

The A310-300 and 767-200 pioneered the use and efficiency of long-range twins and introduced the concept of family aircraft. Despite a few weaknesses, no aircraft have been developed that can directly replace them in many airline fleets.

A farewell to Etops pioneers?

The 767-200 and A310-300 introduced several new efficiencies of larger commercial aircraft. They were the first two-man widebodies with flightdecks and features that were common with other types. Most importantly they pioneered extended-range twin-engine operations (Etops). These aircraft opened, developed and continue to serve medium-density and medium-/long-distance markets.

The 767-300 and A321; development of the 767-400, 757-300, A330-200 and the possible introduction of the A330-100 and 777 shrink; and higher traffic volumes, could make the position of the A310-300 and 767-200 unsustainable in first-tier airlines. Has the time come to replace these Etops pioneers?

767-200 history

The A300-600/310 and 767-200/-300 were the first aircraft to be marketed as a family. Each family had identical cockpits, as well as similarities between systems, components and operation.

The advantage would be reduced cost of operation and ability to match seats with demand because of different sizes. This can only be exploited, however, if range performance is sufficient on the routes where the capacity is required.

The 767-200/-300 attracted more sales than the A300/310. There were several reasons behind this. The most important was that the 767-200/-300 family had its range capability extended to beyond that of the A300-600/310.

Initial versions of the 767-200 were developed as US domestic and medium-range aircraft. Maximum take-off weights (MTOWs) were between 284,000-317,000lbs and they had a range of up to 3,900nm with a two-class seat capacity of 224 (see table, page 16). More than 100 were built and these were acquired (and still operated) by Air

Canada, All Nippon Airways (ANA), American, Ansett, Delta, El Al, Japan Airlines (JAL), TWA, Transbrasil and United.

In 1982, the higher gross-weight 767-200ER had its MTOW increased to 337,000-395,000lbs and its tri-class range up to 6,700nm (see table, page 16). Ninety-eight aircraft were sold to airlines that wanted to take advantage of its size and range and open routes that were previously uneconomical using the DC-10-30 and 747-200.

The 767-200ER was superseded by the larger 218-seat -300ER in 1987, which has a range of 6,150nm.

The 767-200/-300 have identical flightdecks and the same type rating. This allows crews to operate them as one type. The 767 family was further complemented by the 201-seat 757-200 narrowbody, which shared the same flightdeck. The 757 and 767 have a common type rating. This minimises crew training between the sub types.

The 767-200/-300 became the most frequently used aircraft across the Atlantic. Market liberalisation and the 767's long-range capability allowed it to exploit many new city-pairs between North America and West Europe.

Another market where the 767-200 found substantial sales was South America. Varig, TACA, Avianca and Aeromexico, all found the 767-200ER a useful addition to their fleets and operations.

A310-300 history

Despite the 767's high profile, about 250 A310s were sold. The A310 has a dual- and tri-class seat capacity of 220 and 191, respectively.

There were about 80 A310-200s built, but 40 of these have been converted to freighters for FedEx, with the remaining 40 still being operated by Air France, Cyprus Airways, China

Northwest, Hapag Lloyd, Middle East Airlines and Turk Hava Yollari (THY). The A310-200 has low gross weight and a short range of 3,600nm. Most operators found that this limited the aircraft's flexibility and it was restricted to short-range operations.

The A310-300, with higher gross weight and a longer tri-class range of 4,300-4,750nm, has been more prolific with its original operators. Emirates, Swissair, Sabena, Austrian and Thai have replaced their fleets with the A330-200.

About 155 A310-300s are still in passenger service. The A310-300's main customers are Aeroflot, Air India, Air Jamaica, Bangladesh Biman, CSA Czech Airlines, Emirates, Hapag Lloyd, Kenya Airways, Kuwait Airways, Lufthansa, PIA, Royal Jordanian, Singapore Airlines (SIA), Air Portugal and THY.

Air France, Emirates and SIA will be retiring their fleets between 2000 and 2002, while THY has already sold its A310-200s and is in the process of selling its A310-300s. The first two A310-300s have been converted to freighter. THY may convert two aircraft to freighters, while Kuwait Airways is considering conversions for some of its fleet.

The A310's larger family counterpart is the A300-600. This has 266 and 231 seats in dual- and tri-class arrangements and range of 4,000nm and 4,500nm. The A300-600 and A310 have a common type rating. Airbus has since developed all its other types with an identical fly-by-wire (FBW) flightdeck. All these aircraft have the wide-reaching benefit of cross-crew qualification (CCQ). The A300-600 and A310 do not have any flightdeck commonality with these later models.

The A300-600R and A310-300 have a 2,000nm shorter range than their similar-sized 767-200/-300 counterparts. This limited the A300/310's appeal on the trans-Atlantic market and in other regions where long range is a necessity.

The 767-200 and -200ER continue to have good operating economics compared to younger types. Their long range and flightdeck commonality with the 757 and larger 767 variants means there is little basis for replacing the 767-200.

The other major A310 and 767-200 markets have been the Middle East, Africa and the Asia Pacific. The A310 and 767-200 were bought in similar numbers by airlines in these regions.

Case for A310 replacement

As already described, the A310-300's biggest weakness is that its range is about 2,000nm less than the highest gross weight 767-200ER with a similar number of passengers (see table, page 16). The A310-300 is used on regional routes by most of its operators, flying just a few routes closer to its range capability.

Lufthansa, for example, used the A310 on its long-haul network to destinations in Africa and the CIS from Frankfurt. It now uses the type on domestic and European regional routes.

The A310-300 is heavy for its small size compared to the 757-300, for example. On short routes the lighter 757-200 or -300 will provide higher efficiency for similar or smaller passenger numbers, provided little additional freight capacity is required. The A310's two-class 240-seat capacity is 20 seats less than that of the 757-300 (see table, page 16).

On longer routes the 767-300, 767-400, or A330-200 can provide more seat and freight capacity and have more route network flexibility through longer-range capability than the A310-300 (see table, page 16).

The development of new aircraft types means various fleet mixes are preferable to the A310. The A310, since it is operated mainly in isolation rather than with the A300-600, has no commonality with other types in its operators' fleets. Airlines are now minimising aircraft types and pilot pools.

The 757-200/-300 and 767-300/-400 is one range of aircraft with a 200-305 two-class seat capacity and several commonality features. The only Airbus alternatives are the A321 and A330-200 with 185 and 295 seats, respectively. These have the benefit of CCQ.

"We have the A321 and A300-600 in our fleet and if we dropped the A310 we would have a gap in our fleet structure," says Wilfried Zahlman, deputy head of fleet planning at Lufthansa. We have the A340-200 configured with 212 seats and it has very good range, so we do not need to find another type the same size as the



A310 with long-range capability".

The Boeing fleet mix of 757/767 provides a common type rating between the two and an even spread of aircraft sizes. Replacing the A310-300, an airline could select the same-size 757-300 for routes up to 3,250nm, or the 30-80 seat larger 767-300/-400 for longer and heavier routes.

Faced with the need to replace the A310-300, the Airbus option provides an airline with the choice of either the 35-seat smaller (two-class) A321-200 on sectors up to 2,950nm or the 62-seat (tri-class) larger A330-200 on longer routes. Swissair, Austrian and Sabena have already used these two types to replace the A310. Launch of the A330-100 would provide a 220-seat aircraft, 29 seats more than the A310.

Either the Boeing or Airbus options will increase flightdeck commonality and crew savings across a fleet. The A310/A300-600's lack of commonality with any other Airbus types of a similar size is both the A310's and Airbus product line's weakness. This is a rationale for the A330-100. Lack of CCQ commonality and poor range are the rationale for A310 replacement.

Financial implications must be considered when replacing the A310. A higher used-market value makes replacement easier, since net acquisition cost for new aircraft can be reduced. A strong aftermarket is desirable.

The largest market for the A310-300 is freight conversion. It will face competition from the 767 for a finite market. The winner will be the type whose values fall to a low level first.

"The South American market is also reported to have an interest in acquiring

used A310s, and airlines in the CIS already have several aircraft," says Zahlman.

While the 767-200ER is likely to remain popular, A310-300 operators are already showing signs of a desire to replace their fleets because of the disadvantages described earlier.

Case for 767-200 replacement

The medium-range 767-200 limits the aircraft's flexibility in the same way the A310-300's performance does. The -200's maximum range of 3,900nm restricts it to regional and US domestic operations. This is reflected by the fact that its operators are US carriers as well as JAL and ANA.

The 767-200 is heavy for its seat size. The two-class arrangement of the 767-200 is about 220-230 seats, which is only 20-30 seats more than the lighter 757-200 and 10-20 seat less than the also lighter 757-300. The 757-200 and 757-300 can operate to 4,100nm and 3,200nm. The 757 will have lower unit air-seat mile (ASM) cost.

For routes that require higher traffic volumes, the 767-300 with 45 more seats, is preferable, since operating costs will be incremental. The 767-400, with a further 31 seats, will increase efficiency even further if airlines can fill the extra seats.

The A321 and A330-200 options only provide solutions in either extreme. That is, the A321-200 is 30 seats smaller than the 767-200 and the A330-200 72 seats larger. Even the A330-100 (220 seats) would be a large increase for a 767-200 operator.

Unlike A310 replacement, selecting larger 767 models to replace the -200

A310-300, 767-200 & POTENTIAL REPLACEMENT CANDIDATE PERFORMANCE SPECIFICATIONS AND PAYLOAD CAPACITY

Aircraft type	A321-200	757-200	757-300	A310-300	767-200/ 767-200ER	767-300ER	767-400	A330-200
Payload lbs	50,500	51,060	67,600	73,100	71,390/ 70,248	95,400	103,600	108,000
Two-class seats	185	201	240	220	224	269	304	293
Tri-class seats	N/A	N/A	N/A	191	181	218	245	253
Two-class pax range nm	2,950	4,100	3,200	4,300-4,750	6,100	5,600	5,400	6,000
Tri-class pax range nm	N/A	N/A	N/A	4,300 -4,750	3,900 -6,700	6,150	5,625	6,400
Belly freight	10 LD-3			12 LD-3	22 LD-2	30 LD-2	30 LD-2	26 LD-3
Bulk volume cu ft	208			610	430	430	345	695
Total volume cu ft	1,828	1,790	2,387	2,654	3,070	4,030	3,945	3,815
Container tare lbs	2,150	n/a	n/a	3,010	2,574	3,432	4,004	5,590
Maximum payload range nm	2,200	3,100	2,300	2,950 -3,900	2,300 -5,100	3,900	3,750	5,200
Excess freight capacity lbs at 6.5 lbs/cu ft	5,870	5,103	7,716	9,451/ 7,553	12,675	17,453	15,673	15,275

will not improve flightdeck commonality and pilot productivity. Improvements will only be made when selecting the A321 or A330-200 if other FBW Airbus types are also used.

Disposal of 767-200s could be difficult because of limited opportunities. A secondary passenger market will require longer-range variants. This leaves freight conversion. Conversion for 767-200s has already begun with specialist US domestic carrier ABX. Although it may take more, there are 105 aircraft that need to be absorbed.

The case for 767-200ER replacement is different. Range performance is certainly not a problem. The aircraft is ideal for airlines operating long-distance routes that have low traffic volumes. Traffic growth, however, will necessitate larger aircraft.

Options include the 767-300ER, 767-400ER, A330-200 and, if launched, the A330-100.

The -200ER will not have the same difficulties in the used market as the -200. The 767-200ER is the only aircraft that will have similar payload-range characteristics to the DC-8-70 series following conversion. The 767-200ER will not have a problem in the used market. There are about 105 DC-8-70s and the 767-200ER has a good chance of replacing all of these.

The earliest-build -200ERs have current market values in the \$19-22 million range. Total build cost considering conversion and maintenance

will be in the \$30 million range and lease rentals required to make an investment case for a lessor in the \$350,000-400,000 range. This may be too high compared to the DC-8-70's economics. Values of -200ERs are unlikely to reach distress levels or fall too fast because of their limited number and attributes.

There are few signs of 767-200ER operators considering retirement in the same way that A310-300s are expected to be sold. Many -200ER fleets total less than six or seven aircraft and some operated by African and South American carriers with limited traffic growth.

One other factor is that even with traffic growth on long-haul routes, airlines operate their -200ERs efficiently on a mixture of regional and international routes. Air New Zealand, for example, operates its four -200s to Australia but also via Fiji, Tahiti and Honolulu to Los Angeles and Tokyo and to Singapore.

American has a similar mixed operation for its -200ERs. It has a mixed fleet of 30 -200s and -200ERs and operates tri-class service on trans-Continental US sectors and low-density trans-Atlantic routes from Chicago and New York.

"The 767-200 is the right size aircraft for our trans-Continental US markets which need tri-class service," says Matt Pfeifer, managing director of fleet planning at American.

The majority of 767-200 operators also have the -300 series. Retirement of

just the -200 is unlikely to see an operator switching to the A330-200 or other Airbus types, but more likely an upgrading to larger 767 models.

"We are growing our 777 fleet and using some to the top end of the international fleet in terms of aircraft size," says Pfeifer. "We will eventually decide if our 767-200ERs will stay in the international fleet and the market could outgrow the aircraft, but there is no urgent need for us to find a secondary market for them".

Only a whole 767 fleet replacement could see Airbus with a chance of gaining some sales. US Airways, for example, has ordered A330-300s with options on -200s. Ansett and Air Canada have evaluated whole 767 fleet replacements.

Replacement economics

The case for replacing the A310-300, 767-200 and 767-200ER is determined by traffic volumes and revenue potential, range requirements and operating costs.

Low traffic volumes or a desire to increase frequencies will favour the A321 and 757-200. Higher traffic volumes and the need to preserve range performance will dictate larger widebodies. In either case, selection will be heavily influenced by a desire to maximise flightdeck commonality. The need to increase flightdeck commonality and range performance is a rationale for A310-300 replacement, although there is no Airbus aircraft with FBW flightdeck that can

Although the A310-300 has its flexibility limited by its range, there are no direct Airbus replacement candidates. Some airlines have been able to replace it with the A321 and A330-200, while others may require the launch of the A330-100 to provide a strong enough case.

directly replace it. The choice of replacement aircraft will thus be affected by an operator's existing fleet.

A study of operating economics requires a look at both costs and revenue earning potential of aircraft. Two scenarios are examined. The first is for regional or US domestic operations where the A310-300 or 767-200 are compared with the A321, 757-200 and 757-300. This is on medium-range sectors where the aircraft are more likely to be deployed to make better economic use of their size. The sector length used here is 1,200nm, similar to routes such as Chicago-Miami or London-Moscow.

The second looks at the 767-200ER in contrast to potential long-range replacement candidates: the 767-300ER, 767-400ER and A330-200.

Aircraft operation and utilisation has a large influence on ASM costs. The 1,200nm sector analysis has been made assuming a hub style of operation. A 10-12 hour working day and one-hour turn time would result in about 2.4 flight cycles (FC) per day and so 2,600 flight hours (FH) per year. The A321 thus generates about 190 million ASMs and this increases to 245 million ASMs for the 757-300, the largest aircraft.

All aircraft are able to carry full payloads on this sector length. Taking account of a 30lbs baggage weight per passenger packed at 6.5lbs per cubic foot, the remaining volume allows the A321-200 to carry up to an additional 5,870lbs and the 767-200, 12,675lbs (see table, page 16).

Long-haul aircraft should achieve about 4,500FH per year. The flight time of 9.7FH results in about 490FC per year.

Additional freight that can be carried on a 4,000nm sector is about 12,000lbs for the 767-200ER and -400ER, 16,000lbs for the -300ER, and 15,000lbs for the A330-200. The maximum payload range for these aircraft is close to 4,000nm. Actual available payload will depend on permitted take-off weight and the prevailing wind.

The costs that vary because of aircraft type are fuel, maintenance, flight crew, weight related user fees, hull insurance and finance charges.

The basis of these costs are summarised (see box, page 20). The fuel price used is the expected long-term



cost, despite current high levels. The maintenance charges are a combination of engine reserves and airframe, component and line maintenance FH rates. The component costs include an element for rotables and line replaceable units. The cost per FH for rotables can vary widely because of fleet make up and commonality. Airlines will therefore have different costs for the same aircraft.

The same is true for flight crew and associated costs of training. Flight crew commonality, the savings it generates and the effect on airline operations, have such a great influence that most large carriers have opted for a fleet supplied by one manufacturer in the past 10 years. This is not only because of commonality savings, but also the purchase deals manufacturers have given airlines.

New aircraft can be financed with monthly lease rate factors of 0.7-0.9% of acquisition cost. New aircraft are acquired at generous price discounts and are being financed with high residual value guarantees provided by manufacturers at low interest rates. This compares to a more traditional level of 1.0%, at which the A310 and 767-200 are more likely to have been financed.

Replacement analysis

In the regional analysis all five aircraft types have similar unit ASM costs. The A321-200, perhaps not surprisingly, has the lowest trip costs of about \$13,300. This makes it the lowest-risk aircraft.

The 757-200, with similar freight capacity, but 16 more seats has higher ASM costs and about \$2,500 higher trip charges.

The 757-300, A310-300 and 767-200 all have trip costs of about \$17,000. Despite a finance charge advantage, the 767-200 has inefficiencies of fuel burn and maintenance cost, making costs similar to those of the 757-300. The 757-300 can thus generate more revenue from its 16 extra seats. The 757-200 provides a \$1,000-1,200 saving over the 767-200 and A310 if its 23- and 19-seat larger capacities are not required.

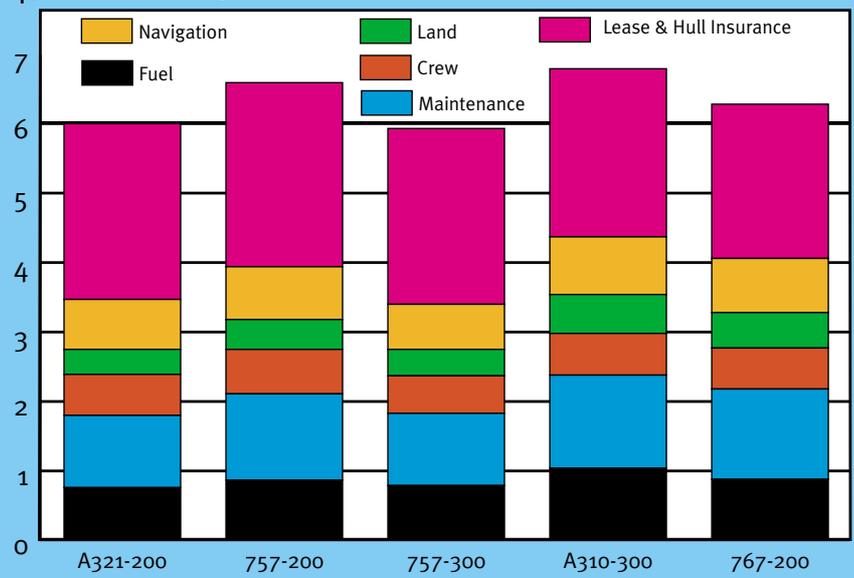
However, this does not provide a straightforward case for 767-200 and A310-300 replacement. Many operators, such as American, use the 767-200 on tri-class US domestic markets, which command premium yields and widebody service. The use of a narrowbody may drive away premium passengers, for the sake of small cost reductions.

"The 757-300 is more efficient on seat-mile basis than the 767-200", says Pfeifer, "but the 757 cannot offer the same comfort premium product that our trans-Continental markets require. We are basically happy with the 767-200 and see no reason to replace it". This indicates the A310 and 767-200 are not always interchangeable with the 757-300.

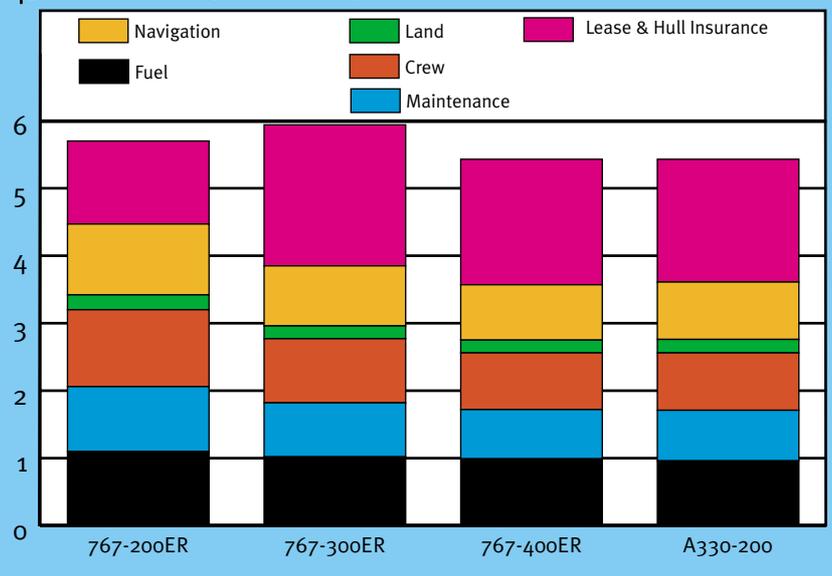
"There are no replacement candidates which can equalise their additional cash operating costs with sufficient benefits," says Zahlman. "The higher capital costs of new aircraft are too high compared to their lower direct operating costs. Replacing older aircraft on an economic basis is not easy".

The A310-300 and 767-200 have slightly higher additional freight capacities than the narrowbodies. At a yield of 50 cents per lb the A310-300 and 767-200 could generate \$1,000 and \$2,500 more revenue than the 757-300.

¢/ASM Regional Analysis Relative Available-Seat Mile Costs



¢/ASM Long Haul Analysis Relative Available-Seat Mile Costs



ECONOMIC ANALYSIS COST BASIS & METHODOLOGY

Sector length:

1,200nm for US domestic/regional operation; 4,000nm for international operation.

Fuel:

Price of 65 cents per US gallon used.

Maintenance:

Total costs per FH: A321, \$745; 757-200/-300, \$970; A310-300, \$1,150, 767-200, \$1,130; 767-200ER/-300ER, \$755; 767-400ER, \$775; and A330-200, \$850.

Flight crew complement annual salaries:

Regional analysis: A321, \$220,000; 757/767-200 & A310, \$265,000. Additional annual cost of \$65,000 per crew. Annual productivity of 700FH.

Long-haul analysis (1 supernumerary crew member per crew): 767-200ER/-300ER/-400ER \$400,000 & A330-200, \$435,000. Additional annual cost of \$150,000. Annual productivity of 625FH.

Finance charges:

A310, 767-200 & 767-200ER assumed to be paying out original finance leases at \$450,000, \$420,000 and \$450,000, per month. New aircraft assumed to be acquired at 20% discount of list price and financed at lease rate factor of 0.8% per month. Hull insurance 1% per year of acquisition cost.

Landing fees & navigation charges:

\$9 per tonne MTOW and \$1 per nm of square of MTOW/50.

In the long-haul scenario the 767-200ER has \$10,000-13,000 lower trip costs than the three larger replacement candidates.

All four types have similar additional freight capacities on a 4,000nm sector length, eliminating any possible freight revenue-generating advantage.

Only extra passenger demand and yields high enough to cover incremental costs will justify 767-200ER replacement. A 65% load factor means 24 of the 767-300ER's 37 higher seat capacity would have to be sold at a one-way net yield of \$420 to cover the additional costs. This could be hard for many 767-200ER operators to achieve. The 767-400ER has a smaller incremental cost over the -300ER of \$1,500 for an additional 27 seats.

The A330-200 represents a large increase in cost for 767-200ER replacement. Filling the A330's 72 extra seats at a 65% load factor would require an average one-way fare of \$280, which is not high in relation to the sector length. The number of extra seats is too large for many operators, however. This highlights the need for Airbus to launch the A330-100.

Similar ASM rates will apply to A310-300 replacement on longer routes with respect to the 767-300ER/-400ER and A330-200. Despite the A310-300 not having widely different unit ASM costs compared to the larger 767 models, the case for A310 replacement is related to having more range flexibility and increasing CCQ with other Airbus types in the fleet. The A310 is still hard to replace, since other Airbus types are too small or large in comparison.

Some airlines are using the -200ER on a diminishing number of long-haul routes, but using them on more premium regional and domestic sectors which require their widebody comfort. Their design for long-range networks does not make them inefficient in regional markets. The -200ER will have little difference in ASM unit cost with the lower gross weight -200.

Conclusions

Although the A310 has some weakness with range performance, there are no aircraft that can directly replace the A310 and 767-200. Both provide acceptable unit ASM costs now their finance charges are low compared to new aircraft. Operators of 767-200s can gradually transgress to the -300 and -400 where long range is required. This will not force retirement of 767-200s, since they can still operate economically on domestic and regional networks.

A strong enough freight conversion market exists to take a portion of A310-300s as they are retired, but the A330-100 is probably required for airlines to make a case for replacement.

