Airbus & Boeing will both soon offer comprehensive groups of widebody products than can satisfy most airline capacity and range requirements. Both product lines are based on high levels of commonality. Can either provide a fundamental difference in operating costs?

Widebody selection: A330/340/350/380 versus the 787/777/747

With Boeing expected to launch its 747 Stretch project, the world's major airlines are entering a new phase of widebody aircraft selection. Both Airbus and Boeing will soon provide comprehensive groups of aircraft that can suit most airlines' seat capacity and range performance requirements. Can airlines benefit from an all-Airbus or all-Boeing widebody fleet?

Fleet options

Neither the Airbus nor Boeing widebody families cover all possible seat and range requirements. The Airbus product line starts with the 253-seat A330-200 and extends up to the 550-seat A380, but has a large gap between the 380-seat A340-600 and the A380 *(see table and chart, pages 26 & 30)*.

The Boeing product line starts with the 217-seat (tri-class) 787-3/-8 and extends to the 420-seat 747-400. The launch of the 747 Advanced would take this up to 450 or 460 seats.

Both product lines offer a range of aircraft with seat capacities mainly increasing in increments of 40 or 50 seats, with a few exceptions. The Boeing option has the advantage of offering a smaller widebody than the A330-200, but Airbus has the monopoly on aircraft larger than 450 seats.

Not all types are operational. The A350-800/-900 and A380 are yet to enter service. The 787-3/-8/-9, 777-200LR, 777-300ER and 747 Advanced have yet to be certified, built and launched. Both Airbus and Boeing widebody families will be complete within five years.

Airbus products

The A330 and A340 make up a family of 250- to 380-seat medium, long and ultra-long-haul aircraft. There are four models, which are similar to each other in terms of structure, flightdeck and systems: the A330-200, A330-300, A340-500 and A340-600. The main differences are the type and number of engines, gross weights, fuel capacity and range performance. The A340-500/-600 have a larger wing than the A330.

The average seat numbers used by airlines and corresponding range performance of these six types are shown *(see table, page 26)*. While the A330-200 and -300 have about 10% fewer seats in operation than their standard layouts, the A340-500 and A340-600 have up to 30% fewer seats.

The A340-500's average seat number is 235, 80 less than Airbus's 315-seat configuration. This is explained by many operators having longer seat pitches in their first- and business-class cabins, and using lie-flat seats. Galleys and toilets are also larger than the manufacturer's standard arrangement and these features are collectively utilised to provide high comfort levels for the ultra-long-distance flights operated by these aircraft. This leaves less cabin area for the economy-class cabin, which in many cases also has longer seat pitches than Airbus's standard of 32 inches. The A340-500 is able to fly up to 9,000nm with 235 passengers *(see table, page 26)*.

An extreme example is Singapore Airlines (SIA) which operates its A340-500 in a 181-seat layout. SIA uses the A340-500 on its Singapore-New York route, which has a flight time of 17 OR 18 hours. For this reason, SIA has configured the economy class with seven-abreast seating, one less than the standard configuration.

Since the launch of the 787 by Boeing, Airbus has added the A350. There are two models: the -800 and -900, both of which have the same fuselage and cabin capacity as the A330-200 and -300. The A350 incorporates several technological differences over the A330, including a higher MTOW, larger fuel tanks and use of carbon fibre in its structure.

The A350-800 and A350-900 are designed, however, as ultra- long-range alternatives to the similarly sized 787-9 and 777-200ER *(see table, page 26)*. This may result in airlines configuring their A350-800 and -900 aircraft with fewer seats than in the A330-200 and -300. The A350-800 and -900 have a range at least 2,000nm longer than their A330 counterparts.

The A350 will similarly operate with fewer seats than Airbus's standard tri-class configuration. The A350-800 and A350-900 will have at most the same number of seats as the average configurations for the A330-200 and A330-300.

While the A380 has not yet entered service, some airlines have already disclosed their seat configurations.

Emirates will use three different configurations: a 533-seat three-class layout; a 653-seat two-class layout; and a three-class 500-seat aircraft that can fly non-stop from Dubai to Australia. Qantas's A380 will have 500 seats. The average seat capacity of the A380 is expected to be about 500 seats.

AIRBUS & BOEING WIDEBODY PRODUCTS: SEAT CAPACITIES & RANGE PERFORMANCE

Aircraft type	Standard 3-class capacity	Typical 3-class seat capacity	Corresponding range nm	Freight capacity lbs
A380	550	500	8,750	73,450
A340-600	380	314	7,800	72,060
A340-500	305	235	9,000	64,650
A340-300	295	266	7,500	41,840
A350-900	295	266	7,500	N/A
A350-800	256	227	8,800	N/A
A330-300	295	266	5,650	68,970
A330-200	256	227	6,750	50,000
747 Advanced	450	430	8,750	N/A
747-400ER	420	385	7,600	54,150
747-400	420	393	6,900	42,740
777-300ER	365	320	7,750	82,800
777-300	368	340	6,000	75,200
777-200LR	305	240	9,500	67,600
777-200ER	305	287	7,300	49,730
787-9	257	235	8,300	N/A
787-8	217	200	8,500	N/A

Boeing products

Boeing's widebody product range is based on three main types: the 747, 777 and 787. There are two models of each of these three main types, offering six main models and seat capacities to airlines *(see table, this page)*. These are the 747 Advanced, 747-400, 777-300, 777-200, 787-9 and 787-3/-8.

These have a Boeing standard tri-class layout from 217 to 450 seats.

On the basis of actual seat numbers in the A340-600 compared to Airbus's standard, the competing 777-300ER may have an actual seat capacity of about 320, 45 less than the 365 standard. This would give it a range of 7,750 nm, 550nm longer than with 365 seats. This allows the 777-300ER to operate non-stop on routes such as Paris-Los Angeles, London-Johannesburg, and Taipei-Amsterdam.

The average tri-class seat capacity for the 777-200/-200ER for a group of airlines is 287 seats, 18 seats less than Boeing's 305-seat standard. This would give the -200ER a range of 7,300nm, 1,465 nm longer than with standard seating.

The 777-200LR, which has yet to be certified and enter service, has the same cabin capacity as other 777-200 models. The 777-200LR's seat number is likely to be as low as 240 seats, given an average seat capacity of 235 for the A340-500 compared to Airbus's standard seat number of 235. This will give it the 777-200LR range of 9,500nm, and will allow it to operate a non-stop flight for up to 18 hours on ultra-long sectors such as Singapore-New York, Dallas-Sydney, Paris-Taipei, Atlanta-Hong Kong.

The 787-3 is a short- and medium-haul aircraft with a 3,500nm range, and has the same fuselage capacity as the 787-8. Using a proportional reduction in seat numbers, the 787-3 is likely to have about 275 seats in two classes.

The 787-8 has 217 seats as standard, but is more likely to have about 200 seats in three classes. It will have a corresponding range of at least 8,500nm. The 257-seat 787-9 will have a seat capacity of about 235 calculated on the same basis, and a corresponding range of 8,300nm.

Payload-range capability

The seat capacities and range performance of the aircraft analysed are summarised *(see chart, page 30)*.

This clearly illustrates the coverage of aircraft sizes and range capability, and also gaps in each manufacturer's product range. This is demonstrated by dividing the aircraft into four size categories.

The 200- to 250-seat category includes the 787-3/-8, the A330-200, the A350-800 and 787-9. The smaller 787-3/-8 is a clear indication that Boeing anticipates the development of a fragmented long-haul market. While Airbus now has an aircraft to satisfy a requirement for long-thin routes, it has not developed an aircraft to compete directly with the 787-8. Maximum range capability is similar for Airbus and Boeing aircraft, however.

The second group is the 250- to 300-seat category, which includes the A330-300, A350-900, 777-200 series, A340-300 and A340-500. Again, maximum range capability is similar for Airbus and Boeing aircraft.

Airbus has medium- and long-haul requirements in this bracket well covered, although actual seat numbers used by airlines indicate that the 777-200 is better placed in the 270- to 300-seat group. The exception here is the A340-500, although most of its small number of operators configure it with less than 250 seats.

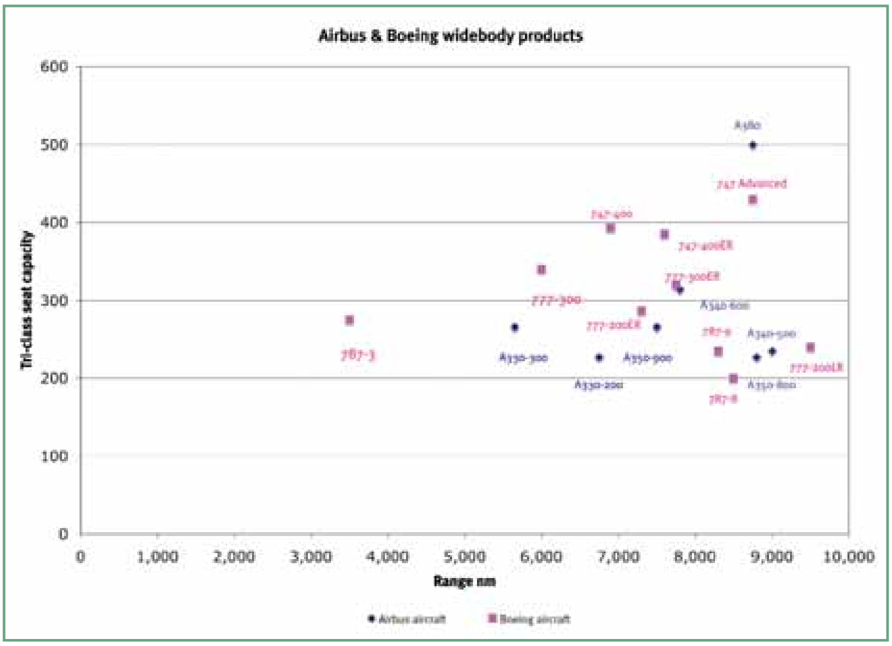
The third category is the 300- to 375-seat group, which includes the 777-300 and A340-600. The fourth category is aircraft larger than 375 seats. Boeing fills the gap up to 430 seats with the 747-400 and 747 Advanced, while the 180-seat gap between the A340-600 and A380 is clearly demonstrated *(see chart, page 30)*.

Market rationale

Two decades ago the major long-haul markets of the transatlantic, trans-Pacific, and Europe-Asia routes were dominated by a few trunk routes operated by 747s. Liberalisation across the Atlantic caused traffic volumes to decline, making the 747 too large. The 200- to 250-seat 767 family was first adopted to fly some transatlantic thin routes, but stimulated fragmentation and the opening of new routes. In 1990, 747s made 57,871 transatlantic departures, but by 2000 this had declined to 54,412. Departures for 767s and A330-200s have increased from 33,502 to 81,368 over the same period. Aircraft size has increased again due to continued traffic growth. Operations by the A340 and 777 increased by 250% over this period.

The dominance of the 747-400 in the trans-Pacific market has been broken by the 777 and A340, although the 747 has yet to diminish as it has on the transatlantic. As an example, Cathay Pacific has replaced the 747-200 with the A340-600/-300 and operates two daily flights from Hong Kong to New York. The 777 accounts for 60% of flights between Tokyo and New York.

Before 1996, there was no service between Guangzhou and Los Angeles, but China Southern Airlines' 777-200 with 280 seats made this route viable.



From 2000 to 2005 71 routes from Europe to Asia were opened, while 48 routes were dropped.

The 747 has been replaced in many cases with smaller aircraft over the past two decades. This is partly because the 747 was always too large for many airlines, but also because smaller aircraft have stimulated fragmentation in the major markets.

Over the next 20 years, liberalisation in the transatlantic, trans-Pacific, Europe-Asia and Inter-Asia markets is expected to continue with various rates of traffic growth. Airlines have several fleet planning options in liberalised long-haul markets.

One option is to open new routes with smaller aircraft, leading to fragmentation.

The second option is to add frequencies by using smaller aircraft, such as the 777-200ER, 777-300/-300ER, 787-3/-9, and A330, A340-300/-600, A350-900, while using existing larger types such as the 747 on the original services. Adding services with smaller aircraft will stimulate demand, but will probably incur a unit seat-mile cost penalty.

The third option is to replace the current aircraft with larger aircraft, such as replacing the 747-400 with the 747Advanced or A380. This measure may lead to lower unit seat-mile costs.

Market developments

The EU is negotiating with the US about the Transatlantic Common Air Area (TCAA), which will allow both parties' airlines to fly to each other's territory with minimum restriction. It is hard to predict the outcome of the negotiation, but the TCAA will significantly affect aircraft selection in this market.

With more than 10 years' gradual route development, this market's fragmentation has been mature, but some new thin routes might be opened or frequencies added with the 787 or A350-800.

The routes and frequency from the west coast of North America to Europe are still fewer than those from the east coast. This may be a new market for these aircraft.

Due to slot restrictions on the transatlantic market, it is not possible for some airlines to increase frequency to the big hubs. On the routes being operated by the 747 this may be replaced by larger aircraft to accommodate the growth. For example, there are 13 daily services from London to New York operated by 747-400s, 777-200s, and A340-600s operated by British Airways, American Airlines, United Airlines, Virgin Atlantic and other carriers. While the 747-400 can be replaced by the A380 or 747 Advanced, consideration has to be given to the traffic growth required to fill the large jump in available seats. The 430-seat 747 Advanced may be preferable because of its smaller increase in seat capacity.

Liberalisation continues to evolve in the trans-Pacific and the Asia Pacific-Europe markets. The basic character of the two is that flight times are more than 10 hours and at least a seven-hour time difference exists. This implies that most operators are not able to have a frequency of more than three daily flights.

An agreement to liberalise international air transport, known as the "Kona" Open Skies Agreement, was signed in 2001 by the United States, Brunei, Chile, Singapore and New Zealand, all of which are members of the Asia-Pacific Co-operation Organisation. This led to the development of liberalisation in Asia Pacific. China, the largest under-developed aviation market, has been more positive about liberalising its market since 2003 and has signed several Open-Skies agreements with its neighbours, such as Singapore and India. Although there is no negotiation between China and the US or the EU about Open Skies, the markets from China to the US and the EU are expected to liberalise over the next 10 years.

High growth rates will lead to large fragmentation in the two markets if suitable aircraft are available. Boeing predicts more than 40 long-haul routes will open between China's secondary cities that have a population of more than two million, and various cities in the US. An example could be Nanjing-Los Angeles.

Fragmentation, however, is not the only trend that will occur over the next 20 years. Due to Asia's large population, strong traffic growth and slot restriction at hub airports, consolidation will also be a characteristic in these two markets, making the A380s more viable.

Airbus predicts that monthly seats carried between hubs in the trans-Pacific market will increase by 70% between 2004 and 2014. The number of routes between hubs is predicted to increase from 73 to 118.

"Qantas chose to operate the A380 from Sydney to London and to Los Angeles, replacing the current 747-400. Load factors have reached high levels on these flights. We have two daily flights on each route, so we need the A380 to accommodate traffic growth," says David Cox, executive general manager engineering at Qantas.

SIA has three daily frequencies between Singapore and London using a 375-seat 747-400. SIA can only increase capacity by using the A380, since additional frequencies are not possible.

The inter-Asia market can be divided into mature and developing parts. The mature sub-market is the north-east Asia, including Japan, South Korea and Taiwan. Japan's airlines operate high-density 747-400s with 569 seats on domestic routes. These may be replaced by the A380 or 747 Advanced with more than 600 seats.

The developing sub-market includes the domestic markets of China, India and South-East Asia. Due to the large population in these areas, the next 20 years will see airlines opening new routes with small aircraft.

Commonality

Development of the market requires airlines to consider what kind of fleet best fits their route networks. One issue airlines will consider is simplifying their fleets to increase commonality between

With the launch of the A350, Airbus now has products that will both cater for high-density traffic between hubs and low demand on point-to-point routes in its product range.

aircraft and engine types, and so reduce costs relating to pilots, spare engines, and inventories of rotables and spare parts.

Air Canada had an ambitious fleet plan, but it was vetoed by its pilots. This plan involved reducing its five aircraft types (the A330-300, A340-300 and A340-500, 767-200 and 767-300) to three (the 777-200LR, 777-300ER and 787 series) to benefit from higher levels of commonality.

It is estimated that about two-thirds of savings derived from commonality between aircraft types are related to flightcrew costs. This cost saving comes from flightdeck commonality between the A330/340/350/380 and 747/777/787 options.

Many airlines allow pilots to have ratings for two aircraft types to lower labour costs and increase their schedule flexibility. A high level of commonality between types increases the chance that a dual-type rating would not require any more recurrent training than a single-type rating. A dual rating with the 767/777 or 777/747-400, for example, would only require 2-6 days recurrent training per year. The pilots with dual rating on the A320/A340 and A330/340 are required to have 6-7 days per year for recurrent training.

Flightdeck commonality also reduces transition training when pilots are acquiring a new rating for a type. The identical flightdecks and fly-by-wire (FBW) flight control systems used by the A330/340/350/380 allow cross-crew qualification (CCQ) between them. This reduces the differences training required for pilots to get a second rating on one of these types when a rating is already held on one type. For example, a further three days are required to get an A340 rating when an A330 rating is already held. When an A340 rating is already held, 12 days training is required to get an A380 rating. The length of transition training for Boeing's combinations of the widebody aircraft types is 13 to 15 days. This is in contrast to the 25 days training required between two types with no commonality.

For the Boeing fleet another important cost saving may come from the engine commonality of the 787 and 747 Advanced, which will both use the GEnx engine. The Airbus fleet can benefit from the parts commonality as the A350 is based on the A330 and shares the same fuselage, and the A330 is in the same family as the A340. Commonality between the twin-engined A330 and the four-engined A340 is a major benefit.

Economic analysis

Although the 787, A350, 747 Stretch, 777-200LR and A380-800 have yet to come into operation and their accurate operation data are still to be revealed, estimates of their mature maintenance costs and fuel burns can be made.

The A380's and 747 Advanced's fuel burn can be compared against the 747-400's, while the 787's fuel burn can be compared against the 767-300ER and 767-400ER. The A350's fuel consumption can be compared against the A330's.

Maintenance costs comprise four main elements of line and ramp checks, base airframe checks, engine reserves and flight hour costs for rotables. Costs per FH for each of these four elements can be made using benchmarking against similar types. Typical or probable engine reserves can be used for the younger aircraft types.

The list prices for most new types are known, and so monthly finance charges or lease rates can be estimated using typical purchase discounts and lease rate factors. These three main cost categories can be used as a basis for analysing probable trip and seat-mile costs of competing types on typical route lengths.

The costs analysed include: fuel; direct maintenance (including line, airframe base maintenance, engine overhaul reserves, and rotable flight hour charges); flightcrew and flight attendant employment costs; and aircraft leasing and financing charges.

Six scenarios are used to analyse the aircraft. These are as follows:

- 787-3, A330-200 & A350-800 on a 1,200nm sector
- 787-8, 787-9, A330-200 & A350-800 on a 3,500nm sector
- A330-300, A350-900 & 777-200ER on a 5,000nm sector
- A340-500 & 777-200LR on a 6,500nm sector
- A340-600 & 777-300ER on a 5,500nm sector
- A380, 747 Advanced & 747-400 on a 5,000nm sector

These sector lengths in each scenario have been selected to represent typical average route lengths across a network where the aircraft types will operate. For example, an average route length of 6,500nm is probable for an airline considering either the A340-500 or 777-200LR.

787-3, A330-200 & A350-800

In this scenario, the 787-3, A330-200 and A350-800 have been analysed in two-class configurations. This assumes seat capacities of 275 for the 787-3, and 292 for both the A330-200 and A350-800. The 787-3's seat capacity is a 10% reduction of Boeing's 289-seat standard, which is commensurate with the A330-200's average of 292 seats over Airbus's standard.

All three are assumed to complete 900 flight cycles (FC) per year. The block time for these aircraft on this trip is about 200 minutes, though a few more minutes may be required by the A330-200.

This translates into about 3,000 block hours (BH) per year. The 787-3, A350-

Operators which have selected the A340-500 are utilising them on ultra long-routes. As a consequence they have configured them in a high-comfort layout, and tri-class seat numbers are on average 25% less than Airbus's standard configuration of 315. Singapore Airlines, which uses the A340-500 on its SIN-JFK route, has just 181 seats.

800 and A330-200 will therefore generate 312 million, 315 million and 315 million available seat-miles (ASM) per year, respectively.

The 787-3 is expected to save 20% of the fuel burn compared to the 767-300. The A350-800's fuel burn remains unclear, but it is expected to be 17% less than the A330-200's. On a 1,200 nm route, the A330-200 consumes about 4,600 USG and therefore the A350-800 will consume about 3,800 USG. A fuel price of $1.35 per USG has been used.

The 787-3 will use carbon fibre to build its fuselage and will also use piezoelectric sensors, which together will lengthen the 787's base check interval to about 36 months from the traditional 18 months. The use of carbon fibre will also lead to less non-routine MH than the conventional aircraft. These in total will provide an expected 15% saving of base check cost compared with the 767. The 787-3's reserves for base checks are about $550 per flight hour. The 787 is assumed to have the same line maintenance, heavy component repair and rotable costs as the 767 in this analysis.

The A350-800 will also use carbon fibre, but the material will only be used in its wingboxes and wing skins. The limited application of carbon fibre can only be expected to deliver a small reduction in base maintenance reserves, which are estimated to be $20 lower than the A330-200's $715 per FH.

Total costs for rotables are assumed to be the same for the three aircraft types in this analysis.

The GEnx and Trent 1000 engines for the 787-3 and A350-800 are likely to have longer intervals between shop visits, but their material costs are likely to be higher than the A330-200's current generation engines. Hence the three aircraft are assumed to have the same reserve in this analysis. These three elements of maintenance cost result in a total of $1,350 per FH for the 787-3, $1,514 per FH for the A330-200 and $1,495 per FH for the A350-800.

The three aircraft all will use a standard crew of two, the annual salary of which is assumed to be $195,000. Salaries are escalated by 25% for additional costs of employment and the pilots are assumed to complete about 650 BH per year. This results in crew costs per trip of $1,240 for all three aircraft.

All three types are assumed to use nine flight attendants, resulting in an annual cost per aircraft of $400,000, equal to $1,900 per trip.

The total cash direct operating costs (DOC) for the trip for the 787-3, A330-200 and A350-800 are $11,800, $14,300 and $13,200, respectively.

The list prices of the 787-3, A330-200 and A350-800 are $120 million, $150 million and $163 million, respectively. With a purchase discount of 30% and a lease rate factor of 0.9%, the lease rate charge per trip will be $10,000 for the 787-3, $12,600 for the A330-200, and $13,700 for the A350-800.

All these elements result in a total trip cost of $21,800 for the 787-3, $26,900 for the A330-200, and $26,900 for the A350-800. These are equal to seat-mile costs of 6.62 cents for the 787-3, 7.69 cents for the A330-200 and 7.67 cents for the A350-800.

The 787-3's main advantage is its low list price compared to the A330-200 and A350-800, which are $30-43 million higher. Boeing has stated the 787-3/-8's list price is the same as the 767-300, at $120 million.

787-8/-9, A330-200 & A350-800

Here the 787-8, 787-9, A330-200 and A350-800 are compared on a typical long-haul route length of 3,500nm.

The flight time is about 460 minutes, and the aircraft would generate about 550FC and 4,400BH per year.

Fuel burns for new aircraft have been estimated on the basis of benchmarking.

In this scenario, airframe and engine maintenance reserves will be lower than on a medium-haul sector because of longer FC times.

The slightly larger 787-8 is assumed to have a higher flightcrew salary of $201,000 per year. A standard complement of two pilots is assumed to be used on this route length, with salaries escalated by 25% to take account of additional employment costs.

Cash DOC trip costs are lowest for the 787-8 and -9, mainly because of fuel and maintenance.

The 787-9 is assumed to have a similar list price to the 767-400ER of $145 million. Both 787 models have a list price advantage compared to the A330-200 and A350-800.

A330-300, A350-900 & 777-200

These three types are closer in size, although the 777-200ER's MTOW is 150,000lbs heavier than the A330-300's and 116,000lbs heavier than the A350-900's. A 5,000nm trip will be close to average route length for most A350-900 and 777-200ER operators, but is long for the A330-300.

Unsurprisingly the 777-200ER has the highest fuel burn, which is $9,000 higher than the A330-300's and $5,000 higher than the A350-900's. This is particularly significant, since the A350-900 has been pitched as a 777-200ER 'buster'.

Applying known maintenance costs for the A330-300 and 777-200ER, and benchmarking for the A350-900, the Airbus options will have about $65-90 per FH lower maintenance costs than the 777-200ER. Similar flightcrew salaries, and one less flight attendant for the A330/A350 overall result in the 777-200ER having the highest cash DOC trip cost. This is $7,000 more than the A330-300 and $12,000 higher than the A350-

Boeing is soon expected to launch the 747 Advanced. Many 747-400 operators have ordered the A380, but only in small numbers. The same carriers are likely to place larger orders for the 747 Advanced.

900.

The 777-200ER also has the highest list price at $190 million, compared to $166 million for the A330-300 and $180 million for the A350-900. This further adds to the A350-900's advantage, as overall it has a $13,000 lower trip cost than the 777-200ER. The A330-300 is marginally more expensive to operate than the A350, which will have a payload advantage on this route length and so carry more freight revenue.

The 777-200ER has the advantage of a 24-seat higher capacity, which allows it to partially overcome its higher trip cost. The 777-200ER still, nevertheless, has the highest cost per seat.

A340-500 & 777-200LR

These two aircraft represent a niche, and only a small number of each type have been ordered. The two have small seat counts for their size, since airlines will require a high level of comfort for 12-15 hour sectors. An average stage length of 6,500nm represents a 14-15 hour trip.

Not surprisingly, the A340-500 suffers a high fuel burn because of its four-engine configuration. Taking into consideration previous analyses of A340-300 and 777-200 maintenance costs, benchmarking for the heavier A340-500 and 777-200LR indicates that the A340 will be at a disadvantage mainly because of higher reserves for four engines.

Crew costs will be indentical for the two, and both types will use two supernumerary flightcrew. Overall the A340-500's cash operating DOC is $16,000 higher than the 777-200LR's on account of fuel and maintenance.

The A340-500's lower list price of $24 million is a partial help in overcoming this disadvantage. The 777-200LR, however, has about $14,000 total lower trip costs overall. These translate into high seat-mile costs because the aircraft is configured with a small number of seats compared to its size. The 777-200LR has a unit cost of 8.40 cents per ASM which, although high, is 1.1 cents lower than the A340-500.

A340-600 & 777-300ER

This analysis compares the A340-600 with 315 seats and the 777-300ER with 320 seats on ultra long-range mission of 5,500nm.

As with the A340-500 and 777-200LR, the A340-600's four-engined configuration gives it higher fuel burn and maintenance costs than the 777-300ER. With crew costs the same for both types, cash DOCs for the trip are about $16,000 higher for the A340-600 at $99,400. The A340-600's list price of $208 million is $17 million less than the 777's, and so the A340-600 might be expected to have a $100,000 per month lower lease rate if the two aircraft received the same level of pricing discount. The A340-600's total trip costs are $13,000 higher than the 777-300ER's. With relatively few seats, the two have high unit seat-mile costs for the long stage length. The A340-600's unit cost of 7.9 cents is 0.9 cents higher than the 777-300ER's, which equals a $50 difference in cost per seat. This does not consider the additional costs of navigation, landing and airport handling charges, and catering costs.

747 & A380

The 747-400, 747 Advanced and A380 will all be operated on trunk routes, and 5,000nm is representative of an average for longer routes operated by major airlines. Sectors between the eastern US and west Europe, for example, are shorter than this. These three aircraft will, however, be heavily used on longer routes connecting Europe and the Asia Pacific.

Benchmarked fuel burns and maintenance costs indicate that the A380 could have cash DOC costs per trip close to the 747-400 and 747 Advanced. The total for fuel, maintenance, flightcrew and flight attendants is about $225 for the A380 and $250 for the 747-400.

The 747 Advanced will benefit from being a stretch development of the 747-400, and so the Advanced model will have higher fuel burn and maintenance costs that are in proportion with its higher seat capacity.

The A380's list price of $287 million is similar per seat to the 747-400. An equal price discount of 30% for all three aircraft results in all three having similar total trip costs per seat of $460-470.

Summary

In the first two scenarios, the 787 achieves lower trip and unit costs over the A330-200 and A350-900 as a result of the 787's lower fuel burns and maintenance reserves, but also its favourable pricing. Boeing has stated the 787's list price is comparable to the 767, which gives the 787 a major advantage over the A350-800 which has up to a $40 million higher price.

The 777-200ER, however, is disadvantaged by its large size and high weight compared to the A330-300 and A350-900. The 777-200LR and -300ER fare well against their four-engined A340-500 and -600 counterparts, mainly as a result of the high weight, fuel burn and engine-related maintenance reserves of the A340's design.

In the case of the largest aircraft, the 747Advanced and A380 may be able to deliver similar trip and seat-mile costs, although they do not compete directly.

Trip costs are relatively close between competing types, and purchase discounts can bring the economics of competing types close together. AC