**Values of medium widebodies are approaching levels at which their conversion to freighter will be economically viable. The first A300-600s and A310-300s are now already being converted, but market values of 767-200/-300s are falling. Does one pair make the better option?**

# Medium widebody freighter selection

Market values of several twin-engined widebody aircraft have begun to reach levels that make their conversion to freighters economic. These are the A310-300 and A300-600R, with the first few now under conversion. The 767-200/-300 could soon follow.

These aircraft can fill several roles, including DC-8 and 707 replacement and capacity for growth on routes using smaller aircraft in the small package and general freight markets. These four aircraft are also candidates to replace or supplement the A300B4F, which was converted in large numbers, but is not ideal in some of its current roles.

The fleet of medium widebody freighters is expected to increase from its current size of 200 aircraft to about 700 in 20 years, with a net increase of about 550 units. The availability of passenger aircraft for conversion exceeds the probable demand for converted aircraft from the freight sector, so competition for this secondary market will be strong.

The important factors in airline selection of one or two of these four types are unit cost performance and payload capability. Capability concerns weight, volume, container types used; and their ability to be interlined with other aircraft.

Operating economics can be viewed by analysing gross profit generating capability of the aircraft. This considers payload and revenue generating capacity in addition to costs. Gross profit performance of aircraft types thus accounts for differences in their payload capacities, as well as the variation of payload with route length and packing density of the material. Gross profit performance takes account of the unit revenues of freight carried, and so illustrates the performance of the aircraft in different markets and operating conditions. It also indicates when additional capacity should be added.

## Economic viability

The economics of the A300-600R, A310-300 and 767-200/-300 will have to be at least as good as or better than current types. The closest aircraft to these four, in terms of airframe size and age, is the A300B4-200F. This provides a guide to the economic performance required of potential conversion candidates.

The A300B4 is used in express package and general freight operations. Its advantages are a low lease rate, in the region of $225,000 per month, a structural payload of 95,000lbs, a containerised volume of 11,200 cubic feet and the use of containers that interline with several other aircraft types. Its structural payload and containerised volume allow a maximum packing density of 8.5lbs per cubic foot. Since small package operations have typical packing densities of 6.5lbs per cubic foot, the A300B4 can use all its available volume.

The A300B4 can only carry a full structural payload of 95,000lbs about 2,000nm. The A300B4 suffers from an available payload reduction on longer sectors, and so is not optimised for general freight operations in markets between Europe and the Middle East or Africa, between and North and South America, and in several intra-Asian markets.

The A300B4 also has poor field performance compared to younger widebody twins, and this limits its application on routes from hot and high airports in South America to the US.

The A300B4 has therefore become more limited to small package operations operating shorter route lengths. The A300B4's is disadvantaged in this market because it has high engine maintenance reserves on short sectors. This raises aircraft maintenance and total operating costs.

## New conversions

Aircraft utilisations in most freight operations are low, and so economics are sensitive to aircraft financing or lease rates. It is generally held that the 767-200ER and A310-300 will have to be offered at lease rates in the region of $225,000-250,000 per month to be considered by general freight carriers. The larger types, the A300-600R and 767-300, will have to be offered at rates of $275,000-300,000 per month.

Lease rate factors of about 1.2% per month for aircraft converted at 15-18 years old means the A310-300 and 767-200 will have to be built for a maximum cost of about $20 million, and the A300-600R and 767-300 for no more than $25 million, for lessors to justify the investment in aircraft, conversion, modifications and bridging maintenance.

"The highest lease rate for general freight operators to consider the A300-600R is probably about $300,000, because their yields are generally low and they will not be able to make profits with a higher aircraft lease rate," says Jurgen Haberman, director of sales and marketing at EADS-EFW. "Small package operators can afford higher lease rates."

Express package carriers can therefore justify lease rates of up to about $275,000 for the A310-300 and 767-200, and up to about $350,000 for the 767-300 and A300-600R. This would raise corresponding maximum allowable build costs by about another $5 million. The implications of this are that express package carriers are more likely to be the first airlines to convert aircraft. This is because aircraft only become viable for conversion when their values fall. They will reach the higher level acceptable for express package carriers before reaching a value where general freight operators can justify acquisition. Express freight carriers can also finance aircraft easier.

**40-55 TON FREIGHTER STRUCTURAL & VOLUMETRIC PAYLOAD SUMMARY**

| Aircraft type | A300B4-200F | A300-600RF | A310-300F | 767-200SF | 767-300SF |
|---|---|---|---|---|---|
| MTOW-lbs | 363,760 | 375,900 | 361,554 | 335,000 | 352,000 |
| Structural payload-lbs | 95,590 | 109,740 | 86,300 | 95,000 | 121,000 |
| Containerised volume-cu ft | 11,180 | 13,712 | 10,044 | 10,620 | 15,696 |
| Packing density (lbs/cu ft) | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 |
| Volumetric payload-lbs | 72,670 | 89,128 | 65,286 | 69,030 | 102,024 |
| Packing density (lbs/cu ft) | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Volumetric payload-lbs | 83,000 | 109,696 | 80,352 | 84,960 | 121,000 |

## Build costs & conversions

List price of conversion for the A300-600 and A310 is $7.5-8.0 million, while it is higher at $10.4 million for Boeing's conversion of the 767-200/-300. Bedek is, however, in the process of acquiring its own supplemental type certificate for the 767-200/-300 conversion. This may be at a price closer to the A300-600 and A310.

These costs have to be considered against the additional expense of bridging maintenance, aircraft purchase and possible upgrades for maximum take-off weight (MTOW). These factors therefore set a ceiling for aircraft purchase values, thereby determining the viability of individual aircraft for conversion.

Bridging maintenance will vary according to maintenance status, but high requirements will be balanced by reduced purchase values. The costs of various airframe checks and shop visits differ between the A300-600/A310 and 767-200/-300, but will not make a large impact in the difference of the build costs of the A300/310 and 767-200/-300.

The maximum build costs of the 767-200 and A310-300 will be close, and are $20-25 million for them to have lease rates acceptable to potential lessees.

The bridging heavy check and component maintenance costs of these two aircraft types will be about $1.5 million in both cases for aircraft of the same maintenance status. An engine shop visit would add to this cost, but would reduce purchase price. The conversion for the A310-300 is $7.5 million, while it is $10.4 million for the 767-200.

The 767-200 could also incur upgrade costs. There are many different MTOW specifications of the 767-200, and aircraft can be upgraded with kits from Boeing, but this adds extra cost. Aircraft below line number 85 can have up to $2 million spent on weight upgrades. This is unlikely to be invested by operators converting aircraft for small package operations. Later build and higher weight specification aircraft will be used for longer range missions.

The 767-200's purchase price will have to be about $8-13 million and the A310-300's about $11-16 million for the two to have the same build cost of $20-25 million. The difference in purchase costs is explained by the 767's $3 million higher conversion cost.

The A300-600R and 767-300 have similar bridging maintenance and differences in conversion costs. The 767-300's purchase price will therefore also have to be about $11-16 million compared to $15-20 million for the A300-600R's for the two to have equal build costs in the region of $25-30 million.

## Operating roles

There are many roles freight aircraft can take, but the A310-300, A300-600 and 767-200/-300 will either operate in small package or general freight markets with their first lessees.

The A310-300 has a volume of 10,044 cubic feet *(see table, this page)*, the 767-200 10,620 cubic feet, the A300-600RF 13,712 cubic feet and 767-300 15,696 cubic feet.

Express package operations have typical packing densities of 6.5lbs per cubic foot, and the A310-300 has volumetric payload of 65,286 lbs. This is 3,744 lbs less than the 767-200. The volumetric payloads of the aircraft in this role are shown *(see table, this page)*.

General freight packing densities are higher, and generally in the region of 8lbs per cubic foot. This higher density increases volumetric payloads in the order of 15,000lbs for the A310 and 767-200, neither of which exceed their structural payload *(see table, this page)*.

The A300-600R's volumetric payload at 8.0lbs per cubic foot is virtually the same as its structural payload. The 767-300, however, is unable to pack freight at this density, since structural payload is exceeded. The 767-300's maximum packing density is 7.7lbs per cubic foot, which generates a volumetric payload of 121,000lbs *(see table, this page)*.

## Economic profiles

The gross profit of the different aircraft types over a range of payloads will thus reveal the most economic type. Once payload exceeds an aircraft's capacity, a larger type has to be introduced or a frequency of the same type has added. The gross profit of either option can also be analysed.

The four aircraft types, and the A300B4, have been compared in two operations: express package and general freight. The most important differences in these operations are average stage length, aircraft utilisation, aircraft lease rate and unit revenue per lb. or ton of payload. Stage length will also affect aircraft maintenance cost per flight hour (FH).

Express package operations involve operations in the US or west Europe, and typically involve short average stage lengths. In many cases average FH to flight cycle (FC) ratio is about 1.5-2.0, corresponding to a stage length in the region of 700-900nm.

Aircraft in many airlines also operate just two flights per day, although in some exceptional cases three or four flights per day. Airlines also only operate six days per week, and thus aircraft typically accumulate about 600FC per year. FH utilisation is therefore only 900-1,400FH per year, depending on stage length.

At these stage lengths all five aircraft are able to use their maximum volumetric payloads *(see table, this page)* when packed at 6.5lbs per cubic foot.

General freight operations involve longer sector lengths and a wider range of markets. These include the US to South or Central America, Europe to the Middle East and Africa, and intra-Asian routes. Airlines cannot justify lease rates as high as express package carriers, and also rely on higher aircraft utilisations.


It is generally expected that A300-600s and A310-300s will come onto the market at low enough rates to justify conversion before the 767-200. Conversions of A300-600s and A310-300s have already started, and more A310-300s have been retired or parked.

Stage lengths vary, but a 2,500nm route length is representative. In parallel to this an aircraft utilisation of about 2,750FH per year is typical. This corresponds to about 500FCs per year.

At this stage length the A300B4F is not capable of a full structural payload, and is limited to about 83,000lbs. This is more than a 6,000lbs reduction on the maximum volumetric payload at a typical packing density of 8.0lbs per cubic foot. Not one of the four younger aircraft has a payload limitation at 2,500nm, although the A300-600RF is close to the route length at which its payload starts to reduce. The same is true for low gross weight versions of the 767-200SF. Against a headwind, therefore, the A300-600RF will have a reduced payload. The A300-600F is payload limited on sectors longer than 2,000nm, meaning it is only suitable for short- and medium-range operations.

## Traffic demand and revenues

Demand varies on each route. Closed express package operations, however, keep a tight record on traffic volumes and therefore aim to keep load factors high by not operating excessive capacity.

Volume increases with traffic growth, and larger aircraft or additional frequencies have to be added at an appropriate traffic volume. This makes both the A310-300/A300-600R and 767-200/-300 attractive pairings for closed express package operations. Both aircraft in each pair use the same containers and have some commonalities, leading to savings. The difference in volumes offered by the two types means that airlines can match capacity closely with demand, using larger types on heavier routes. Airlines can also switch to larger types following traffic growth.

The 767 has received criticism for not using the same containers as most current widebody operations. The 767-200/-300, however, has good range performance and a common pilot type rating with the 767. The 757/767 could therefore present themselves as an attractive fleet combination for a freight carrier.

While the A300-600/A310 use the same belly LD-3 containers as the DC-10/MD-11, the maindeck containers are also unique to the Airbus cross-section. These are small in profile compared to the DC-10/MD-11, thereby leaving unused volume if these were interlined with the A310/300-600 or 767.

Although express package carriers monitor loads, variation in daily demand means airlines will be subject to 'spill' of payload if demand exceeds capacity. A maximum load factor at which additional capacity must be added has to be planned for. This will be 85-90% in the case of express package operations.

In general freight operations, demand is more variable, and so the average load factor cut-off point at which airlines will add capacity will be lower at about 80%.

Net yields are higher for express packages than general freight. Yields also vary widely, and little data is available. Gross yields are also reduced by 7-25% for freight forwarders' overrides, surcharges and commissions. Surcharges vary with geographical market. The net yields used to analyse these two markets are rates similar to those received by some of the airlines in these markets.

Gross yields of $0.61 per revenue ton kilometre (RTK) are average for US express carriers, and as high as $1.45 per RTK for European airlines. These translate into rates of 46 cents per lb. for the US operation at 900nm and 110 cents for the European operation. A net rate of 60 cents per lb. has therefore been used for the analysis of the express package operation *(see first chart, page 46)*.

Gross revenues for general freight are 28-45 cents per RTK for all geographic regions. This translates to 65-90 cents per lb. gross yield. A net rate of 45 cents per lb. has been used for the analysis of aircraft operating in the general freight market *(see second chart, page 46)*.

This defines the revenue generating capacity of the aircraft. For example, an A310-300 in the express package market has a volumetric payload of 65,300lbs. If the operator sets a 90% load factor as the cut-off for adding capacity, the maximum revenue capacity of the aircraft is set at $38,200 for a net yield of 65 cents per lb.

## Aircraft trip costs

The relevant trip cost elements that should be included in this gross profit analysis are fuel, maintenance, flight crew, aircraft lease charges, insurance, landing fees, navigation charges and handling fees for loading and unloading.

The small package operation uses a utilisation pattern of 600FC per year, which generates about 1,450FH for the 900nm sector for all aircraft types.

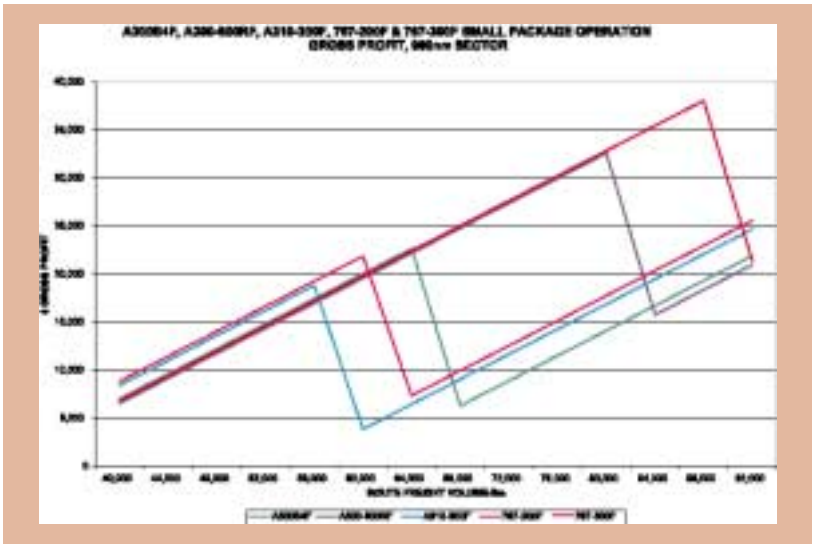
The aircraft lease rates in this analysis are higher than for general freight, on the basis that express package operators have the capacity to pay higher rates than general freight carriers, and that they are also more likely to operate the aircraft before general freight carriers can justify modernising their fleets.

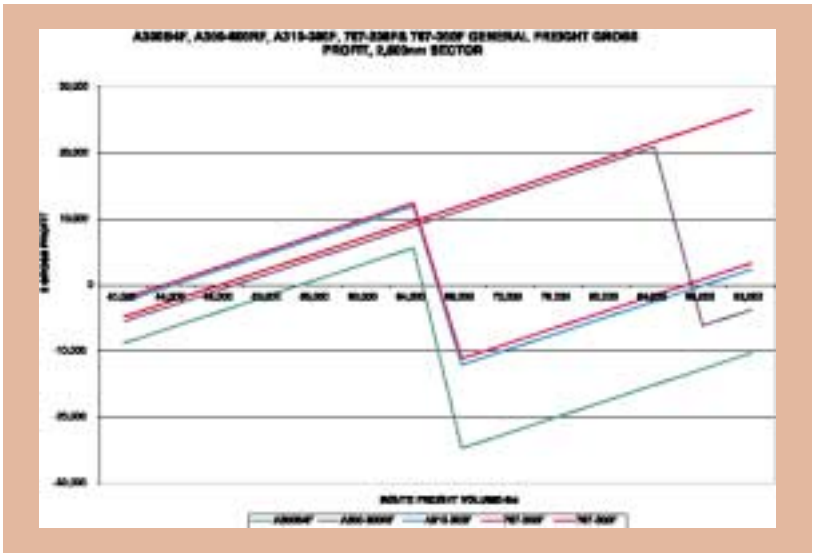
The monthly lease rates used in this analysis are as follows:

A300B4F: $215,000
A300-600RF: $325,000
A310-300F: $275,000
767-200F: $275,000
767-300F: $325,000

Lease rates for the four younger aircraft reflect what airlines are probably prepared to pay for them, rather than what they would necessarily have to pay for them if they were converted at current market values.

Maintenance costs form a large element, and engine related costs will be high on short flight cycles. Engine reserves will be in the region of $385 per





engine flight hour (EFH) for the four younger aircraft types with similar engine types, but higher for some 767-200 variants with older engine models. The larger aircraft will have higher engine reserves because of higher aircraft take-off weights and so engine thrust ratings.

The A300B4F has high engine reserves on short stage lengths and FC lengths, and will be in the region of $500 per EFH.

Airframe and component related costs will also be similar for the four younger aircraft, with variations. These will be in the region of $850 per FH for the A300-600R/A310-300, and higher at about $900 per FH for the 767-200/-300 because of its more complex airframe check system.

Again, a short average stage length will incur costs per FH higher than longer FCs because of FC related elements of total aircraft maintenance. The A300B4F will have higher airframe and component maintenance charges, in the region of $1,050 per FH.

The general freight analysis is based on an operation of an average stage length of 2,500nm and utilisation of 2,750FH per year.

Lease rates used are lower for the younger aircraft than in the express package operation. The rates used are as follows:

A300B4F: $215,000
A300-600RF: $275,000
A310-300F: $225,000
767-200F: $225,000
767-300F: $275,000

Engine reserves for the four younger aircraft will be in the region of $220 per EFH, while the A300B4F engines will still be disadvantaged at a reserve rate of $300 per EFH. Airframe and component maintenance charges for all aircraft will be slightly lower, because of longer average FCs. The A300-600R and A310-300 will still maintain an airframe cost advantage over the 767-200/-300.

In both cases fuel cost has been taken as 80 cents per US Gallon. Flightcrew costs are dependent on salaries and employment charges and flightcrew productivity. Salaries for a flightcrew complement are $220,000 per year for the four young aircraft and $305,000 per year for the three-man A300B4F. Salaries are escalated by 25% to account for training, subsistence, benefits, insurance and pensions. Flightcrew productivity is assumed to be 550FH per year. This results in flightcrew costs in the region of $500 per FH for the four younger aircraft and $694 per FH for the A300B4F.

Insurance is taken at a rate of 3.2% per year of hull value. Insured hull values are $18 million for the A300B4F, A310-300F and 767-200F. Hull values are taken as $26 million for the A300-600RF and 767-300F.

Combined landing, navigation and handling charges are $9.00 per 1,000lbs of MTOW.

Aircraft trip costs for the express package operations are $17,000-$19,400. The 767-200 and A310-300F have similar costs, although the A310-300F has costs about $450 per trip higher because of the overall differences in fuel, maintenance and weight related charges. The 767-300F and A300-600RF are closer, with only a $150 per FH difference. These two aircraft also have a similar trip cost to the A300B4F, which is just $500 per trip lower than the A300-600RF. Despite its lower lease rate, the A300B4F has a disadvantage in fuel, maintenance and flightcrew. Only weight-related charges are marginally lower than the younger aircraft. This small difference between the A300B4F, A300-600RF and 767-300F illustrates why small package operators will be prepared to accept lease rates in the region of $325,000 per month for the younger aircraft.

While trip costs are similar between the A310-300 and 767-200 and also the A300B4, A300-600R and 767-300, there will be differences in unit costs because of the differences in payload capacity between these types. These will not be important when the gross profit performance of two competing aircraft is compared for the same volume of demand and thus equal revenue. The difference in gross profit will equal the differences in aircraft trip costs.

The trip costs of the aircraft on the 2,500nm general freight trip also have the same proportional differences in trip costs between competing types.

## Express package market

A packing density of 6.5lbs per cubic foot and consequent volumetric payloads means the A300B4F is close in capacity to the 767-200F and A310-300F. Once the 90% load factor cut off for additional capacity is considered, the difference


Although the 767 remains popular, the number of aircraft available on the market has increased in recent months. Residual values of 767-300s have also not held up as well as originally expected.

between the A300B4F and 767-200F is reduced even further, as illustrated by the revenue and gross profit capacity of the aircraft *(see first chart, this page)*. The A300B4F, however, has trip costs closer to the larger 767-300F and A300-600RF.

The only advantage the A300B4F has over the A310-300 and 767-200F is its marginally higher capacity, meaning the A300B4F only has to operate a single flight for volumes higher than about 62,000lbs, where the A310-300 and 767-200 would have to fly two flights per day. The A300-600RF and 767-300F, however, have similar trip costs but higher capacity than the A300B4F. The A300-600RF and 767-300F both also have commonality with their smaller counterparts, which would result in some cost savings not illustrated in this example. The A300-600RF or 767-300F are therefore better alternatives to the A300B4F. The A300B4F therefore has no advantages compared to the younger aircraft. This illustrates how the younger aircraft will be acceptable to lessees at the lease rates used in this analysis.

The 767-200/-300 has the advantage of higher capacity over the A300-600R/A310-300 option. This allows each 767 model to carry higher volumes at a single frequency for where the A310-300F and A300-600RF would have to either operate a second frequency or introduce a larger aircraft. That is, an average daily volume of 60,000-64,000lbs can be carried by a single 767-200 operation, while the A310-300 would have to operate two daily flights to avoid the possibility of spillage or a single A300-600RF flight would be required *(see first, page 46)*. Either alternative would incur higher trip costs than a single 767-200F flight for the same revenue. The 767-300F has a similar advantage over the A300-600RF for volumes exceeding 62,000lbs *(see first chart, page 46)*.

## General freight market

The A300B4F's limited payload at this 2,500nm sector means it has no capacity advantage over the A310-300 or 767-200. The A300B4F also has higher trip costs, so a poorer gross profit profile *(see second chart, page 46)*. This illustrates the A300B4F's inability to compete in this market.

The 80% load factor cut-off point for adding capacity means the A310-300 and 767-200 have similar capacities, although the 767 still has a capacity advantage of about 3,500lbs. The two aircraft also have virtually equal trip costs and so gross profit profiles for the same freight volumes *(see second chart, page 46)*.

The capacity difference between the A300-600RF and 767-300F is more than 11,000lbs, which gives the 767-300 a 9,000lbs advantage when the 80% load factor cut-off is taken into account *(see second chart, page 46)*.

The gross profit profiles of the four younger aircraft indicate that the A310-300 and 767-200F are virtually equal, as is the A300-600RF to the 767-300F. The only exception to this is the 767-300F's capacity advantage over the A300-600RF. This does not necessarily make the 767-200/-300 combination a better choice. An A300-600 operator may require a large capacity aircraft, such as the DC-10 or MD-11 for a large number of other routes in its network. The 767-300 would therefore not have an advantage.

## Summary

The 767-200/-300 and A310-300/A300-600R will both provide economic options for freight operators requiring capacity in the 55,000-121,000lbs range. The two aircraft in either option allow more efficient matching of capacity with demand.

These gross profit profiles are based on aircraft lease rates that will be acceptable to lessees. In most cases, these are lower than the lease rates that lessors would require to make acceptable returns from their investments if aircraft were bought at current market values and converted to freighters.

The current market values of all four aircraft types are high compared to the values required for sufficiently low lease rates to be possible. The exception to this is the A310-300, where values of a few aircraft have been low enough to justify conversion. With the exception of Korean Air, which has completed sale and leaseback transactions, first tier A300-600R operators still have no plans to retire their aircraft. One main problem for these airlines is the lack of a similar sized replacement. The supply of available A310-300s and A300-600Rs is expected to increase in two or three years.

The availability of 767-200s and -300s is even tighter. The 767-200 has a similar problem to the Airbuses, in that there is no direct replacement for it. The availability of 767-300s has increased, and values have come under pressure in recent years following the introduction of the 767-400 and A330-200.

The A310-300 and A300-600R are more likely to become available in larger numbers before the 767-200/-300. The demand for these converted aircraft is less than the total supply of passenger aircraft, and so the A310-300/A300-600R may take the majority share of freighter modifications. The A300-600 and A310 may also have a small advantage through a smaller requirement for upgrade costs, and also being able to interline LD-3 containers with the DC-10/MD-11.

Payload-range performance will also have an important influence for airlines operating medium- and long-haul networks. Airlines operating from hot and high airports in Central and South America to the US or longer trans-Atlantic routes will select aircraft with the best available payload performance. AC