designers face tradeoffs with every aircraft. Selecting the key dimensions for a wing is no doubt a process replete with many arguments within engineering teams. For example the A380 AR is relatively low, but was the outcome of building an aircraft of its size and speed while making it fit in the same airport gate "box" as the 747-400. This was a request from Singapore Airlines. Airbus gave the customer what they wanted and secured orders. The tradeoff here was a business decision that overcame a likely quite different wing design the engineers might have preferred. Of course, taking a leaf out of the Boeing 'big wing' design handbook, the wing enables Airbus to stretch the A380 with minimal wings changes and keep its prodigious fuel capacity.

In our assembling data for the charts it became clear that OEMs regard wing data to be commercial secrets. Consequently we had to be creative with some of the data; for example the A320 and A321 have the same wing. Airbus will not provide any updated data after adding sharklets the basic wing – which impacts the wings' dimensions and therefore it's AR.

For our estimates we selected wings at rest from public sources and used that information as a departure for estimates we produced. These estimates are shown with a red asterisk. We had our estimates evaluated for credibility by a third party expert.

As the charts illustrate, the aircraft evaluated fall into broad categories. On the first chart are the single aisle aircraft that operate flights typically under 2,000 miles. Within this group you see three arrows showing changes in AR from earlier to later models.

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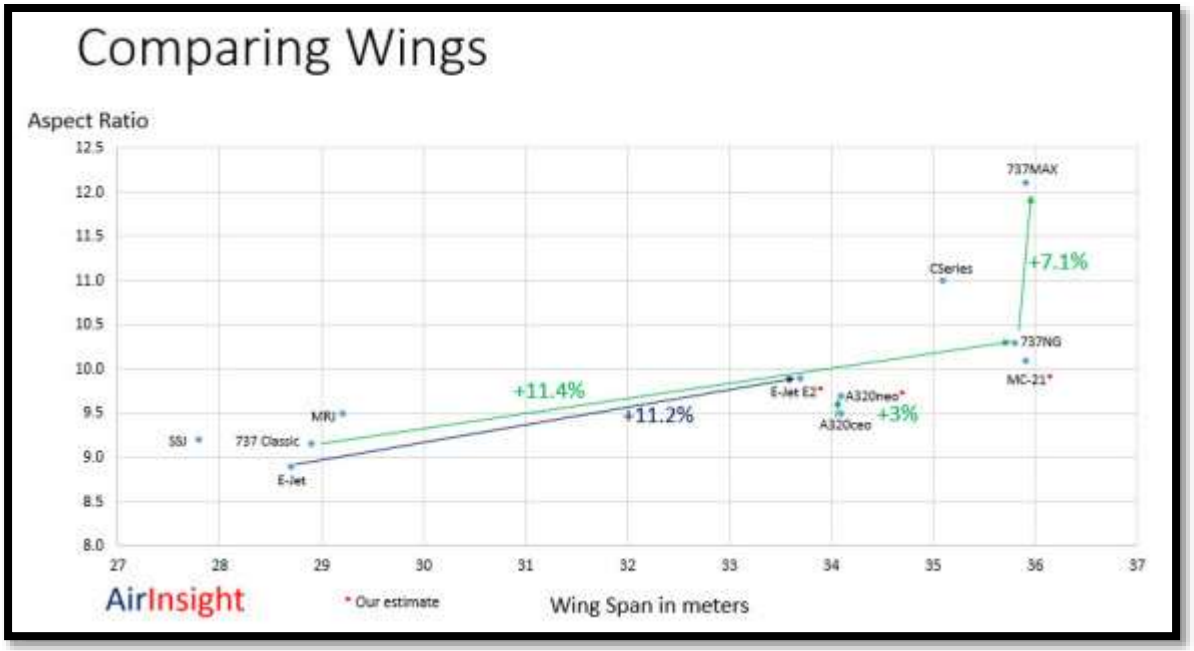

Even though AR is a complex part of the design tradeoff, one can see the shorter an aircraft's planned range, the lower its AR. As OEMs update aircraft, we see AR is rising. Note the changes between the 737 Classic and NG for example. While the span increase on the E-Jet to E2 is public, we believe the wing will see an appreciable increase in AR based on our estimates. Embraer would not provide us with AR or wing surface area. But we expect to see the E2 wing offer similar rates of improved AR as the 737 NG did over the Classic.

The next chart is for the VLAs and super twins. Notice the growth in AR for the 777; as the aircraft has grown more capable, its AR has grown. We expect the 777X to have a wing with substantial improvements and have a higher AR than on the 300ER. Key to this superior performance is its design heritage based on a scale-up of the 787-9 wing, plus the addition of extra span through the use of foldable wingtip sections.

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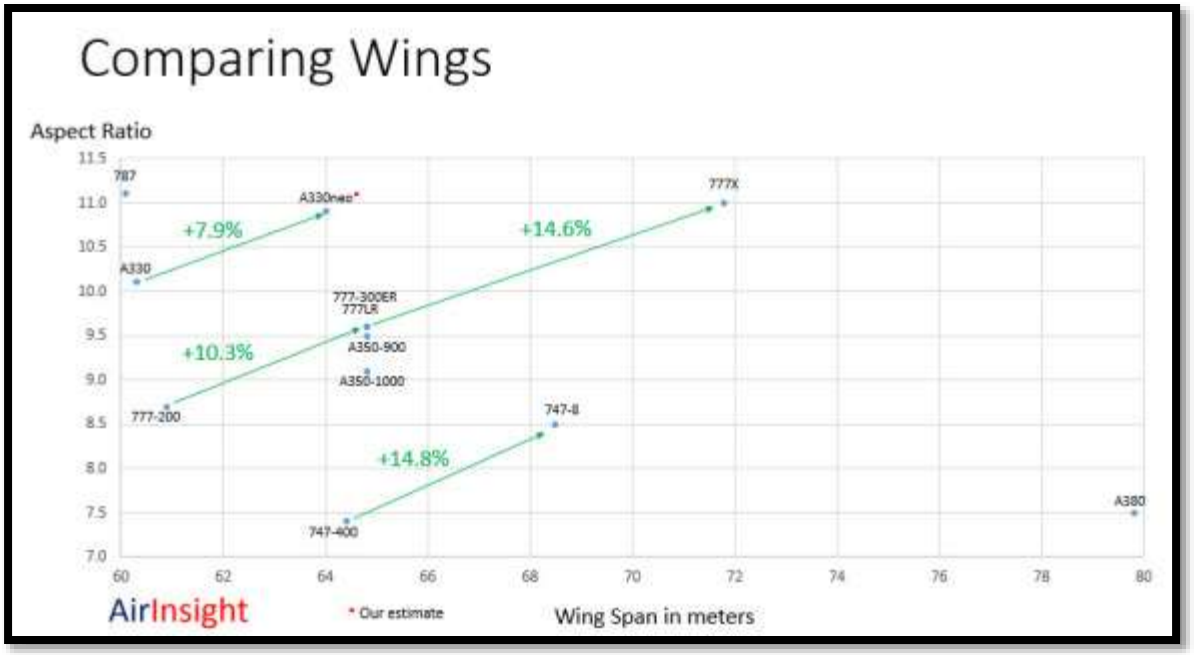

We can see how Boeing improved the AR on the 747-400 moving to the 747-8 and think this is a reasonable guide for what to expect on the 777X. Given the 777X dimensions and the fact it will use lower thrust engines, we expect the greater capabilities are largely attributed to the new wing.

The A380 has a relatively low AR, but this is offset by other features. As explained above, there was an influential customer request. Its wing delivers high speed and long range. Airbus has managed to increase the aircraft's range so that it can fly from Dubai to Los Angeles non-stop. Even if one were to argue that its wing is not as advanced it could be, it meets the effectively operational requirements. Indeed many expect Airbus to eventually offer an A380-900, which would be a stretch of the current A380. Airbus could probably do this stretch using the existing wing.

The 747 has seen a growth in its AR and it is aimed at the same type of service as the A380. Whether Airbus would also tweak the A380 wing for a neo version is not something that has brought up publicly – the focus has been on newer technology engines. Yet as we can see, a wing tweak could be of great value.

Let's look at how AR is evolving in the real world.

- Starting with the 737 - note how Boeing worked on the design and kept improving AR with each generation. We estimate the AR for MAX to be a bit higher than the NG, we estimate 10.3. The NG was a huge leap forward (11.4%) compared to the Classic. On the chart you will see that we used the AR provided by Boeing at 12.1. This AR was much higher than our estimate and is based on Boeing using nearly 15% less wing surface than we estimated.
- The A320ceo wing had a higher AR than the 737 Classic, but the 737 NG is much higher. We don't have an estimate of how the A320 wing AR rose after adding sharklets, but we are certain it did. Both OEMs are stretching the capabilities of these two aircraft to fly further at ever lower fuel burn, and the improvements to wings are playing a role.

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- Note the SSJ has a slightly better AR than the current e-Jet. We estimate the e-Jet E2 will have a significantly higher AR. The E2 will also see capabilities improved in terms of range and fuel burn because of this, helped of course, by new engines. Embraer would not share wing surface area, so we estimated the improvement to be of the order of the AR change between 737 Classic and NG.
- The A330 has a relatively good AR to start with, and we estimate the A330neo will see a 7.9% improvement. This may not seem like much, but this improvement catapults the A330neo very close to the 787 AR at a much lower selling price. The move shows how Airbus can use the A330neo as a spoiler against the 787. An airline considering these two aircraft will (inter alia) make a trade off with an A330neo likely offering 85% of the range/payload performance of the 787 at 60% of the price with a fuel burn 5% higher. It could be very disruptive; much to the annoyance of Boeing. Delta selected the A330neo over the 787. If the 787 offered a much better ownership cost differential, Delta probably would have waited for it.
- Boeing has done a tremendous job driving up AR on the 777. Boeing is using many 787 wing ideas for the 777X. The improvement in AR from the 777-200 to the 777X is over 26%, by our estimate. Given the success of the 777, we think the 777X is also looking at a great future. It is likely to offer excellent economics. Indeed the 777-9 is going to be capable of replacing the 747-8 and compete with the A380. In this role the 777 is likely to be disruptive to Airbus.
- The 787 has the highest AR (11.1) among the larger aircraft in the chart. Just like the A350's wing design offsets its low aspect ratio compared to the A330neo, the 787 also has seen its design evolve from the 767 and end with a much better wing and high AR. Boeing used lessons from the 787 wing and applied these to the 747-8, resulting in a near 15% improvement in AR. This did not help make the aircraft a best seller; but one airline we spoke with pointed out that the 747-8 offers superb economics not because of its passenger capacity. The secret is its cargo capabilities and this is a weakness for the A380. We see the 747-8 has a much higher (13.3%) AR than the A380. But this is a Pyrrhic victory as the 777-9 will likely eclipse the 747-8 in passenger service.
- Note the crowded area with wingspans at ~65m and AR between 9 and 10. The A350 has an AR lower than the A330 and the A330 neo which is eye catching. A wing with lower AR is not necessarily “worse”. The A350 is optimized for flights of 5,000 miles and more at high cruise speeds. Its wing may not have the same AR as the A330, but it is a much more efficient airfoil. The A350 intentionally has deep inner-span section (for good fuel volume and providing lift), while its outer span section exhibits a higher AR. Like the 787 and 777X, the A350 wing will curve in flight, increasing its efficiency. Adding span, and increasing AR, could mean going into a larger gate classification category, creating operational restrictions and more fees charged by airports.
- Finally there are only three aircraft in the charts on the AR line at or over 11 and we have discussed the 787 and 777X. We are surprised to see the CSeries in this group - kudos to Bombardier for this achievement. Many believe the CSeries will have superb hot and high capabilities, and the wing is the reason, along with powerful engines. Odyssey Airways pointed out to us that they plan to serve Chicago from London City non-stop. What other aircraft can do that with 50 passengers?

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Premium #150 - A sense of quiet confidence at Mirabel

12/16/2014

Last week we visited Bombardier's Mirabel facility. In this newsletter, we will share our views on what we observed, and what it means for the CSeries program and Bombardier Commercial Aircraft.

The CSeries program has encountered a few delays, as Bombardier has faced the same challenges that Airbus (A380) and Boeing (787) endured as they developed new aircraft unlike any previous models. New-technology aircraft programs are complex, testing people, engineering, and certification processes. But like its competitors, Bombardier appears to now be meeting those challenges and while the airplane will be late, it appears quite attractive.

In the remainder of this post we'll summarize the key points from our visit.

Bombardier is an organization with a corporate culture that likes to keep thing close to its vest. However, despite the corporate culture, we ended up having discussions that seemed more open than we had previously experienced. Perhaps this is a reflection of a growing confidence that the CSeries program that has overcome major challenges, and that things now appear to be moving forward toward certification and an on-time EIS in late 2015. With improved sales of the CRJ and Q400, the immediate pressure to increase their backlog has also abated to a slight degree.

CSeries

The CSeries program remains the key topic for discussion at Bombardier, and rightly so. The sheer scope of the program and the impact on Bombardier financially is immense, overwhelming everything else in commercial aerospace. The predictable big technical items that face any new aircraft program, and that were overhanging the program on our last visit, have now been completed. The pressure on the technical team appears to be winding down, while pressure on the sales team will be ramping up as the aircraft nears EIS.

Fortunately, the sales team is closer than ever to being able to demonstrate the promise of the CSeries. In a sense of relief that Airbus and Boeing sales teams will vividly recall, sales campaigns become more focused when there's a real airplane to show and demonstrate. The CSeries is a tantalizing program that has proven disruptive to the industry – engendering three re-engining programs. Airlines and lessors we have spoken with all believe the aircraft will be a technical success. The key question is whether the Bombardier sales team is up to the challenge? To date sales for the aircraft have been slower than desired.

A Challenge for Marketing and Sales

In the recent reorganization, there have been some major personnel changes in the sales and marketing functions at Bombardier. As a result, the frequency and intensity of communications is just now returning to prior levels, as the new players take over relationships developed by those who have departed. This takes time, and the dust is still settling from the reorganization.

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One explanation for slow sales is that airlines have recently been burned by placing early orders and deposits for new technology aircraft, in particular the A380 and 787. The logic in the minds of potential customers is that if Airbus and Boeing stumbled with new program development, Bombardier was going to do so as well. And indeed they did, falling about two years behind schedule. Even so, the CSeries has seen more sales in its category than directly competing aircraft from Airbus and Boeing combined. From what we can discern, we believe that there is likely to be a stronger and more positive market reaction to the aircraft after the 1Q15 when aircraft performance data are announced.

Technical Progress and Performance

Bombardier is expected to announce the performance results, including fuel burn, climb, take-off and landing performance, and range from data gathered from FTV4, which is being used to prove performance and economics.

Program VP Rob Dewar was uncharacteristically effusive and confident when we asked about this. His confidence is supported by feedback we have from Pratt & Whitney. We would not be surprised if when performance data is released, the fuel burn numbers are 1-2% better than promised. We asked why Airbus has an “advanced” version of the GTF for the A320neo from 2019 that offers an additional 2% improvement. Rob Dewar indicated that we should not believe that the CSeries GTF is lacking in any way. While he would not share any numbers, when pressed he indicated that when he shares the data with customers early next year that he would be doing so "with a big smile".

He reminded us that the CSeries and GTF combination was optimized from the start. The growth potential of the CSeries, including introducing a higher gear ratio, provides a lot of room for future engine improvements.

Overall, there appears to be more confidence in the program than we have seen before. For example, the decision to push CS300 first flight to January will not delay the program. The initial plan was to have an inaugural flight with the existing software, but then return to the hangar for a software upgrade and not fly for a week, similar to what happened with the initial CS100 that caused concern among some industry observers.

Instead, the team has decided to upgrade its software to the latest version now and then do the first flight when the full team is working after the holiday. Rob Dewar pointed out that many on the team, including him, have not really had a Christmas holiday in recent years. We know that nobody takes any vacation when there are substantial problems. However, since the team will take some time off, the implication is that there is confidence that the program is progressing well to the latest schedule.

The certification process continues at Bombardier. The picture below is of the CS100 aircraft preparing to be used for evacuation tests. You might notice that all of the windows are covered in the

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photo. Typically for evacuation testing, an aircraft is packed to the maximum number of seats possible, which is what the test will determine – how quickly can everyone on board leave an aircraft, and what the maximum capacity is. As with most evacuation test aircraft, interiors are jammed with seats in higher densities than airlines would use normally nor its passengers endure – typically worse than a Ryanair configuration. Virtually every commercial airplane has a higher "exit limit," determined by these tests, than normal seating configuration, which is 125 for the CS100 aircraft in a high-density layout.

Rob provided us statistics that make us feel more confident about the program meeting its current schedule:

- The flight test program has now flown more than 660 hours – they are more than a quarter of the way through the estimated 2,400 hours to obtain certification.
- Earned credits are higher than actual flight hours because many tests did not require a "second go around." Test programs build in extra hours in case a test needs to be repeated. It turns out that many of the tests passed the first time through, reducing the overall number of hours required.
- The flight test program has reached the neck of the hockey stick. Last month the program recorded the most test flight hours to date. The flight test program also achieved a company record with all four FTVs flying, totaling more than 17 hours in one day.
- The fly-by-wire software is maturing, and is currently at version four of six planned iterations. The test aircraft have experienced no delays or interruptions since all aircraft have been modified to use version four of that software.
- The team used the engine delay to update the fleet software using the CIASTA ground testing system, and as a result the flight test aircraft were modified from version #2 directly to version #4, without the need for the third revision. Typically it takes about a week of tests to validate the software is working when installed in an aircraft before it can fly again, as this software directly impacts safety of flight.

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- Confidence in the aircraft appears to be growing rapidly. Flight crews are pleased with the aircraft handling and performance, and there are no significant items causing any concerns.
- Wing tests have performed better than expected, and the wing strength test designed to break the wing has absorbed more than 5,000 pounds additional weight than initially anticipated and not yet broken. While testing continues, the pressure is now off.
- Economics – no data will be available until 1Q15. But Bombardier seems very confident. FTV4 is economics test vehicle. It is currently reportedly performing better than initially expected. This is backed up by what we have heard at Pratt & Whitney, who make the GTF engine.
- Although officially Airbus and Pratt & Whitney say the neo is first to get 2% GTF "advanced" fuel burn improvement, Bombardier will obtain some additional benefits with software updates. Because engine and aircraft are optimized for each other as opposed to a re-engine of an aircraft designed with another engine, the CSeries aerodynamic integration is better than its re-engined competitors. We believe CS will still have a better than 5% advantage over A319neo in operating economics.
- Company tests now appear to be on or ahead of schedule. Cabin evacuation is up next. Critical tests for flutter, wing strength, and software are complete or past the point of any unexpected showstopper. Normal fly-by-wire mode is now the routine for all flights.
- Though Bombardier won't name the launch customer, they are confident of 4Q15 delivery and EIS.
- Even though Bombardier is currently in a financial disagreement with Alenia, parts for the aircraft are coming in on schedule. Quality of the parts being received is not an issue. The production ramp-up starts in January, but no further details were provided during our visit.

Aircraft Production and the New Facility

We were able to visit the new production facility in Mirabel and see the new production lines for CSeries. The facilities are impressive, and incorporate high technology that should help improve productivity.

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- The production factory floor is highly automated, including robotics. The first fuselage is going to be moved in the area shown below in January for wing join. The empennage is already in the storage area to the back of the scene in this image. There are two production lines on this floor. The devices on the floor descend below the floor when fuselages are moved into place and then rise underneath to hold the airframe and other components for wing join and assembly activities.

- Here we see fuselage #7 in assembly during shift change. The hull to the left is a CS300 (two over wing exits). On the right is #7 now in fuselage join and called a cigar. Both these fuselages are production models. #7 will be lifted and moved forward next month and robots will place it on frames that rise from below the floor. Lasers will then ensure the fuselage is placed with great accuracy. This ensures minimal use of shims and much tighter fit. Airbus is using similar technologies with lasers on the A350.

The Bottom Line

It appears that Bombardier has turned the corner with the technical aspects of the CSeries program. Key players who earlier this year looked beleaguered now appear smiling and confident.

The question now is whether the market will develop for Bombardier, and if they can withstand the price competition from Airbus and Boeing, who are offering their larger models (which can compete on a seat-mile economics, but not aircraft mile economics) against smaller CSeries models. There have been few sales in the 130 seat class, as A319neo and 7MAX are not selling well at all – to the point that there is some question if either will be built, leaving the 130 seat market to the CS300 and E2-195. Nonetheless, sales in the 100-150 seats segment have not been lighting the world on fire.

We believe Bombardier will meet its goal of 300 firm orders by EIS, and could easily do so if existing options and purchase rights, which exceed 500, are executed. The question is whether sales momentum

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can be built prior to EIS, and whether market confidence in the aircraft can be quickly established to increase the customer base. 2015 is a critical year for the new marketing team at Bombardier.

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Premium #151 - 2014 in Review

12/23/2014

2014 was an interesting year in aviation, with the launch of the A330neo and first delivery of the 787-9, continued high demand for the A320neo and 737MAX narrow-body families, and a return to record profitability for the major US airlines, particularly as fuel prices decreased in the fourth quarter. Let's

revisit some of the key events in 2014, player by player.

AIRBUS

The major news at Airbus in 2014 included the launch of the A330neo at Farnborough, and the certification and first delivery of the A350XWB to Qatar Airways yesterday.

The A330neo will be available in -800 and -900 models that correspond to the current A330-200 and -300 in size. These new aircraft promise a substantial fuel burn improvement over the A330ceo. While not as fuel-efficient as the Boeing 787, the A330neo will be priced significantly lower, and is strategically positioned to erode margins from 787-9 and -10 sales.

Being offered alongside the new technology A350, Airbus now has both economy and premium options in the medium size twin marketplace. With a recent order from AirAsia X, the A330neo appears to be gaining traction. The big question is how long demand for the existing A330ceo model will continue before additional production cuts, beyond those already announced, will be needed. The A330ceo, and at Boeing the 777-300ER, face a similar challenge of filling production slots in the wake of new and more efficient variants being offered. That will require significant discounting.

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The A350 delivery to Qatar is Airbus' answer to the high technology 787, and has very competitive operating economics. The smoother introduction of this high technology airplane, with only minor schedule delays when contrasted against the A380 and 787, is a major accomplishment for Airbus. We expect strong success for the A350.

The A320neo is moving forward, with its first flight featuring PW 1100G GTF engines, to soon be followed by the CFM LEAP engine in 2015. The neo is about 2 years ahead of the 737MAX in development, and is reflected as such in its backlog of 3,436 firm orders and 4,938 commitments (orders, options and MOUs). Market share for engines on the neo program are fairly even, with 35% CFM, 29% PW, and 37% undecided. We expect a 50/50 share long-term on the A320 model, and a bit higher market share for PW on the A321 due to its higher thrust.

Within the A320 family, the A321 appears to be the most popular choice to replace Boeing 757s, and is selling much better than the 737-9MAX, which has not garnered significant orders. We expect that trend to continue. The A319neo has not generated many orders, and we believe Airbus may drop the program, similar to the A350-800 model, transitioning customers to the A320neo.

The A380 has been controversial, with conflicting signals being sent by Airbus management at last week's investor conference. Airbus indicated that the program will be profitable by 2018 and pass break-even point. Airbus is now considering both a re-engining and stretch of the A380, with pressure from Rolls-Royce (which has an alternative engine based on the Trent XWB that could readily be available) and Emirates, which stated that they would purchase an A380neo. The question is how large is the market for an A380neo or stretch.

Engine Alliance, a joint venture of GE and PW, which makes the competing A380 engine, GP7200, is the best-selling engine on the A380. It may have a more difficult time developing an alternative engine within the time frame as Rolls-Royce. We believe that the A380 EIS was a decade before its time, and with a new engine option, will now come into its own as traffic congestion increases at key hub airports.

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BOEING

The major news at Boeing in 2014 is stability, with no major problems and a return to normalcy after a rocky 2013. The highlight of the year is the first delivery of the 787-9, which entered service with Air New Zealand.

The good news at Boeing is that the 787 aircraft program appears to have finally reached its intended objectives. The 787-9 production ramped-up without the problems that the previous 787-8 had, and the 787-8, despite a rocky development program and terrible EIS, including a grounding of the aircraft in 2013, is operating smoothly. Those problems now appear largely in the rear-view mirror, and delivery schedules are now being met on time, with the aircraft performing well.

The 777X has had strong demand since its launch in late 2013 at the Dubai Air Show, and has generated 220 orders to date in 2014. Meanwhile the 777-300ER has generated only 39 orders during the same period. With six years of backlog to fill until the new model arrives, and only about 3 years' worth of orders in backlog, there is a significant gap that Boeing will need to fill in order to maintain existing production rates in Everett.

Interestingly, the 777X has a new set of key vendors for many components, including Heroux-Devtek rather than UTAS for the landing gear, and GE rather than Honeywell for the electronics bus that integrates avionics and flight controls for the aircraft. Boeing's partnering for success program is having an impact, as they tighten margins for component suppliers on new aircraft programs.

The 737MAX continues to generate strong order volume, with 2,558 firm orders and 3,734 commitments. The aircraft is essentially sold out through 2020 based on production schedules ramping up from the current 42 to 47 per month by 2017 and 52 by 2018. Even with the increased production levels of 620 aircraft per year in 2018, the commitments represent a seven year backlog. The bulk of MAX orders are for the -8, with the -7 not selling well at all, and the -9 finding it difficult to compete with the more capable A321neo. If Airbus drops the A319neo, the -7MAX may not be far behind.

The 747-8 is not selling well as a passenger aircraft, and freighter demand, expected to be the mainstay of this program, is also weak. As a result, Boeing has reduced the production schedule to a little over one per month, and appears to be waiting for the Air Force One replacement RFP in 2017 before

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dropping the 747-8 program. The 777X accommodates roughly the same number of passengers with better efficiency, rendering the 747-8 economically obsolete.

BOMBARDIER

Bombardier had a rocky 2014, with the grounding of the CSeries test fleet due to an oil seal issue with the PW1000 GTF engine during flight testing, resulting in a partially contained engine failure. This delayed EIS from early 2015 to the second half of 2015.

The good news from Mirabel is that after the disruption from the engine, the test program has resumed with positive results. Virtually all of the "showstopper" tests, wing bending, flutter, and fly by wire have passed the critical elements, and there is a new confidence that the program, which is now over 660 flight hours, will be completed on schedule.

The CSeries is an interesting aircraft, and has now achieved 263 firm orders and more than 500 commitments, including an order from Macquarie leasing for 50 aircraft this summer. While Bombardier will not yet confirm economics, their senior executives indicated that they expect to be smiling while delivering economic results from FTV4 early next year. While demand in that segment has been slower than desired, the CSeries is outselling the 737-7MAX and A319neo combined.

The CRJ program experienced a resurgence, with a major order from American. The cabin for the CRJ remains cramped, but the seat-mile economics within its class remain compelling. The question is how airlines will balance economics and passenger experience in their fleet planning decisions. The larger CSeries offers both.

The Q400 introduced two new variants, a 50-seat passenger/freight combi model for the developing world, and an 86 seat high density variant for LCCs. With an 86 seat Q400, it is unlikely that we will see the development of a new 90-seat turboprop from Bombardier in the near future.

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EMBRAER

Embraer launched the E2 series, a re-engining of its existing EJets, at Paris in 2013 and revealed additional information on the program in 2014. Much like A330neo and 777X, Embraer faces the problem of filling the production lines in the near term with the existing models prior to the EIS of the E2 in 2018, 2019, and 2020.

From 2010-2013, Embraer averaged 100.5 deliveries annually. With a firm backlog of 266 EJets the company can sustain a production rate of 66.5 annual aircraft before the new models are introduced, leaving a gap of about 1/3rd of production capacity to fill, the same dilemma as A330neo and 777X. The E2 jets had 210 orders at the end of the third quarter.

The E2 Jets, with improved economics from the Pratt & Whitney GTF engines and other improvements, will be economically competitive with other new aircraft, including CSeries, Mitsubishi RJ, and Sukhoi Superjet.

MITSUBISHI

Mitsubishi rolled out the first flight test aircraft earlier this year, and now appear to be making significant progress after some program delays.

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The MRJ, with the PW GTF engine, should be quite competitive in the marketplace. To date, MRJ has received orders from ANA, Trans States, SkyWest, wew Eastern, Air Mandalay, and JAL, with 223 orders and 184 options. After two delays, the question facing the program is similar to any other new program after the A380 and 787 -- will it be on time?

SUKHOI

The Superjet program has been quite successful in its North American debut at Mexico's Interjet, with reports of 7% better fuel burn than forecast being reported.

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That said, the limited production capacity for the program is likely slowing potential growth. The Superjet is a modern aircraft with western suppliers for key components, and should be selling better than it is. However, the current political environment and financial sanctions against Russia continue to negatively impact the program, despite no “official” sanctions against aviation.

COMAC

After years of delays, the ARJ-21 is finally close to EIS. Vice-chief designer Zhao Keliang recently admitted that COMAC’s inexperience in aircraft development, supply chain management and certification led to the long delay in the program, which started in 2002. This aircraft is already outdated, and will be severely so compared with the Embraer E2 and Mitsubishi MRJ. Given the primary focus being sales within China, we suspect that Chinese airlines might have a tough time placing orders for these competing aircraft in order to COMAC.

In terms of the C-919, we see this a follow on to the ARJ-21. It is a more ambitious project but will likely suffer the same fate. Although it is an order of magnitude more advanced than the ARJ-21, it is still far behind its competitors. The C-919 competes with the 737 and A320. COMAC today does not have the people and IP to compete with the established OEMs in the segment. Even with next generations engines (LEAP), the C-919 will not be anywhere near a threat to the 737MAX or A320neo. Chinese airlines may be "encouraged" to buy local. This will possibly hurt Boeing more than Airbus, which has an A320 FAL in China.

Of some interest is the potential cooperation between China and Russia on a twin aisle aircraft, ostensibly to be called C-929. China will need two decades of learning, failing and improving to possibly reach the level to compete effectively with Airbus and Boeing. China has the financial capital to get there and its ambitions should not be underestimated.

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ATR

ATR had a very good year - in November ATR and Indonesia's Lion Group signed a $1bn purchase agreement for 40 additional ATR 72-600s, marking a milestone in ATR's history, as Lion Group became ATR's largest customer ever. ATR announced 155 firm orders in 2014. This almost matches their best year in 2011 with 157 firm orders. As air travel becomes more cost effective in Southeast Asia, especially Indonesia with over 1,000 islands needing air service, ATR should continue to see order growth.

UAC

While UAC is typically associated with the forthcoming MC-21 (also known as MS-21), it is also able to claim success with the Sukhoi Superjet (SSJ). The SSJ has been a surprise - it has proven to be a better aircraft than many expected. Interjet is exercising options and recently Dutch carrier VLM placed an order. With this foundation, UAC is moving forward with plans on its MC-21. The aircraft follows SSJ ideas - western avionics and engines. This should ensure the aircraft attracts attention from airlines beyond the CIS.

The MC-21 is expected to be certified and have EIS in 2016. Given the current situation in Russia that may be delayed. The Russian Industry and Trade Ministry has reduced budget spending program for 2016 and 2017 by 2%. The overall 2015-2017 investment program was reduced to $2.7bn from $2.8bn. Spending will be cut for projects which have not been initiated so far, including the development of several models of helicopters and planes for regional flights, the ministry said. Although the MC-21 is well advanced, as a state funded company in the midst of high spending on the program, we expect the program to be slowed.

CFM INTERNATIONAL

CFM International, a joint venture of GE and SNECMA (part of SAFRAN) will continue its leadership position in the narrow-body engine market, largely due to its exclusive position on the 737MAX, and as a competitive option on the A320neo family. The current market share leader on A320 and exclusive engine on 737NG, CFM has a strong customer base that makes it easy for existing customers to select the LEAP. We foresee continued growth for CFM International as the market leader in narrow-body engines.

ENGINE ALLIANCE

Engine alliance, a joint venture of GE Aircraft Engines and Pratt & Whitney, makes the GP7200, which has the leading market share on the Airbus A380. Discussions of an A380neo are underway, with Rolls Royce offering a new Trent variant. The strange bedfellows syndrome may impact EA's ability to compete for a new A380 engine, as GE and PW must each independently validate the business case for an A380neo, and agree to move forward. That situation is complicated by the increased competition between the partners on A320 family. It appears doubtful that Engine Alliance will have a new alternative for the A380neo program in the near term.

GE AIRCRAFT ENGINES

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GE and Boeing appear to be moving closer together, with exclusivity on the 777X matching the exclusivity on 737MAX and 747-8. Only the 787 series remains competitive at Boeing, and GE engines are now available on all Boeing products. GE's participation at Airbus remains strong, with half of the A320 and A320neo family, and a portion of A330ceo. We understand that GE was asked to consider its GEnx from the 747-8 for the A330neo, but demurred.

The outlook remains positive for GE Aircraft Engines, which has a strong market share and backlogs for the foreseeable future.

PRATT & WHITNEY

Pratt & Whitney will be introducing six new GTF engine models on 13 different aircraft with five manufacturers on four continents within the next five years. The success of the GTF engine has returned PW to major player status in the market after a period of decline, with commitments for more than 7,000 engines in place. With the GTF now in production for CSeries and being readied for A320neo, PW is in a growth mode for the next five years. As a result, it has its hands full, and we don't expect to see a PW GTF engine for a wide-body application in the near future, as their internal capacity is focused on executing the multiple programs they have acquired within a very short time frame. The outlook is positive for PW, and the task going forward is execution. PW's selection of a geared technology has now been also selected by Rolls-Royce for its future Ultrafan engine.

ROLLS-ROYCE

Much like GE and Boeing, Rolls-Royce is developing a strong relationship with Airbus, becoming exclusive on the A350, A330neo, and potentially the A380neo. Rolls-Royce is currently not competitive in the narrow-body market, having sold their share of International Aero Engines to Pratt & Whitney. Nonetheless, they are developing a new geared concept that would appear appropriate for a 757 replacement sized aircraft. Rolls-Royce appears to have a solid position in the wide-body marketplace, including a competitive offering for the 787. The outlook for Rolls-Royce is also positive.

THE MAJOR AIRLINES

In the domestic US market, the three major legacy carriers and LCC Southwest achieved record profitability, perhaps reflecting the new oligopoly nature of the industry and lack of true competition in many markets. Unlike years past, when one airline would block fare increases, 2014 saw several increases go through uncontested, increasing profitability. The decrease in fuel prices in the fourth quarter should enhance profitability to record levels, as they have not adjusted fares downward in response. We expect the US domestic airlines to remain profitable in 2015, with steady yields.

Internationally, market conditions vary by region, with mediocre financial performance in Europe, and strong performance in Middle Eastern and Asian carriers. The center of gravity internationally has shifting to the south and east, with traffic growth and capacity, and European carriers are no longer the dominant force they once were.

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AIRINSIGHT

AirInsight has had a wonderful 2014, and we look forward to an even better 2015. Thank you and Happy Holidays to all of our subscribers and friends in this industry in which we are most fortunate to work.

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Premium #152 - LOOKING AHEAD TO 2015

12/30/2014

It is that crystal ball time of year, when we look forward and attempt to discern how next year will be different and what events will shape the industry in the coming year. Let's begin with a look at the external factors impacting the industry, and then expectations for each of the major industry players.

Economics

The global economy will continue in an overall slow growth mode, as recessionary influences pervade Europe, Asian growth is slowing, while the United States is showing some preliminary signs of a potential recovery. Lower fuel prices will negatively impact the Gulf region, but the impact on air traffic will pale compared to the impact on national budgets that were bloated when oil revenues were high, and could cause new difficulties for the UAE and other countries in the Middle East.

Oil prices have dropped; I recently paid $1.99 per gallon for gasoline in Michigan, with prices still falling. The question is whether this drop is sustainable. We believe it is possible, as the US has become a major producer from shale, and can do so at reasonably competitive prices. We foresee a swing in oil prices, with the pendulum swinging lower than many anticipate (into the $50 per barrel range) prior to swinging back to settle in the $60-$70 range by year-end 2015.

Low oil prices will begin changing the economic relationship of new and used aircraft, placing more price pressure on the former and increasing the economic lives of the latter. While we don't anticipate a let-up in demand for aircraft in the near term, we believe a bubble is building in narrow-body aircraft that will likely burst in 2019-2020, just as Boeing and Airbus complete massive increases in capacity.

Technology

Engine technology continues to drive aircraft economics. The PW GTF, recently certified for the A320neo, has several more variants on tap for certification. The competing LEAP is in ground test and will enter test flight in 2015, and remains about a year behind in terms of schedule. There are no new narrow body programs in development yet at the engine selection stage, although it appears Boeing may accelerate the development of a 757 replacement, given the Airbus 2-1 plus lead in orders for A321neo over 737-9, as it is simply a more effective aircraft for those missions. For that application, the PW GTF and RR Advantage geared turbofans appear to be the leading candidates.

There are no new wide-body programs without engine selection currently on the books, but Airbus is considering an A380neo. Rolls-Royce is ready to roll out an updated version of its Trent XWB, possibly to be named the 9000, for an A380neo. Engine Alliance, a joint venture of GE and Pratt & Whitney, does not have as clear a growth path for a new alternative, but both parties are researching the opportunity. With engine selection in place for A330neo and A350, and 787 and 777X, this will likely be the last wide-body opportunity to be decided this decade.

2015 could also become the year of breakthroughs in batteries. We've seen a prototype of a replacement for the 787 battery; it provides equivalent output using low volatility chemistries in the same packaging as the initial battery. The design eliminates the need for the exhaust system and should

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save weight. Rapidly changing battery technology could bring new chemistry lithium-ion batteries into the aviation arena quite quickly, with enhanced safety.

E-enablement and cyber security will reach the forefront in 2015, particularly with Boeing's decision to utilize an open architecture for 777-X to save weight by combining computing capacity on a network. While efficiencies can be gained with the new architecture, any penetration of that architecture could result in the ability for aircraft systems to be hacked. As an open system it may be easier to accomplish. While industry participants prefer to keep incidents close to the vest in order not to alarm the public, several cyber security issues have been thwarted, and others resulted in potentially dangerous situations that fortunately have, to date, not resulted in the loss of aircraft. Cyber-security will become a significant issue for the industry to address this year.

New Aircraft

There are only a few "all new" programs in process, in addition to the several re-engined and derivative programs set to reach the market this decade. The question is whether or not they will make their planned EIS dates:

We do not foresee any major "new" program announcements in 2015, with the possible exception of an A380neo and a stretched A380-900 model to further improve seat-mile economics. Either, or both, of these are possibilities as Airbus (under pressure from Emirates and Rolls Royce) evaluates the potential for its VLA over the longer term.

Airbus

Airbus is celebrating the first A350-900 delivery and will celebrate the A320neo EIS in 2015. The key decision of 2015 will be on the direction for the future of the A380. We're betting that the neo is launched, along with a stretch, ensuring that the program will continue for the foreseeable future. There may yet even be interest in developing an A350-1100 before 2025.

Boeing

Boeing will continue current development programs in 2015, with no new programs coming on line. Work will continue on 737MAX, 787-10, and 777X. While Boeing is examining a 757 replacement, no firm decision is expected in the coming year.

Bombardier

Bombardier will celebrate the first delivery of the CSeries in late 2015, which will provide a needed turnaround in cash flow. The CRJ will remain viable with lower fuel prices and heavy discounting in the near term, and will achieve multiple orders in 2015. The Q-400 remains the only turboprop in the market close to the 90-seat goal some have been looking at.

Embraer

Embraer will be working hard to fill the production gap between the current EJets and the E2, not scheduled until 2018, 2019 and 2020 for EIS.

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Irkut /UAC

Development continues on the MS-21, as there are technically no sanctions on commercial aircraft in the current rift with Russia. Nonetheless, sanctions on banks could delay the program past 2017, something key to watch in 2015. Sukhoi is talking of increasing production of the SSJ to 80 per year. The recent win at VLM gives the SSJ program a boost in Europe.

COMAC

COMAC continues to struggle, while purchasing expertise by acquiring companies in general aviation around the world. The ARJ-21 and C919 programs appear to remain well behind schedule, as China has yet to learn the complicated process of building a new technology aircraft. We expect further delays to both programs in 2015. But there is growing talk of cooperation with Russia on a twin aisle aircraft. China can afford this program, but we don't see the Russians being able to match this.

Mitsubishi

With the MRJ roll-out in 2014, the MRJ appears now poised for flight testing in 2015 for EIS in 2017. However, we've seen roll-outs before that have led to further delays at Airbus, Boeing and Bombardier, and we expect Mitsubishi might face similar challenges. We're currently 50/50 as to whether the MRJ will meet its revised 2017 target for EIS.

Engines

Pratt & Whitney has now certified 2 of its 6 planned GTF engine variants for five programs on four continents. We expect the GTF to be on schedule for its remaining applications. The market eagerly awaits the news of the CSeries testing - we understand that Bombardier will announce their results early in 2015. Certainly before the end of 1Q15.

GE has begun activity for the GE-9X for the 777X program, and there is still adequate time for technology substitution and improvement before the expected 2020 EIS.

Rolls-Royce has delivered on the Trent XWB for the -900, and is working on a variant for the -1000, as well as developing a new engine for A330neo. The key question for Rolls-Royce is whether an A380neo engine will be defined by Airbus in 2015. Rolls-Royce has only 30 more A380s to engine on current announced engine selections.

Consolidation

The industry supply chain continues to consolidate, with fewer players obtaining a larger share of the pie. While some new entrants have emerged as a result of the 'Boeing Partnering for Success' program, such a Montreal-based Heroux-Devtek for landing gear on the 777-X. Consolidation among major players is expected to continue. United Technologies will likely make a major acquisition in 2015, potentially of similar size to the Goodrich acquisition. We believe at least one, and potentially two, blockbuster mergers will occur in the aviation supply chain in 2015.

Our Crystal Ball

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We expect lower fuel prices to result in higher airline profits. Better personal income levels from lower fuel bills could fuel demand for airline seats, but that those additional seats will be provided by existing aircraft that will be retired later than planned, rather than additional new aircraft in the short-term. We also expect continued success for Airbus and Boeing, but for new orders to be at lower levels than the past couple of years, reflecting the current large backlogs at each manufacturer. The sheer size of these backlogs could be an advantage for Bombardier and Embraer in the sub-150 seat market.

Equity values in aerospace will continue strong in the short-term, and most industry OEMs and suppliers will have strong performance and multiples.

In short, 2015 will look at lot like a continuation of 2014, with companies focused on executing the programs already in place and delivering their products to market on time.

We wish all of our readers a happy and prosperous 2015.

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