The 747 has been filled many roles for two decades. The advent of new long-range aircraft provided more flexible options for long-haul fleet planning and more appropriate types to fill each of the 747's duties. The economics of each type in isolation and in a group of types is analysed.

The multiple options for 747-200/-300 replacement

Since the 1980s the 747 has met increasing criticism that it is inflexible and does not meet most airlines' requirements. The aircraft was conceived for the regulated market, with traffic being fed through major airports. This made it still too large for most major carriers not serving the busiest routes.

The youngest 747-200/-300s are now 15 years old, and the oldest operating in mainline passenger service are now 29 years. The 747-200/-300 have tri-class seat capacities of 379 and 420 seats.

Many airlines have already made replacement decisions, while others are in the process of selecting new fleets. This has been made more flexible by the variety of long-range aircraft types now available.

747 market development

Markets have evolved in several ways and so present different options for 747 replacement.

Liberalisation across the Atlantic made the 747 too large to be flexible. The 767 became the most popular aircraft across the Atlantic. This saw average aircraft size almost halve, although it is now increasing again with continued traffic growth. This will lead to the most popular type being similar in size to the A330/340 or 777-200.

Major airline fleet plans have seen the 747 dropped in favour of the 777, A330 and A340 by Air France, British Airways (BA), Aer Lingus, Continental, United, Air Canada and Cathay Pacific on many routes.

Many airlines adopted revenue and route network strategies to help fill the 747. BA used its position at Heathrow to offer cheap interlining fares between points in Europe and the US, via London. This helped fill 757s on short-haul routes and 747-200s on the north Atlantic.

"We developed a database to see where on our network we were carrying low fares," explains Dick Wyatt, general manager fleet planning at BA. "This revealed that transfer traffic yields between Europe and the US did not cover the incremental costs of the 747-200's extra seats over the 777-200's. Our new system also revealed a huge difference between origin and destination (O&D) fares and transfer fares. These low yields were compounded by the additional costs of transferring passengers at London. We therefore dispensed with the low yield transfer traffic and downsized our trans-Atlantic aircraft. We originally needed the 747-200 because of its range, but the 777-200ER has made fleet planning more flexible. Moreover, we also expect the long-range market to fragment in the same way as Boeing's forecasts".

As a 747-200 replacement, the 747-400's range allows it to satisfy the requirements of those airlines that operate international trunk routes and still need high capacity. The 747-200/-300 have been transferred to shorter routes. Thai Airways, for example, has already replaced its 747-200s but has a few -300s left. Thai requires a replacement with equal capacity, although this strategy could change. The airline suffers a payload penalty with the 747-300 when operating from Bangkok to Europe, and also requires more belly freight.

Qantas has similar requirements to Thai. "Our replacement strategy is based around the A380. A few of our routes could sustain a 300-seat aircraft, but most are better suited to the 747-400 or A380," explains David Forsyth, executive general manager aircraft operations at Qantas. "Because of our geographical location, range is often a consideration for replacement aircraft, and the 747-400LR and A380 will meet this need".

In cases where the 747-200/-300 do not have a range shortfall, forecast traffic growth could mean their capacity or that of an even a larger aircraft will be required. Some Europe-Asia and trans-Pacific routes fall into this category. This will be filled by the 747-400 or A380.

There are cases where the 747-200/-300 are too large, but their range is too short. Examples are trans-Pacific and Europe-Asia routes, which still have low traffic volumes, but where regulation keeps average aircraft size close to the 747. In some cases the 747-200/-300 have already been replaced by the A340 or 777.

Another 747 market is the high-density intra-Asian routes which require similar capacity and range to the 747-200. Some 747-200/-300s have already been replaced, or are about to be. The prime aircraft for this role has been the 777-200/-300, with Singapore Airlines (SIA), Cathay Pacific, Japan Airlines (JAL), All Nippon Airways, Korean Air and Thai having placed orders. The A330 has also been selected by Cathay, Garuda, Malaysian, Thai, Korean and Qantas.

BA is one carrier that has followed a strategy of downsizing from the 747. Analysis revealed that net yields of interlining fares did not cover the incremental costs of flying its extra seats compared to the 777-200's. The airline has therefore replaced 747-200s with 777-200s, and 757s with A320s.

747-200/-300 replacements

Considering 747-200/-300 replacement markets, replacement candidates require seat capacities in the 300-550 range.

Airbus starts with the 295-seat A330-300 and A340-300, and rises up to the 556-seat A380-800, with the 656-seat A380-900 as a possibility if launched.

Although pitched as a medium-range aircraft, the A330-300's range performance allows it to operate many routes currently operated by the 747-200/-300. The A340-300 has the ability to replace the 747-200/-300 on longer Europe-Asia and trans-Pacific routes, by consolidating capacity and increasing frequency.

The A340-300 has been overshadowed by the A340-500, which has a longer range and is larger by 18 seats. The A340-500 is accompanied by the 380-seat A340-600. The A340-500 is therefore more likely to be considered than the A340-300.

Airbus' weakness is the 175-seat gap between the A340-600 and A380-800. Airbus provides up to five different types and variants for 747-200/-300 replacement, although only up to four are likely to be considered by an airline. All five aircraft have the same fly-by-wire system, and cross-crew qualification (CCQ), which minimises training requirements if the customer wishes to operate mixed fleet flying.

The A330-300 has three engine choices. The A340-300 uses the CFM56-5C, the A340-500/-600 the Rolls-Royce Trent 500 and the A380 would introduce a fourth engine type if all models were used by an airline. All five Airbus choices have extensive parts and component commonality.

Boeing provides a similar number of types and seat capacities, ranging from the 305-seat 777-200 to 420-seat 747-400. This would have been extended up to 522 seats if the 747-X Stretch had been launched. The 747-400X has been launched, and this will have different engines to the current -400 model.

The Boeing option has two basic types; 777-200/-300 and 747-400. The 777-200/-300 are virtually identical and have a same pilot type rating.

Although the Boeing option appears to offer a less complicated choice than the Airbus range, the issue is made more complex by there being several 777-200 and -300 variants. All -200 models up to a maximum take-off weight (MTOW) of 657,000lbs and -300 variants up to 660,000lbs can use the same engine. The 752,000lbs higher gross weight -200LR and -300ER, however, use the GE90-115, which reduces engine and spare parts commonality across a 777 fleet of varying gross weights.

If the higher gross weight 777 variants are required in addition to the 747-400 and 747-400X four different engine types will be used.

While the Airbus option has CCQ because of an identical flightdeck, the 777 and 747-400 have different flightdecks and so pilot type ratings. This increases pilot training over a mixed A330/340/380 fleet.

The importance of commonality varies between airlines. The increased involvement of original equipment manufacturers (OEMs) in the aftermarket has reduced the emphasis of commonality benefits. "While we try to avoid small fleets to help improve crew utilisations, support contracts for engines from the OEMs undertake to maintain the engine for life, and so have reduced the need for engine type commonality," says Wyatt.

All these new aircraft offer several cash operating cost benefits over the 747-200/-300. New types also offer the advantages of smaller payload and performance limitations on longer routes, which have the effect of increasing revenue generating potential. "We did have some restrictions across our network with the 747-200 at certain times of the year," admits Wyatt. "The 747-200s are now confined to our shorter trans-Atlantic routes, while the 777-200s are now used on African sectors which caused problems for the 747-200s. The 777-200 also has the same belly freight as the 747-200".

KLM is also focusing on 300-seat aircraft, and will consider replacing its 747-300s with smaller aircraft. El Al has already followed this strategy, and is another airline to replace its 747-200s with 777-200s. KLM requires an aircraft with better range performance, enhanced operational performance and more belly freight capacity than the 747-300.

Most other carriers agree on the need for better range and belly freight capacity. "We generally look for improved payload-range performance to ensure the fleet remains flexible," says Forsyth "and freight is an important part of our revenue stream, and look for as much capacity as possible in addition to passenger revenue".

747-200/-300 economics

With the different 747-200/-300 replacement scenarios and variety of replacement candidates, analysis of the most economic replacement option can be considered for a mixed fleet.

Most 747-200/-300 routes have only 2-4 flights per day. The highest difference between revenue generated and aircraft trip costs for a level of passenger demand on a route indicates which aircraft types are the most economic.

As demand grows load factors increase. As load factors rise close to the 65-75% level there is an increasing chance that passengers will be 'spilled'. This is because demand conforms to a standard distribution curve.

747-200/-300 REPLACEMENT CANDIDATES SPECIFICATIONS

Aircraft type	777-200LR	777-300ER	747-400
First seats	16	22	21
Business seats	58	70	77
Economy seats	227	273	322
Total seats	301	365	420
List price ($ million)	170	180	185
Volumetric belly freight payload at 70% load factor (lbs)	14,566	20,849	23,616

Aircraft type	A330-300	A340-500	A340-600	A380-100
First seats	18	12	12	22
Business seats	49	42	54	102
Economy seats	228	259	314	431
Total seats	295	313	380	555
List price ($ million)	135	159	169	230
Volumetric belly freight payload at 70% load factor (lbs)	14,666	13,138	19,370	12,751

As average load factors rise above 70% the risk of spill increases, and capacity will have to be added to avoid spill. Airlines therefore not only consider which types generate the highest gross profit at current passenger demand, but also what will be the most economic over the long term following growth.

The 747's inflexibility is illustrated by the limited ways in which its operators can respond to increased demand. When the 747 was the only option, a flight frequency had to be added when demand approached a 70% load factor.

Plotting gross profit generated against passenger demand would result in a characteristic saw-tooth curve. Gross profit rises with passenger demand and revenue up to the point at which the airline adds a frequency to avoid passenger spill. An additional frequency increases trip costs, with little extra passenger numbers and revenue. Gross profit falls, and rises again with more demand *(see chart, page 21)*. This profile would be dramatic with the 747 as the only option, since adding a frequency would double trip costs and halve revenues per flight. This would make both flights unprofitable, and the situation could only be improved by more revenue and increased passenger demand.

This problem could be overcome by accepting higher load factors and spill, offering discount fares or using a smaller capacity aircraft. This last option could only be achieved in the past by introducing a 747 Combi or DC-10-30.

Besides the steep reduction in gross profit with additional frequencies, the 747-200/-300 has the additional problem of being hard to fill for most airlines. This was overcome by many airlines selling high discount O&D and transfer fares. This reduced average yield per seat; reflected by a less pronounced gross-profit profile. The implications of this are that the range of load factors at which a gross profit is generated was narrowed, making the 747 hard to justify.

Downsizing

These difficulties have been overcome with the new long-range aircraft previously described, which are 70-110 seats smaller than the 747-200/-300.

Several airlines have followed a similar strategy to BA in their 747-200 replacement. BA has downsized from 747-200s to 777-200s. As Wyatt explains, BA's transfer economy class fares were some of the lowest on its network and lower than O&D fares, but the transfer passengers were necessary to fill the 747-200. Disposing of these transfer passengers has increased average yields in the process. This has made operating smaller aircraft more profitable.

Two or three daily 747-200/-300 flights can therefore be substituted with the same number of operations by the A330, A340-300/-500 or 777-200 carrying a smaller volume of traffic at higher average yields. These aircraft can be configured with the same number of first and business class seats, but less economy class seats. Since only O&D economy fares will be sold, average discount level from full fare will be reduced and average fares increased.

Maintained capacity

In some cases average yields are high enough to make operating the 747 profitable. Airlines will then want to maintain capacity, and increase it in line with traffic growth.

Replacement options include maintaining size, with the 747-400, and frequency. Capacity can also be maintained, while frequencies are altered with larger or smaller aircraft. Consolidation with the A380 may reduce unit seat-mile costs, while smaller types and higher frequencies could stimulate traffic and passenger yields. Larger types could also be used during peak periods of the day and week, and smaller aircraft at less busy periods. This increases flexibility and allows better matching of supply with demand.

Alternatives are to increase frequencies by using the A330, A340 or 777 models, followed by use of larger aircraft on some and eventually all frequencies with traffic growth. Limited landing slots, time zone differences and flight times mean airlines operating the busiest routes, for example London-Singapore, are finding it harder to increase frequencies. This will lead to replacement of the 747 with the A380.

The range of aircraft types available allows more flexible responses to increased traffic, because smaller increases in capacity and aircraft size can be made as average passenger demand rises. This also allows moderate increases in aircraft trip costs and reductions in passenger load factors and gross profit generated as one type is replaced by a slightly larger aircraft. For example, a three times daily 747-200 operation can be replaced in several ways. This could be with a combination of A330, A340-500/-600 and A380 operations, or similarly by a mixture of 777-200/-300 flights.

The net effect is a smaller drop in gross profit generated, as each increase in capacity is made compared to the addition of another 747 frequency. The saw-tooth profiles for each of these new aircraft would then be less pronounced, and so offer a more economic alternative to a pure 747-200/-300 fleet. Moreover, the collective gross profit saw-tooth profiles of the various types together will be less pronounced than the 747's *(see chart, page 21)*. The range of new long-haul types has thus made fleet planning for traditional 747 routes more flexible.

Although a better matching of supply with demand is possible with mixed fleets, more types are introduced into the fleet. The increase in costs will be offset because of extensive parts and engine commonality and pilot CCQ.

Aircraft type	A330-300	777-200LR	A340-500	777-300ER
Seats	295	301	313	365
Average sector length (nm)	3,300	5,000	5,000	4,000
FC per year	665	560	560	630
BH per year	4,988	6,216	6,216	5,670
ASMs per year (millions)	647	854	876	920
Average flight crew complement	2.0	3.0	3.0	2.3
Flight crews/aircraft	7.7	9.6	9.6	8.7
Cabin crew size	10	13	13	16

Aircraft type	A340-600	747-200	747-400	A380-100
Seats	380	380	420	555
Average sector length (nm)	4,000	4,000	4,500	4,500
FC per year	630	630	612	612
BH per year	5,670	5,670	6,186	6,186
ASMs per year (millions)	958	958	1,158	1,532
Average flight crew complement	2.3	3.0	2.5	2.5
Flight crews/aircraft	8.7	8.7	9.5	9.5
Cabin crew size	16	17	17	20

Economic analysis

While there are many scenarios and economic circumstances under which 747-200/-300 replacement has to be considered, one has been analysed.

In this scenario capacity is maintained, while analysing which mix or aircraft types and respective frequencies generate the highest gross profit at each level of average daily passenger demand. This assumes average fare does not change with aircraft type. The average daily one-way demand passenger volumes over which this is analysed is equal to 1-3 daily 747-200 flights, with a load factor constraint of 70%. This is equal to 180-500 passengers.

The gross profit saw-tooth profiles of each aircraft type under consideration are analysed *(see chart, page 21)*. This will reveal the most economic saw-tooth profile for a fleet mix or single aircraft type.

A 70% load factor constraint with the assumption that up to this level there was a zero risk of passenger spill would produce a gross profit profile increasing at a constant rate.

Aircraft capacities are assumed to be the manufacturer's standard tri-class number. There are, however, differences in the ratios of first, business and economy class seats between types and the manufacturers. Most Airbuses have smaller percentages of first and business class seats than Boeing types. Since airlines would not want to lose high-yield passengers, all aircraft would have to be analysed with an equal number of first- and business-class seats, irrespective of eventual fleet choice. This suggests Airbus standard seat numbers would be reduced by larger premium cabins, or standard Boeing seat numbers increased by smaller premium cabins.

Airlines will analyse aircraft gross profit profiles on all their routes, but the analysis is made for a typical route. An average equivalent still air distance of 4,000nm for both directions on the route, equal to a flight time of about nine hours, has been used. This is close to the average route length for many 747-200/-300 operations.

Passenger demand & revenues

The gross profit profiles calculated *(see chart, page 21)* show average levels of daily passenger demand over the long-term for the airline as traffic grows.

With passenger demand increasing steadily with traffic growth, the portions of fares sold and average fare may remain constant. This analysis therefore assumes average fare is the same at all levels of passenger demand.

Irrespective of aircraft type operated, the demand for first-, business- and economy-class seats will be the same. This analysis assumes frequency does not affect the proportions of demand for first-, business- and economy-class tickets.

The portions of first, business and economy class demand are 5%, 18% and 77% for all demand levels. The analysis also assumes that each cabin in each aircraft type does not experience passenger spill.

The same one-way net fares for first class and business class have been used. While full fare economy seats can be sold at levels close to business class fares, the large number of discount fares means average economy fare will be diluted. Interlined tickets are also apportioned at lower rates than O&D fares, and so reduce average yields in all classes. The average economy class fare is taken as $300. The average one-way fare is $504.

Additional revenue

Airlines also use the belly freight to generate revenue. Passenger baggage will use some belly capacity, but the remaining space can carry freight. Average belly freight rates vary widely throughout the world, but 50 cents per lb has been used.

The additional freight capacities for each type have been calculated taking container volume for baggage into consideration, and packed at only 3lbs per cubic foot. Remaining container volume is assumed to be sold at an average load factor of 70% and packed at a density of 6lbs per cubic foot. The net available freight capacity for each aircraft is shown *(see table, page 16)*. This generates additional revenues of $6,400-$11,800, depending on aircraft.

The A340 has provided flexibility in 747 replacement. Routes can now be opened at higher frequencies and additions to capacity following traffic growth are not so large, making it easier to generate gross profits at all traffic volumes.

Aircraft trip costs

The costs included in this analysis are fuel, maintenance, flight crew, cabin attendants, catering, landing and navigation charges, insurance and costs for aircraft finance, lease or depreciation.

The most important factor in determining trip costs and operating efficiency are the number of available seat-miles (ASMs) generated. This is determined by how aircraft are operated across a route network. Although a range of different aircraft can replace the 747-200/-300, shorter-range types are more likely to have average shorter route lengths than longer range types. The assumptions for average route length and annual utilisations for each type are summarised *(see table, page 17)*.

The trip ASMs on the 4,000nm route then account for a portion of total annual ASM productivity for each aircraft. The magnitude of finance or lease charges, and pilot and flight attendant costs for the 4,000nm trip are influenced by this portion of ASMs as a percentage of annual ASM productivity.

Fuel burns are those for a full passenger load plus a 70% belly freight load factor for each aircraft. Taxi time is assumed to be 20 minutes.

Fuel price also varies globally, but an average cost of 65 cents per US gallon has been used. Fuel costs are $10,200-21,500 per trip for the aircraft included.

Maintenance costs used are the time and material costs for line and airframe checks and major component repairs amortised over their respective intervals, and time and material charges for engine shop visits amortised over intervals as reserves per FH. Line replaceable unit costs per FH are based on what airlines would typically have to pay when leasing inventory and paying a fixed power-by-the-hour rate for a fleet of 15 aircraft.

Estimated mature total maintenance costs per FH are about $1,000 for the A330-300 and rise up to about $1,700 per FH for the A380-800. This generates trip maintenance costs of $9,100-15,200 for the range of new aircraft. The 747-200/-300 have higher maintenance charges in the region of $2,100 per FH, and $19,000 for the 4,000nm trip.

Flight crew costs are determined by how each aircraft is likely to be operated in an airline's network. Longer routes require supernumerary crew to be rostered, while shorter sectors can use the standard flight crew complement of the aircraft's flightdeck. In most airlines, flights up to seven or eight hours block time will use two-man crew for a two-man flightdeck. The 747-200/-300 will use a crew of three on flights up to nine or 10 hours.

Average crew complement for each aircraft will increase with average route length. The average flight crew complement for each aircraft in this analysis is based on the average sector length it is likely to operate across an airline's network *(see table, page 17)*. The A330-300 will be operated on the shortest average sectors. The ultra long-range A340-500 and 777-200LR will be deployed on the longest average routes. The remaining aircraft will be used on 4,000-4,500nm routes by most airlines.

Supernumerary crew will be made up of both captains and first officers, and increase average annual crew employment costs. Combined annual salaries for a standard two-man crew of captain and first officer used here are $170,000-227,000 for the range of aircraft included; with the A330-300 crew having the lowest salaries up to the highest for the A380-800. These annual salaries have then been adjusted for average crew size and then escalated by 50% to account for all additional costs of employment, such as training, subsistence, meals, per diems and accommodation. Crew costs per ASM and per trip are then affected by how many crews on average are employed per aircraft. Flight crew productivity is assumed to be 650 block hours (BH) per aircraft, and so 7.7-9.6 crews are needed per aircraft depending on annual utilisation *(see table, page 17)*. Crew costs for the trip are then apportioned on the basis of ASMs for the trip as a percentage of annual ASMs generated. These are $3,600-5,900 for the new aircraft, and $8,300 for the 747-200/-300.

Flight attendant costs are determined by the cabin service level offered by the airlines and so number of crew rostered on the trip. Most airlines operating long-haul services have high ratios of cabin staff to passengers in first and business class. Crew complements used are 12-20 staff, with numbers increasing in relation to aircraft size. Average annual salary is taken as $37,000 and a crew productivity of 700BH is assumed. Seven to nine crews are required per aircraft, depending on annual utilisation. Trip costs are $4,800-9,500 for the aircraft included.

Catering charges are based on a cost of $70 for first class, $60 for business class and $12 for economy class passengers. Passenger numbers are based on manufacturers' standard tri-class configurations *(see table, page 17)*.

Landing charges are highly variable at major airports around the world. The US has the lowest rates, while Europe the highest. Landing charges will then depend on the actual route operated. Considering most routes are to or from major airports in the US, Europe and Asia Pacific, averages have been taken for each aircraft. Landing fees are $1,400-2,700, and based on maximum take-off weight.

Navigation charges used assume a flat rate of $3,000 for all aircraft.

Aircraft finance or lease charges account for the biggest portion of all trip costs studied here. In the case of new aircraft it will account for about 30%.

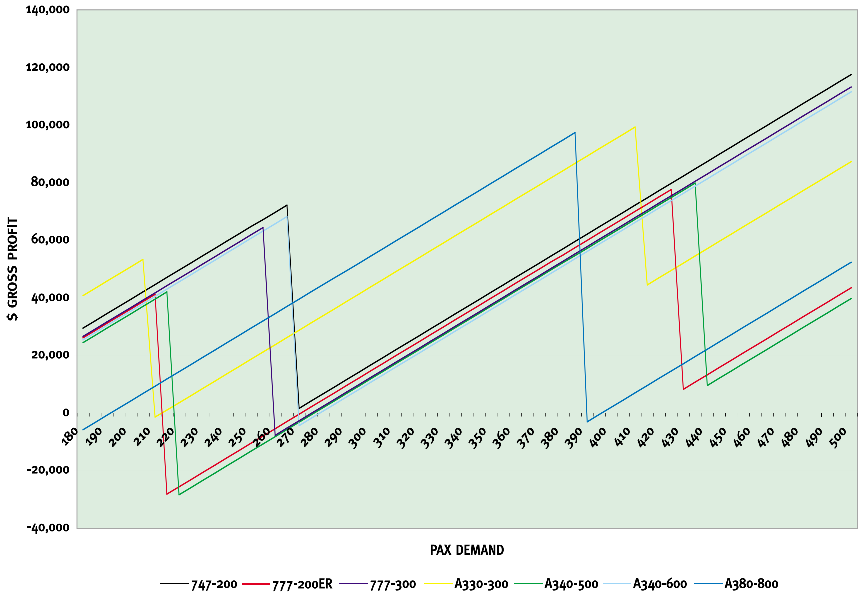
The one advantage that the 747-200/-300 have is that most owned aircraft are now fully depreciated, and so will have zero depreciation costs. This will make it hard to replace the 747-200/-300 on a one-for-one basis purely on an economic basis.

Finance charges for the 747-200/-300 in this analysis have been based on a lease rate factor of 1.5-1.6% per month of current market value. The highest values are for high gross weight -200s powered by CF6-50s and JT9D-7Q/-7R4G2s and -300s; and are in the region of $17-20 million. These will then have lease rates of $255,000-320,000. The lease rate used in this analysis is $270,000. Lower gross weight -200s are valued in the region of $11-15 million.

New aircraft will be acquired at discounts on manufacturer list prices in most cases, and then financed by a variety of means and over a range of terms, depending on the geographical location and financial status of the airline. The assumptions used here for all new aircraft are that a 20% discount on mid-range manufacturer's list price *(see table, page 16)* can be secured and that financing terms secured are equal to a lease rate factor of 0.9% per month.

This results in lease rates of about $968,000 for the A330-300 and up to $1.6 million for the A380-800. These translate into trip finance charge costs of $17,500 for the smallest new type up to $32,400 for the largest.

747-200/-300 REPLACEMENT ECONOMICS



Summary

The economics of replacing old aircraft is largely influenced by the difference between the re-sale price of the old aircraft and acquisition cost of the replacement.

Finance charges of new aircraft are high and can raise total costs per ASM higher than older types with higher cash operating costs. Replacing a used aircraft is therefore easier the higher its residual value. Despite their inflexibility, the 747-200/-300 have the advantage of low opportunity finance charges. This lowers their ASM unit cost and so makes it harder for new types with high list prices to compete. New aircraft are helped by purchase discounts, as used here.

Despite the low finance charge of a $270,000 lease rate, the 747-200's gross profit profile is not higher than any of its replacement candidates *(see chart, this page)*. Where the A330-300's small size is appropriate for the level of passenger demand it has the highest profit profile.

The 777-200ER and A340-500 are virtually identical, although the 777-200ER has a small advantage because of slightly lower trip costs. Perhaps surprising is the A330-300's higher profile compared with the 777-200ER. Despite both being twin-engined aircraft, the 777-200ER is heavier, with higher fuel burn cost, but is designed to compete more directly with the A340-500. A lower gross weight 777-200 variant would be more competitive against the A330-300.

The 777-200ER and A340-500 have profit profiles which almost shadow the 747-200's, meaning the new aircraft are economically suitable as replacement candidates. The A340-500's and 777-200ER's smaller size, however, means the 747-200 has a higher profit profile over a wider range of passenger demand levels. This shows that new aircraft are suitable 747 replacements for some carriers.

The 777-300 and A340-600 also have virtually identical profit profiles, explained by the A340's marginally higher trip costs being offset by its 15-seat higher capacity. The 777-300's and A340-600's profit profiles also shadow the 747-200's. This illustrates the 777-300's and A340-600's suitability as 747-200/-300 replacements. This is explained by the A340-600 and 777-300 having similar capacities and trip costs to the 747-200. This dispels the issue of new aircraft having an economic disadvantage because of high finance charges.

Although not shown, the 747-400 has a lower profit profile than the 747-200. This is because the 747-400 has higher costs than the 747-200, explained by high finance charges. The 747-400 also has higher cash operating costs than the A340-600 and 777-300.

The A380-800 has the most prominent profit profile at a single frequency compared to the other types at two or three daily flights over daily passenger demands of 270-380. This is of course due to the A380-800's large size, which means it is able to generate the same revenue as other types, when operating at lower frequencies and trip costs compared to the other aircraft. This illustrates the A380-800's suitability where high frequencies are not possible or required, or where smaller types do not generate higher yields by stimulating first and business class traffic. "Our older 747s are operated on leisure routes where the cost base needs to be low," says Forsyth. "Thus a replacement aircraft also has to be a lower cost vehicle. The 747-200/-300 have quite low unit costs, and it requires a step change, such as that offered by the A380, to provide an economically viable rollover case".

These results all relate to equal average fares for all types.

The scenario where replacement candidates smaller than the 747-200 (A330, A340 and 777) are used at the same frequency and provide lower total capacity would generate higher average fares for the smaller aircraft. This would produce different gross profit profiles to the ones shown here. In this case replacement candidates would be configured with equal sized first and business class cabins as the 747-200. Replacement aircraft will therefore have smaller economy cabins, and so avoid heavily discounted fares. All aircraft will operate at the same frequency, and airlines could manage fares and revenues so that at the same load factor, average fare increased with decreasing aircraft size. This will raise profit profiles of replacement candidates higher than in the analysis shown here, and also make them more competitive than the 747-200/-300.

This explains many airlines' strategies of replacing 747's with smaller types, and accounts for a large portion of A330, A340 and 777 sales.