

Passenger-configured MD-11s available for freight conversion are limited to less than 100. The MD-11 has the best prospects for freight conversion in terms of performance, age and operating economics. Values are still high, and this may make it hard for lessors to take advantage of a good opportunity.

MD-11 for freight conversion: a good buy, if you can get one

The MD-11 is one of the most desirable freighters around. It has more than 20,000 cubic feet of containerised payload volume and a net structural payload of more than 161,000lbs. This is 40,000lbs more than the heaviest DC-10-30F, and 20,000lbs less than the 747-100SF. The MD-11 benefits from three engines against the 747's four. The MD-11 also holds the advantage of lower fuel, maintenance and flight-crew cash operating costs, and has trans-Atlantic range capability.

It is not surprising, then, that the MD-11 will be in high demand from freight operators. The problem is that there is a limited number of remaining passenger aircraft from which interested airlines and lessors can choose. The aircraft's popularity and limited numbers conspire against it, since market values are high. Once all costs of building a freighter have been considered, the total investment could make the MD-11 too expensive for lessors to consider.

With Boeing now committed to providing United Parcel Service (UPS) with up to 35 freight-converted MD-11s, the number remaining for other interested parties is fast diminishing. Airlines and lessors will have to act fast if they want MD-11Fs. They will have to consider acquisition cost, freight conversion and installation of a cargo loading system, maintenance during conversion and making it serviceable for operation, financing structure, and market lease rates or depreciation costs against remaining operational life.

MD-11 fleet

While the MD-11 remains in passenger service with a few major airlines, there is no doubt that most examples will pass into the secondary market in a few years' time.

The 11 major operators are: Alitalia, with three passenger aircraft and five Combis; American, with a remaining fleet of 10; China Airlines and China Eastern (7); Delta (15); Finnair (4); Japan Airlines (10); KLM (10); Swissair (19); Thai (4) and Varig (13).

The 29 American and Swissair aircraft are already earmarked for conversion, many going to FedEx. With a few other small passenger fleets, the population of remaining passenger aircraft that are freighter conversion prospects totals 93. These are made up from the other nine major operators.

Boeing is now committed to acquiring at least 13 used passenger MD-11s for conversion for UPS. The latter also has 22 options, which it is likely to convert. The first 13 aircraft are believed to be coming from Delta, which has a large number of outstanding firm orders and options for the 777-200 that could be used as replacements.

FedEx has a large fleet of DC-10s, MD-10s and MD-11s, and will doubtless be interested in acquiring more MD-11s at some stage.

UPS, by taking 13 of Delta's aircraft, will reduce the remaining number of MD-11s to 78 aircraft operated by eight airlines. Only three of these, KLM, Varig and JAL, have large fleets. If UPS exercises its 22 options, Boeing will have

to acquire two other major fleets from the three remaining carriers. This will mean two of these airlines will need orders in place for replacements.

There are other acquisition possibilities. JAL has orders for five 777-200s and eight 777-300s, while Varig has four orders for the 777-200. Alitalia's recent order for six 777-200LRs, could make its MD-11s available in a few years. China Airlines has seven outstanding A340-300 orders and China Aviation Supplies Corporation has three 777-200ERs on firm commitment. These orders plus Delta's last two MD-11s could potentially release another 16 MD-11s to fulfil most of UPS' options.

In addition, Garuda has returned three aircraft and Thai operates four, which will become available in a few years' time.

Taking all of UPS' orders into consideration, 56 passenger aircraft and a further seven Combis will remain. FedEx could target some of these for acquisition. This will leave a small number for other freight carriers and lessors.

Unlike the 747 Combi, a freight conversion programme for the MD-11 Combi does not exist. Only seven aircraft were built. The cost of developing a supplemental-type certificate might be prohibitive for a small number.

Aircraft acquisition

The majority of total build costs and therefore the sum to be financed will be accounted for by the acquisition cost of the market value of MD-11s. The oldest remaining passenger MD-11s are nine



years old, but most are operated by Swissair and have already been bought by FedEx.

Most available aircraft are three to eight years old, which is young for a type to go through freight conversion. The durability of the MD-11's airframe means the average aircraft has a theoretical remaining life of 25-35 years. This is a longer than normal period for a used aircraft to be financed and depreciated over. Values and build costs will be high for airlines and lessors, but will be offset by an extended financing period.

Avitas puts the MD-11's current market value of a 1995-built aircraft in the region of \$65 million. This value would put total build costs for a freighter at more than \$75 million, and most airlines and lessors would not be prepared to countenance such a high value. Considering the age and probable maintenance condition of aircraft in operation with major airlines, a trading value of \$50-55 million is more likely to be acceptable. FedEx or UPS might be able to make major aircraft purchases direct for as little as \$40 million.

Freight conversion

There are three conversion facilities. The supplemental-type certificate for freight conversion is held by Boeing. Boeing Services has its own facility at Wichita. Conversions are also licensed to Aeronavali and Bedek Aviation.

Freight conversion costs in the region of \$8 million. Installation of a manual cargo loading system adds a further \$0.5 million, while a powered system will be closer to \$1.0 million.

The MD-11's D check interval is about 22,000 flight hours for most maintenance schedules, which is equal to about five years. It would therefore be advisable to combine freight conversion with a D check. Most airlines and lessors would want newly converted aircraft delivered that had a full D check interval to run.

There are four maximum take-off weight (MTOW) variants of the MD-11. These are: 602,500lbs, 618,000lbs, 625,500lbs and 630,500lbs.

There are upgrade kits of service bulletins and reinforcement parts available from Boeing. These allow MTOW to be taken up to 630,500lbs. These are normally applied to passenger aircraft during conversion. At the same time maximum zero fuel weight (MZFW) and maximum landing weight are also increased to 451,000lbs and 481,000lbs. These improve structural payload and payload-range performance. The kit costs about \$290,000.

The specification MZFW and operating empty weight (OEW) determine structural payload. Converted aircraft have the same MZFWs and OEWs as factory-built freighters, and so the same structural payloads.

Irrespective of MTOW, there are two MZFW options: 461,300lbs and 451,300lbs. The regular MZFW is 451,000lbs. There are upgrade kits at a cost of \$230,000 to increase MZFW to 461,000lbs, which increases structural payload by 10,000lbs. This will not be required for aircraft that are going to operate long-haul, and so will not carry a full payload.

The highest MTOW variant with no

UPS' requirement for up to 35 MD-11s, which will include Delta's fleet, will leave just 56 remaining passenger aircraft for other airlines and lessors to choose from. FedEx could still acquire large numbers, diminishing the passenger fleet population even further. The MD-11F is a good investment, since it has good payload characteristics, long remaining life and good operating economics.

auxiliary fuel tanks has an OEW of 259,258lbs. The auxiliary fuel tanks increase range, but take OEW up to 261,109lbs. Higher MTOWs do not increase payload, but do improve range performance.

The highest gross weight (HGW) variant also has a MZFW of 451,000lbs, and so has structural payloads of 189,361lbs and 191,212lbs.

Crew and equipment weight will take about 600lbs out of this capacity. The MD-11's maindeck has several container options from which to choose. One is to use 26 96in x 125in x 97in containers. These provide 15,444 cubic feet and have a tare weight of 20,540lbs. The same number of 96in x 125in pallets can be used.

The lower deck can use 32 LD-3s or 10 pallets. The LD-3s add another 4,672 cubic feet and 6,880lbs of tare weight.

Total volume and tare weight is 20,116 cubic feet and 27,420lbs. This leaves a net structural payload of 161,941lbs and 163,792lbs, which can be packed up to 8.1lbs per cubic foot.

This conversion cost of about \$8.5 million, including the cargo loading system, compares to about \$16 million to convert a passenger-configured 747-200 and \$11 million for a Combi variant. The HGW 747-200s have a net structural payload of 198,830lbs. This illustrates the MD-11's value for money.

With a full payload the MD-11F can fly up to 3,800nm. Many transatlantic routes can thus fly non-stop. The aircraft can operate a further 1,000nm with 20,000lbs less payload. The 747-200SF has similar performance characteristics.

Acquisition maintenance

The MD-11's young age means buyers can escape many of the items with which buyers of older used aircraft have to contend at freight conversion.

The 747 is the type with most risks and pitfalls. All aircraft usually go through a D check or, in the case of Airbuses, sometimes an 'intermediate layover'. The 747 has the issue of Section 41 modification, which, if not terminated, will cost a buyer up to \$2.25 million (see *The merits and pitfalls of buying used 747-200s*, *Aircraft Commerce*, November/December 1999, page 13). The aircraft has also suffered

SUMMARY OF ACQUISITION & BUILD COSTS FOR MD-11F

Cost item	\$ million
Aircraft purchase	40-55
Freight conversion	8
Cargo loading system	0.5-10.0
D check	3.0
One engine shop visit	1.7-2.0
Landing gear exchange & overhaul	0.45
APU shop visit	0.35
LRU/avionics repair	0.3-0.5
Total	54.3-70.3

several other major airworthiness directives (ADs). Engine pylon modifications cost about \$1.5 million to rectify, although all affected aircraft have now been terminated.

The MD-11's durable design and age means it has not yet been subjected to major ADs, and is less likely to encounter the problems that the 747 has suffered. The MD-11 also has a modern technology two-man flightdeck. The 747's analogue flightdeck means many airlines and lessors are interested in upgrades, and there are several programmes available. These cost several hundred thousand dollars; an expense not incurred by the MD-11.

A D check for an MD-11 going through conversion to freighter will use about 45,000 manhours (MH) and about \$700,000 in material and rotatable repairs. This will total about \$3.0 million. A regular D check on a 747 freighter, excluding completion of any major ADs or modifications will incur a cost of about \$3.6 million.

The 747 going through freight conversion, however, is likely to incur the cost of several modifications. Many 747 owners have left Section 41 to be completed when they sell the aircraft, when conversion to freighter is likely to happen and provide the best opportunity for Section 41 termination. A flightdeck upgrade is also likely, as is an increase in MTOW. These three items could therefore add another \$3.0 million.

The MD-11's other major maintenance costs will come from engine shop visits and the need for repairs of major components.

The MD-11 is powered by the CF6-80C2 and PW4060/62. Both have on-wing intervals in the order of 12,000-15,000 engine flight hours (EFH). These will have shop visit costs in the order of \$1.7-2.0 million. Average aircraft

utilisation and on-wing times mean an engine removal will occur about once a year. Buyers of MD-11s should therefore budget for an engine shop visit in their total build costs.

Given the 15,000 cycle age limits of engine life limited parts, buyers should not have to worry about the additional cost of replacing most of these until the aircraft start to reach an age of 17-20 years.

Taking shop visit and LLP replacement costs into consideration, MD-11 operators should budget for engine reserves of about \$150 per EFH, or \$450 per FH.

The JT9D- and CF6-50-powered 747-200 is different. On-wing removal intervals of the CF6-50 and JT9D-7R4G2 are about 7,000EFH, and 12,000EFH at best. These intervals increase the possibility of more than one engine shop visit being required, raising costs further.

Shop visit costs work out at about \$1.5-2.3 million. The shorter on-wing intervals mean reserves will be higher than those of the MD-11.

These are about \$200 per EFH for the CF6 and JT9D, or in the region of about \$800 per FH for the aircraft.

Major components will raise heavy costs, if they come due for repair at purchase. The two most serious are the landing gear and auxiliary power unit (APU).

The landing gear only comes due for overhaul about every eight years. This coincides with the age at which many aircraft will probably get bought, so buyers should expect to incur a cost at or shortly after purchase. An overhaul and exchange fee will total about \$450,000. The same level of risk exists for 747 purchases.

The MD-11 unfortunately has an APU with poor or variable reliability. The GTCP 700-4E has an average time

between removals of about 1,700 hours. A shop visit is therefore likely to be required, which will cost in the region of \$350,000.

A further \$300,000-500,000 may have to be spent repairing avionics and line replaceable units (LRUs), remoulding or replacing tyres, and repairing brake units.

Total acquisition costs

Depending on the buyer, number being bought, and the age of aircraft and their maintenance condition, the MD-11 should be acquired for \$40-55 million. Smaller airlines and lessors are more likely to have to pay higher prices.

The total of D check, freight conversion and probable maintenance is in the region of \$14.6 million (*see table, this page*). Total build cost for the aircraft will thus be \$55-70 million. This is high for an aircraft of its size, but the MD-11 has 25-30 years of operational life ahead of it. It also offers lower trip and unit operating costs than those of its competitor, the 747-100/-200.

The 747 poses a higher risk for buyers, since there are many modifications and a wider spread of maintenance condition and status among the remaining 747 passenger fleet.

Total maintenance and modification costs will be \$18-25 million, depending on maintenance status. A further \$3 million can be incurred if Section 41 has to be terminated.

The market value of the 747-200 is much lower than that of the MD-11. This is explained by the large number of 747s from which buyers can choose, and the small aftermarket demand for the 747. The 747 is also risky, on account of its sensitivity to ADs and need for modifications. The 747 also has higher maintenance, flight-crew, fuel and overall cash operating costs, while having only a marginally larger payload capacity than the MD-11.

The 747's secondary market prospects are such that the value of used 747s is equal to about the market value of its four engines plus \$1 million. Even CF6-powered 747-200s that are in more demand than any other variant can be acquired for \$12-15 million. Aircraft with JT9D-7R4G2 engines have a similar value.

This will take total acquisition and build cost for an HGW 747-200 to the region of \$30-43 million, depending on modification status, maintenance condition, aircraft specification and passenger or combi configuration. This will be for aircraft that are 14-20 years old. Buyers will therefore have to amortise their investment over 8-14 years.



Financing structure

Financing for a large airline will be based on it raising debt on the strength of its own credit rating, then selling the aircraft to a lessor at a possible small profit when ready for operation and leasing it back for an extended term.

Small airlines rely on lessors to acquire the aircraft and use equity and debt financing. This will work for several 5-7 year leases, with the aircraft re-financed at the end of each term. Equity investment is usually 20-25%, with a high annual return of 20% being expected by most investors. This can come from lease rentals and, less commonly, partially provided by an increase in equity value over each lease term.

The lease rentals therefore have to be high enough to cover debt repayments, provide a return on equity and cover the lessor's overheads. The lessor may make profit on lease rentals, but relies on residual value profits each term to provide its return.

Financing therefore hinges on strong lease rentals and residual value retention. It also depends on how much debt the debt provider requires to be repaid over the term.

A converted MD-11 can command lease rentals in the region of about \$500,000 per month. This compares with \$450,000 for CF6- and JT9D-7R4G2-powered 747-200s.

The current market value of a 1994/5 built and converted MD-11F is put at about \$75 million, and is forecast by *Avitas* to have a value of about \$65 million in six years.

An aircraft with a build cost of \$60 million will have debt of \$45 million. A lessor should be able to arrange debt repayment terms of \$15 million over the same period. An interest rate of 8% will require monthly repayments of \$263,000. This will leave \$237,000 per month, or \$2.85 million per year for return on equity and to cover the lessor's overheads. A 20% annual return on \$15 million equity equals about \$3 million. Lease rentals would thus provide most of the equity investor's required return.

At the end of the six-year-period, a residual value of \$65 million will have increased equity to \$35 million.

The situation is different if the build cost is \$70 million. The equity portion would be higher at \$17.5 million, and would require an annual return of \$3.5 million per year. Debt would be \$52.5 million, and \$22.5 million would have to be repaid. Monthly instalments would be \$395,000. This leaves \$105,000 per month for equity return and overheads. Disregarding overheads, the balance of lease rentals would generate about a third of the required return on equity. The equity investor would thus need to be more sure of an increase in residual value.

After six years and \$22.5 million debt repaid, equity would have risen again to \$35 million on the basis of a residual value of \$65 million. To get a full annual 20% return on equity following a shortfall from lease rentals, the equity investor's portion would have had to increase from \$17.5 million to \$35 million. This would thus take the majority or all of the aircraft's residual value. Financing the aircraft thus

With tare weight and volume taken into account, the MD-11 has a net structural payload of 161,000lbs and maximum packing density of 8lbs per cubic foot. The aircraft can also carry a full payload 3,800nm, and, with 20,000lbs less payload, fly a further 1,000nm.

becomes difficult for a lessor if the build cost is much higher than \$60 million. This implies lessors can only make a case from acquiring and converting aircraft if they can buy them for up to \$45 million, which will be difficult in the current market.

Operating economics

To illustrate the MD-11's value, trip costs for a 3,500nm mission will show how it compares to a 747-200SE.

The MD-11 will have FH maintenance costs of about \$1,400, compared with the 747's \$2,100 per FH rate. About \$400 of this \$700 per FH difference comes from savings in engine reserves. The MD-11 will also have lower LRU

costs, partly because of technology differences, and will make savings in all elements of maintenance.

For the same mission, the MD-11 will also burn about two-thirds of the fuel of the 747-200. The MD-11 will also have about 70% the 747's flight crew costs, on account of the 747's three-man flight crew.

The similarity in lease rates between the two means that overall, the 747's trip costs will be about \$14,000 or 34% higher than those of the MD-11. This compares to the 747's 15,000lbs or 8% higher net structural payload.

Summary

The MD-11 has long remaining life and is attractive against the 747. The MD-11 should have good residual value retention, making it easier for investors to make returns.

It will be hard for some lessors to make a case in investing in the MD-11, however, because returns normally required by equity investors are high compared with its build costs.

Predicted strong residual values mean lessors may be able to arrange debt deals with smaller debt repayments. This will make it easier to acquire aircraft at high market values.

It will still be difficult to take the opportunity of the MD-11, because of the small population of passenger aircraft, UPS' requirement for up to 35 and the possibility that FedEx could still acquire a large number.

The MD-11 will be a good investment – for those who are able to buy one. 