

The MD-11 quickly became unpopular with passenger airlines after the arrival of the A340 and 777. The freight market is the MD-11's only secondary market disposal option and is currently oversupplied. Does the MD-11 pose any operational or economic problems to its operators, or can they wait for the right time to dispose of their fleets?

Displacing and replacing the notorious MD-11

MD-11 sales stopped abruptly when the A340 and 777 entered the market. The MD-11 had already been converted to freighters at the earliest age of any modern jet. Many MD-11 customers have since ordered Airbus and Boeing competitors. The MD-11 is not popular with passenger carriers, which are attempting to replace their fleets. So what can be done with the MD-11, what are its replacement candidates and how do they compare?

MD-11 history

The MD-11 was initially popular because its predecessor, the DC-10-30, had earned respect across the industry and continues to enjoy popularity today. When the MD-11 was launched the A330 and A340 were still a conceptual project and Airbus was still in third position behind McDonnell Douglas (MDC). The 777 project was even less conceived of at the time than the A340.

The MD-11 instantly won sales from DC-10 customers. Swissair, Alitalia, Finnair, British Caledonian, KLM, Martinair, Delta, American, Singapore Airlines, Garuda, JAL, Malaysian, Thai, Korean, Varig and VASP all placed orders.

One of the DC-10's and the MD-11's great strengths was their high weight

specification. Both aircraft have high maximum zero fuel weights (MZFW) in relation to operating empty weight (OEW), giving them a high structural payload. This has made them popular as freighters. The MD-11 was ordered as a factory freighter by FedEx, EVA Air, Lufthansa Cargo and Saudia.

Lack of popularity

The first MD-11s to be converted to freighters were ex-American and Korean Air aircraft. These were converted in 1996, just seven years after the first MD-11s entered service. Freight conversion rarely occurs at this early age. Transition from the world's primary passenger airlines to the secondary market only occurs when an aircraft's market values have fallen and it has been superseded by superior technology.

The MD-11's lack of popularity with passenger airlines began with its performance shortfalls when first delivered. To save development costs MDC opted against developing an all-wing which would have given the MD-11 better fuel burn characteristic and longer range. American Airlines was particularly critical of the MD-11, since the aircraft was acquired to provide the airline with trans-Pacific capability. This was not possible with the original aircraft.

Although MDC addressed the issue, it took several years to resolve, by which time the A330/340 were on the market. The A340 offered better range performance than the MD-11 for the same passenger payload and also had extensive component parts commonality with its short-range sister: the A330. The A330/340 also offered an array of new technological features. These gave investors more confidence in the A330/340's residual value retention. One feature which has become more appreciated in recent years is the A330/340's cross-crew qualification commonality with the A320 family.

Most importantly

The A330/340 also have several features which could aid in keeping maintenance costs low. Most importantly the A340 has had growth potential from the start and this has since been displayed with higher gross weight versions of the original -300 model and more recently the -500 and -600 series.

The 777 became another technological competitor. Not only did it offer many of the same advantages as the A340, it also came from a manufacturer that could offer an airline a whole range of aircraft from 100 to 480 seats. Again the 777 had large growth potential.



The MD-11's main weakness was inferior performance and the absence of growth potential to overcome this. When the 777 and A340 came available no further MD-11 orders were placed and options were not exercised. Sacrificing fleet commonality, American, Delta, Malaysian, Korean, JAL, Thai, Garuda, EVA Air, Varig and VASP all started to order the A330, A340 or 777. Although these aircraft have been ordered, most MD-11 operators have not placed new aircraft orders to replace completely their aircraft. This is explained by the lack of a sufficiently large secondary market to sell their MD-11s into.

Freighter appeal

While the MD-11 is unpopular as a passenger aircraft, it is highly regarded as a freighter. As previously explained, the MD-11 has a high structural payload for its size. The structural payload is the same as a high gross weight converted 747-200. The MD-11 also has the MDC reputation of being highly durable. That is, airframe maintenance checks have low ratios of defects on routine inspections resulting in low non-routine requirements. The escalation factor of non-routine defects with age is also low compared to other aircraft. This provides operators with confidence in the aircraft's durability and ability to avoid expensive structural modifications, unlike several other popular freighter aircraft, such as the 727 and 747.

American and Korean committed their first MD-11s to freight conversion in 1996. While Korean retained its aircraft for its own freight operation, American's aircraft were sold to FedEx;

which until then had been a factory-built MD-11 freighter customer.

American sold further MD-11s to FedEx and the MD-11 operator base realised it had an opening to market its aircraft. This market is, however, limited and the small number of MD-11F operators are in an advantageous position with respect to picking and choosing the aircraft they want.

The largest of these is FedEx. Because of its size and growth, FedEx could potentially buy a large portion of the MD-11 passenger fleet. FedEx, however, has a large number of MD-11s to choose from and need only buy aircraft at terms favourable to it when it needs them. FedEx concluded the purchase of Swissair's and LTU's MD-11s in 1998 at rates considerably lower than the MD-11's fair market value at the time. This came as a result of Swissair taking the decision to replace its MD-11s with the more capable A340-500. Swissair also operated the A320 family prior to selecting the A340-500 and so gained some commonality advantages.

Many other MD-11 operators would like to be in a position where they could market their aircraft, but following Swissair's deal with FedEx, the majority will have to wait several years for enough opportunities to arise.

Operators of passenger MD-11s will have to wait for the freight market to grow enough to absorb the 103 or so aircraft in the passenger fleet that have yet to be sold by their operators.

The rate at which these will get absorbed into the freight market depends on several factors. First freight traffic will have to continue to grow. The problems

FedEx is expected to be a major source for passenger-configured MD-11 sales. As far as other freight carriers are concerned the MD-11 will become more competitive against the 747 as a conversion prospect when MD-11 values have fallen by about another \$10-20 million.

of low yields that the freight sector is currently facing are related to excess capacity. The recent addition of widebodies such as the A340 and 777 with large belly capacities has eroded yields on trans-Atlantic routes. The Asia Pacific recession has eroded yields to and from that market.

Only a continuous period of traffic growth will overcome this excess capacity. Even then the MD-11 will still have obstacles to overcome. It competes with the DC-10-30, 747-100 and early 747-200s for the freight market. The DC-10-30 is more suited to north-south markets to and from the US. The MD-11's range makes it more of a competitor for the 747, which flies east-west sectors to and from the US, Europe and the Asia Pacific.

To be more attractive to airlines than the 747, the MD-11's values will have to drop from current levels. Forecasts of demand for freight shows that the world fleet of aircraft in the DC-10-30's, MD-11's and 747's capacity is expected to grow by more than 550 net units. Once retirements from the current fleet of 747-100Fs and early -200Fs have been considered it is easy to see how all passenger MD-11s will get absorbed into the freight fleet (see *The 20-year scramble for freight conversions*, page 12). The MD-11s will still compete with the DC-10-30, 747-200 and 747-300 during this period and so passenger-configured MD-11s could still take 10 years to be fully absorbed by the freight sector.

One large influence will be FedEx. The airline already has a fleet of 25 MD-11Fs and will take Swissair's 19 aircraft. FedEx also operates the A300-600F, which it uses on the low density trans-Atlantic routes and will switch to larger aircraft as traffic grows. Although with FedEx's containers the A300-600F has about half the MD-11F's payload capacity, traffic growth will mean FedEx will require larger aircraft. At an annual traffic growth rate of 8% an aircraft with 50% larger capacity than the A300-600F will be needed in five years. This illustrates FedEx's capacity for potentially absorbing a large number of the MD-11 passenger fleet.

The cost of acquiring and converting a MD-11 to a freighter and making it ready for service will be a deciding factor in how fast they will be bought by the

freight carriers. Avitas puts current market values of MD-11s at \$51–71 million. The advantageous position of some freight carriers means, however, actual trade values could be up to \$10–15 million lower than this.

Conversion to freighter will cost a further \$8.5–10.0 million. Since MD-11s are young and have not changed ownership, little maintenance will have to be done to make the aircraft ready for service. Actual transaction values will depend on maintenance status, but investors are likely to take the MD-11 in an 'as-is' condition. Total cost of acquisition could vary between \$50 and \$80 million. The youngest aircraft will be the favourites for acquisition, provided their operators want to dispose of them.

Because of the aircraft's age, a monthly lease rate factor of 1.25% will be sufficient to amortise acquisition costs. This puts lease rates at \$625,000 per month for the oldest and cheapest aircraft to acquire. Rates for most aircraft would have to be at least \$750,000 per month to cover acquisition costs.

While lease rates for the 747-100SF and -200SF will be as low as \$200,000 and \$400,000, they have higher cash operating costs compared to the MD-11 with a lease rate in the \$625,000–650,000 range. This makes the total costs of the 747s and oldest MD-11s similar. Since the MD-11 is younger it will probably be the more preferred option. The prospects of the MD-11 being absorbed into the freight sector depend on market values falling to a level of about \$50 million.

Korean's and EVA's conversion of its MD-11s for their own freight operation might be a possibility for others. Wet lessor Gemini Air Cargo has made a success by operating freighter-converted DC-10-30s. Now the airline is seeking to expand its operation by acquiring MD-11s.

MD-11 in operation

There are several candidates to replace the MD-11 from both Airbus and Boeing. The Airbus offerings start with the A330-200 and include the A330-300, A340-300, -500 and -600. The Boeing aircraft are the 767-300ER, 767-400, 777-200, -300 and 747-400.

The reason for this variety of aircraft to replace the MD-11 is that it has a range performance of up to 6,750nm. Airbus and Boeing can offer several aircraft with range performance similar to the MD-11 but with varying seat capacities. This provides airlines with the flexibility to operate at lower or higher frequencies, or offer less capacity than the MD-11's 298 seats.

To understand what MD-11 operator's require in terms of capacity

SUMMARY OF MD-11 OPERATIONS

MD-11 operator	Shortest route (nm)	Longest route (nm)	Aircraft types operated on same routes
Alitalia	317	6,951	A320, MD-80, A321, 767-300ER, MD-11, 747
Finnair	890	5,426	757-200, MD-11
KLM	2,788	5,455	767-300ER, MD-11 Combi 747 Combi, 747
Swissair	2,847	6,395	A320, A321, A310, A330-200 MD-11, 747 Combi, 747-300
American	801	6,693	MD-80, 727, 757, 767, A300-600R, MD-11, 777
Delta	403	6,833	737, MD-80, 727, 757, 767 L-1011, MD-11, 777
Varig	219	6,153	737, 767-300, DC-10, MD-11, 747 Combi, 747-300
VASP	390	6,220	737, A300, MD-11
China Airlines	498	6,188	A300, MD-11, 747-400
China Eastern	662	6,471	MD-90, A300, MD-11, A340
EVA Air	371	5,243	767, 767, MD-11, 747
JAL	195	6,257	767, MD-11, 747, 747-400
Korean Air	4,538	5,251	MD-11, 777, 747-400
Thai	498	5,608	A300, A330-300, MD-11, 777-200, 777-300, 747-400

Source: OAG/Back Information Services

and range performance, it is useful to analyse the routes that operators fly the aircraft and what distance these sectors are. A summary of the range of route lengths and other types operated on the same network by each airline is shown in the table (*see this page*).

In many cases airlines do not use the MD-11 exclusively as a long-haul aircraft. The MD-11 often operates multiple-stop routes. This is partially explained by airline route rights. It is also, however, due to the MD-11's large size and the need to avoid low load factors.

For example, Swissair flies from Zurich to Bangkok and then onto Singapore and finally to Hong Kong or Taipei with the MD-11. Swissair has a similar style of operation from Zurich to Bombay and then onto Hong Kong. Smaller types, for example the 767-300ER and A330-200, can operate these routes, since Zurich-Bangkok is 5,608nm. Smaller aircraft would allow Swissair to operate separate direct flights to Bombay, Bangkok, Singapore and Hong Kong without the problem of low load factors.

In most cases MD-11 operators do not use the aircraft's full range with a full

6,750nm passenger payload. As the table shows, the two exceptions are with Alitalia and Delta. These two airlines both configure their aircraft with less than MDC's standard 298-seat layout. The aircraft's range will therefore be extended with a smaller passenger payload. Alitalia's longest route is from Rome to Buenos Aires, while Delta flies the MD-11 across the Pacific from Atlanta to Tokyo.

American and Delta acquired the MD-11 to provide them with an aircraft without excessive capacity, but with enough range for a trans-Pacific network. This turned out to be not entirely possible, with the MD-11 falling short of expected performance. This was the reason why both airlines did not place further orders. American and Delta both later ordered the 777-200ER in larger numbers.

American has started operating the 777 across the Pacific. Delta has had to stop taking deliveries of 777s after just three aircraft because of problems with its pilot union over the aircraft.

The only route American operates with the MD-11 at the edge of its performance capability is Dallas-Osaka.

POTENTIAL AIRBUS AND BOEING REPLACEMENTS FOR THE MD-11

Aircraft type	A330-200	A330-300	A340-300	A340-500	A340-600
Tri-class seat capacity	253	295	295	313	380
Still air range (nm)	6,450	5,600	7,300	8,500	7,500
Aircraft type	767-300ER	767-400	777-200ER (-200X)	777-300 (-300X)	747-400
Tri-class seat capacity	218	245	305	368	480
Still air range (nm)	6,150	5,635	7,770 (8,600)	5,960 (6,600)	7,200

Atlanta-Tokyo is the only route Delta operates that is on the edge of its range performance. All other sectors are well within the MD-11's capability.

KLM, Swissair, Alitalia, Varig, VASP, Thai and China Airlines all fly multiple stop routes. Many of these are to Asia and across the Pacific.

The longest routes operated by other MD-11 customers are a few of about 6,500nm. This means in most cases potential MD-11 replacement candidates will not be restricted by lack of range performance on existing MD-11 routes. The one exception to this will be the A330-300 in a few cases, but it has its longer-range sister, the A340, available for this purpose.

Airlines may opt to fly more direct routings and so could require aircraft with longer-range performance as a consequence.

MD-11 replacement

Many MD-11 operators have already made replacement decisions. In some cases the aircraft ordered have resulted in the airline increasing commonality. Swissair has ordered A340-500s to complement its A320 and A330-200 fleets. American, Varig and JAL have ordered 777s to complement their Boeing fleets.

In other cases airlines have not yet decided what to do with respect to their MD-11s. This includes Alitalia, KLM and Finnair. Like many other carriers, the fleets of these three airlines are becoming dominated by aircraft supplied by the same manufacturer. Finnair has now placed orders for A320 family aircraft to replace its DC-9s and MD-80s. Alitalia has widened its A321 fleet and started taking delivery of A320s. KLM is

predominantly now a Boeing airline with the exception of its MD-11s.

Once performance issues have been satisfied, commonality is becoming the most important issue in fleet planning. The range of the Airbus and Boeing aircraft on offer as potential MD-11 replacements are summarised (*see table, this page*). Prudent fleet planning would provide flexibility in range performance of future fleets. That is, fleet selections could be for aircraft with longer range than routes on current MD-11 networks.

Despite still air range capability, the effects of take-off weight restrictions and higher than manufacturer's standard aircraft operating empty weight mean a range performance margin of 500nm will provide a good idea of whether an aircraft has sufficient range to meet an airline's requirements.

Most airlines MD-11 routes could be operated by all the aircraft in the table. Although the number of routes affected are small, most types except the A340-500, A340-600 and 777-200ER are restricted in some way on the longest routes on some airline route networks.

The A330-200 is probably limited on the longest route networks of nine MD-11 operators. The A330-300 is affected in 13 airline networks. The A330, however, has its longer range A340 sisters to rely on. The A340-300 may have payload restrictions on Alitalia's longest routes, but again has the -500 variant to rely on.

The 767-300ER is restricted on nine airline networks, while the 767-400 is restricted on the extremities of all networks. The 777-300 is also affected on all but two networks.

The range restrictions on the longest routes of airline networks on the 767s and A330-200 means MD-11 operators

would be forced to operate mixed fleets. This will provide them with seat capacity flexibility on all but the longest routes.

The range capability of the types as large as the MD-11 exceeds the aircraft's performance with the exception of the 777-300. After much deliberation Boeing has finally decided on an engine option to power the 777-200X and -300X. These will have ranges of about 8,600nm and 6,600nm.

In most cases the A340, 777 and 747-400 offer additional range and freight capacity over the MD-11. Replacement candidates can offer superior revenue-generating capacity.

Despite the launch of the 777-200X/-300X, the A340-500/600 provide a better combination in terms of payload-range performance. While the 777-200X and A340-500 have similar range capabilities and seat capacities, the 777-300X's range is about 900nm less than the A340-600's 7,500nm capability. The 777-300X, for example, would not be able to operate the longest routes in Alitalia's, American's, Delta's, and probably also Swissair's, Varig's, VASP's, CAL's, China Eastern's and JAL's networks. The A340 also has an advantage over the 777 of not having any Etops restrictions. Even though with 180 minute Etops clearance the 777 can operate most routes without any disadvantage there are some trans-Pacific routes where the 777 would be forced to fly longer routings. This may be overcome if Boeing is granted 207 minute Etops clearance.

The A340-600 could operate these routes, as well as being able to carry almost a full payload of passengers and belly freight.

The A340-600 and 777-300 are of course about 70-80 seats larger than the MD-11. Airlines will experience appreciable traffic growth and so the A340-600's and 777-300's capabilities will become more important. It only requires five years' traffic growth at an annual rate of 5% for an airline to have to increase aircraft size from an MD-11 to an A340-600 or 777-300. Considering that many MD-11 routes are to the Asia Pacific and this market is experiencing traffic growth rates higher than 5%, the A340-600 and 777-300 could soon be in demand.

Applying the same analysis to routes with lower traffic density, the 777-200ER/X and A340-500 will also be required. This reduces the significance of the A330-200 and 767s as MD-11 replacements.

Economic performance

Two major aspects influence economic performance. These are cash operating costs and commonality benefits.



The only areas where differences in cash operating costs can be realised are in fuel and maintenance costs. Flight crew charges for competing types should be equal in most airlines between directly competing types. Only where airlines have salary scales based on maximum take-off weight will there be small differences.

Fuel burn performance of replacement candidates is varied. The MD-11 has earned the reputation for having poor fuel burn efficiency. This is overstated. The MD-11's seat-mile cost is 0.89–0.95 cents on 2,500–6,500nm routes. At a fuel price of 60 cents per US gallon most alternatives to the MD-11 have similar fuel cost per seat mile.

This is even true with smaller types such as the A330-200 and 767 models, which might be expected to have high fuel burns per seat because of their smaller sizes. The A330-300 and 777-300ER are the only types to have fuel burns that are 0.04–0.05 cents per seat-mile lower than the MD-11. This will make relatively little difference on total costs.

The A340-500 has higher burns per seat than the MD-11. This may be surprising to some. The A340-500 has a gross weight 182,000lbs heavier than the MD-11. The A340's higher performance and gross weight carries the penalty of making its seat-mile fuel costs about 0.13 cents higher than the MD-11's.

The 777-200ER's gross weight is only about 32,000lbs more than the MD-11's. With a seven seat larger seat capacity, the 777-200ER's efficiency is demonstrated by the fact that it has a 1,000nm longer range and seat-mile fuel costs close to the MD-11.

Overall there is little to be gained in fuel economy by replacing the MD-11. This fact will perhaps make replacing it less of an issue for some airlines.

Maintenance costs will be one of two other areas where competing types have an opportunity to gain an advantage.

The two main areas of maintenance costs will be engine related and airframe costs. The nature of engine maintenance now is that most airlines will have negotiated a power-by-the-hour (PBH) contract for their engines. The MD-11 is powered by the CF6-80C2D1F and PW4460/2. PBH rates for these two are similar and are in the order of \$175 per engine flight hour (EFH) and \$75 per engine flight cycle (EFC). The MD-11's engine maintenance costs can therefore be expected to be about \$525 per FH and \$225 per FC. Similar rates will be charged for the same engines powering the 767-300ER and -400.

The A330, A340 and 777 have engines developed more recently than the MD-11's. The small number of engines in service and the engine manufacturers' expansion into the engine overhaul market has meant they have exclusivity in maintaining their engines in their own maintenance subsidiaries. Because of this PBH rates for these engines are not known.

The on-wing times of the CF6-80C2D21F and PW4460/2 are in the order of 11,000EFH. The later technology of the CFM56-5C, Trent 500, 700 and 800, PW4000-100/-112, CF6-80E1 and GE90 is generally expected to result in longer on-wing times than the MD-11's powerplants. Operational experience and high

MD-11s were acquired in some cases to provide trans-Pacific capacity. The initial performance shortfalls and lack of range opened the floor to competition from Airbus and Boeing, which have since developed competitors with range capabilities of up to 8,500nm.

technology have been used in these latest engines, with the purpose of improving temperature margins and on-wing life. The 777 is too young for enough meaningful on-wing data to be available. Many expect that with the long flight cycles on-wing times of 14,000EFH should not be uncommon. Similar should be expected of the Trent 500 on the A340-500/600.

The smaller number of engines on the MD-11's competitors, with the exception of the A340, and longer on-wing times should help them achieve lower engine-related maintenance costs. Working against this is the expensive materials used in these modern engines to achieve temperature margins. This will counter some of their advantages.

Only a few areas will provide the A330/340 and 777 with opportunities to offer lower airframe maintenance costs than the MD-11. The MD-11's durability means the ratio of non-routine maintenance will be low and will not climb as fast as it has with Airbus and Boeing aircraft in the past.

The A330/340 and 777 will have to offer higher reliability and simpler maintenance scheduling and maintainability to gain an advantage.

Finnair's MD-11 maintenance programme uses an A check every 600FH, a C check every 6,000FH or 25 months and a heavy maintenance visit every 24,000FH or five years. Man-hour consumption for these checks are 350–400 for the A check, 3,200 for the C check and 26,000 for the heavy check.

Check intervals of other MD-11 operators are similar to Finnair's. The A330/340's maintenance programme has an A check interval of 400–550FH, C check interval of 15 months and five-year and ten-year structural checks. This is not too dissimilar to the MD-11.

Although few heavy maintenance checks have been performed, A330-300s are consuming about 29,500 man-hours. This is similar to the MD-11, which suggests the A330/340 may be unlikely to have a man-hour input saving.

The 777's maintenance programme works on the basis of a series of inspection cards each with its never exceed interval. These cards are conveniently packaged into checks by the operator, but each is able to have its own unique programme. Operator A check intervals are mainly either 500FH or

The majority of MD-11 operators have already ordered the 777, although it has not completely replaced the older aircraft. The 777 and A340 will also be considered as early 747 replacements.

1,000FH. C checks are performed anything between each year and every four years or every 4,000FC. Structural checks vary from four to eight years.

The 777 was designed with the intention of improving maintainability, rather than Boeing setting itself a maintenance cost target relative to other aircraft. Component suppliers, such as Honeywell and Sunstrand were involved in the development of the maintenance programme, which had never been done before.

With respect to maintainability, the positioning of components was designed so that they could be removed easily when required. Heavy components were therefore not placed high up in the avionics bay, for example. The development of the 777's maintenance programme also involved airline specialists.

The 777's maintainability was achieved by building in extra redundancy into components. This meant then when they failed the aircraft was not prevented from departing and so despatch reliability would be high. The central maintenance computer was designed to manage component failures and defer removals until scheduled checks, such as daily or weekly check. This then minimises line maintenance.

Overall, airline engineers say the aircraft is easy to troubleshoot. Because of the aircraft's computer-aided design, maintainability and reliability, Boeing expects the 777 to have a low ratio of non-routine tasks to routine tasks when compared to earlier types, such as the 767. Although the 777 is still young, Boeing makes the point that no additional inspections have been added to checks and intervals have not been de-escalated. This implies the aircraft is experiencing a low level of non-routine maintenance.

Commonality

Aircraft designs, technology and operating efficiency is now developed to the point that cash operating cost differences between competing types is small. The benefits of commonality are intended to reduce the overheads of maintaining spare parts and engine inventories and to minimise pilot and engineer training costs.

The engine commonality benefits of the 777 and A330/340 families are similar. The A330 will become less of an option to



replace the MD-11, leaving just the A340. With the Trent 500, the A340-500 and -600 will offer more commonality than the 777 can with its different variants of the same basic engine type.

The biggest commonality benefit amongst the A340 and 777 families are the A340's CCQ with the A320 families and A330 models serving other markets. The 777 cannot offer airlines the same flight crew commonality savings with other Boeing types. Flight crew commonality savings are not always taken advantage of, however, since airlines do not always practise mixed fleet flying. Those that do report good savings.

Summary

While aircraft competing to replace the MD-11 may not offer significantly different cash operating costs, the major factors in aircraft selection are fleet commonality, performance, flexibility, growth potential and revenue generating capacity.

The A340-500/-600 have an advantage here, on account of the -600's longer range compared to the 777-300X

and also the A340's avoidance of Etops issues. This could also provide greater fleet flexibility as a result.

Because of the A340-600's range, the A340-500/-600 combination may also offer an overall higher revenue-generating capacity. What should be considered here is that the A340 and 777 families will not be considered as MD-11 replacements in isolation, but as 747-100/-200/-300 replacements as well.

The A340 also offers CCQ with two A330 models and four A320 family models.

The final and perhaps most influential influence is the aircraft types already used by MD-11 operators. American, Delta, JAL, Thai and Varig have all selected the 777s, without completely replacing their MD-11 fleets. Swissair, EVA and China Airlines have selected the A340. The balance of orders and fleets of airlines yet to make a decision suggests the 777 could end out on top.

The MD-11 has already been relegated to shorter routes and has been substantially depreciated. This takes the pressure off its operators to replace the aircraft. 