

Aircraft residual value determines the difference between profit and loss in aircraft ownership and financing transactions. Many factors affect residual value, and these are all issues which can be applied in initial aircraft selection.

Forming a policy to maximise aircraft residual values

Accurate predictions of aircraft residual values (RVs) 10-15 years prior to sale are virtually impossible to achieve. Actual RVs determine the difference between profit and loss in aircraft transactions. Expected RV performance has an effect on financing terms, which have one of the largest influences on operating costs. Profits made on disposal can be high, but poor decisions can incur annual losses in the range of tens of millions of dollars.

Importance of residual value

Aircraft base values reflect what an aircraft is theoretically worth, considering age and performance in normal market conditions. Actual RV will be closer to base value in a normal market, and will diminish in a soft market.

Several factors make RV retention important. The first of these is transaction profits. Lease transactions of are structured on the basis of a forecast RV.

Many lease transactions base debt balloon and financing terms on forecast RV, since debt balloons have to be paid from RV. If RVs are not met, the net present value of the transaction will be diminished. Equity investors can even lose a portion of their investment. Transactions are usually structured with conservative estimates of RVs that provide a margin for reasonably large falls in RV, which will still allow balloons to be fully repaid. Returns of 0.5% can still be made with aircraft sold into a soft market. The difference between base value and RV can be 15% in a soft market.

Profits of airlines that own aircraft are affected by RV performance. The opposite ends of the spectrum of aircraft ownership are represented by Singapore Airlines (SIA), which rarely owns an aircraft for longer than 10 years, and by those airlines that own aircraft for another 10-15 years after fully depreciating them.

Because residual value is more predictable and falls the least in the first 8-12 years of life, the policy of selling at 8-12 years usually results in profits on aircraft disposal. SIA's sale of 747-300s, however, are one of its poorer examples.

The other extreme of long-term ownership for 25 years or more is followed by several US mega carriers, particularly Northwest and US Airways. Although little or no profit can be made at disposal, the operator has the luxury of operating an aircraft with low or zero finance charges after the first 12-15 years. The added bonus is immunity from RV losses. Airlines can then engage in sale and leaseback transactions to release equity in their aircraft, or raise debt against the collateral of the aircraft's appraised value.

RV retention also influences the rate at which aircraft pass through the 'food chain'. Aircraft spend their first 12-18 years as passenger models. Secondary and tertiary use is either with weaker credit passenger carriers or as converted freighters. A faster reduction in RV means that aircraft will pass through from first to second or third tier operators in a shorter time. One example is the MD-11. Aircraft with strong RV retention will

remain in first tier operation for longer than most other types. This usually happens when there are no replacement candidates, as is the case with the 767-200/-200ER.

RV profile & determinants

Putting aside the outside influence of economic conditions, there are many factors that determine an aircraft's RV.

Aircraft RVs are relatively predictable in the first 8-12 years of life. The main contributor to this is that aircraft are rarely overshadowed by replacement competitors with improved technology. An exception to this is the MD-11, which was superseded by the A340 and 777.

RV becomes less stable as an aircraft ages. Older types are more likely to be off-loaded in the event of a recession, making it more likely there will be a large number on the market.

RV prediction also becomes harder later in the production life cycle. When most types are new on the market and represent the latest technology, values are stable. As production progresses they begin to be superseded by competitors with later technology. For many years the 767-300ER was unchallenged, and had stable RV predictions and high transaction values. In the past three years competition has arrived from the A330-200, as well as the 767-400.

Morten Beyer, president at appraisal company Morten Beyer & Agnew, points out that aircraft with a long production run generally have strong RVs. The 737 is the prime example. This reflects the fact





The 767-300ER is a prime example that illustrates the difficulty in estimating aircraft residual values. Six years ago values for 1992-built aircraft sold in 2001 were forecast to be \$64 million. Current market values, prior to the US terrorist attacks, were estimated at \$48-54 million. The 767-300ER has experienced competition in recent years from the A330-200. Competition from alternative types is one factor that severely damages aircraft residual value and is virtually impossible to predict at the start or early years of an aircraft's production.

that they are better aircraft types. "Contrary to this are specialist aircraft or variants, and those with shorter production runs," adds Beyer.

Examples of specialist types with short production runs are the Fokker 100, L-1011, 747SP and 767-200.

The DC-10-30 had a long and sustained production run, as have the A320, 757 and 767. So although their values may have varied downwards during poor market conditions, they have risen again when the market has improved. The L-1011 is a contrast to this, since its market values were consistently poor.

Beyer makes the point that the demise of a manufacturer is another factor in poor RVs. The L-1011 may have also suffered because of this, as has the Fokker 70/100.

Aircraft specification

Aircraft specification plays a large part in RV. Early production aircraft of all types are poorer examples compared to later production aircraft. Early build aircraft have the lowest gross weights, lowest thrust engine models and the earliest component variants.

The first 747-100s have the poorest performance compared to later -100s and -200s. The first A320-100s have either CFM56-5A or V.2500-A1 engines compared to the CFM56-5B or V.2500-A5. Early production A321s will either be marginally Stage IV compliant or non-Stage IV compliant.

The 777-200As have maximum take-

off weights (MTOWs) of 547,000lbs, engines rated at 77,000lbs and a range of 4,100nm. By comparison the 777-200ER has an MTOW of 657,000lbs, engines rated at 95,000lbs and range of 7,700nm. The early built 777s will have limited secondary market appeal.

Similar improvements were repeated during production with the DC-10, 767, A310, A300, MD-80 and A330. The first production 737-300s, for example, had analogue dial flightdecks and low thrust rated CFM56-3B1 engines. This was changed after a short production run, and the majority of 737-300s were produced with glass instrument flightdecks and CFM56-3C engines.

Higher specification variants of an aircraft type overshadow earlier production units. Later build models, with higher specifications, will be younger. These will leave early production aircraft with poor secondary market prospects. Since the biggest secondary market is freight conversion, buyers prefer higher specification aircraft. Examples of this are the preference for the A300B4 for freighter conversion over the A300B2. A similar scenario happened with the oldest 747-100s and youngest 747-200s. The most sought after 747-200s in the freight conversion market have been late build -200s powered by CF6-50 or JT9D-7Q/-7R4 engines. Low specification was the problem for the majority L-1011s.

Beyer points out that higher specification leading to better RV is not a hard and fast rule. Extreme variants such as the 747SP and L-1011-500 have

had some of the lowest RVs of the L-1011 and 747 family. A prime example of low specification variants doing badly compared to higher gross weight models are the 767-200 and -300 compared to the -200ER and -300ER.

Poor RV performance of early production aircraft can be offset by attractive purchase discounts for airlines that order them, to kick start orders.

Other examples of specification affecting RV are minority aircraft. The 747-100/-200 had multiple specifications. This includes five or six different MTOW options, three main engine types, each with several sub-variants. There were thus more than 20 different specifications for the 747-100/-200. There were also several flightdeck instrument variants. Buyers prefer standard specification. Multiple variants divide the fleet into small sub-fleets and consequent markets.

Market penetration

Perhaps the largest influence of all on RV is the market share a type has and its geographical spread. This goes in hand with a sustained production run. The 737 has been operated by almost every airline in the world at some point, which gives it the largest potential market. The opposite of this is the L-1011.

Limited geographical and global fleet spread will limit secondary market prospects. The MD-80 is likely to suffer because of this. There were about 1,100 aircraft built, and the fleet is now dominated by two European flag carriers and three US majors.



Family & technology

In hand with production numbers and geographical spread are family variants and technology level. Aircraft families, such as the 737 and A320, are the most attractive. They provide fleet and capacity planning flexibility for prime users. To date no aircraft from a family of a type has been sold on the secondary market, since this design philosophy is relatively new. Second tier operators will, however, find the A319/20/21 a flexible group of aircraft compared to a mix of types such as the 737-200, 737-300 and 727-200.

Modern technology also improves secondary market prospects, since this lowers operating costs and prolongs useful life. This goes in hand with high environmental standards. Aircraft that were Stage II or marginally Stage III compliant required modification to meet Stage III. The same will apply to types marginally or non-Stage IV compliant and for types with high NOx emissions.

Examples of the modern technology of new types damaging the RVs of older types are the 777 undermining the 747, the MD-11 the DC-10-30, and the 737NG the 737-300/-400.

Secondary market prospects

Conversion to freighter is the largest secondary market. Aircraft RVs are rarely low enough to justify freight conversion before the age of 15 years. There are always several used types competing for each sector of the freight market. These also compete against factory built freighters. The supply of aircraft for freight conversion thus always exceeds the requirement.

One example is the smaller

narrowbody sector. The best placed aircraft will be those with the same or slightly wider fuselage cross-section as the 727. These are the 737-300/-400, 757 and A320/21. The number of conversion candidates among these types exceeds the probable requirement. This therefore leaves the MD-80 out of the freight conversion market altogether.

Smaller market opportunities are the second and third tier airlines. These have included start-up scheduled and charter carriers, or low credit rated flag carriers. These have mainly been Latin America and Africa, but also Europe and North America. China and the CIS have proved to be largely off-limits for used aircraft.

A third market is parting-out for rotables, engines and other components. This is good business for those that can first acquire aircraft at values low enough to make dismantling and selling parts economic. As the fleet implodes parts availability increases and the number of aircraft requiring them diminishes.

In all cases, the first aircraft onto the secondary market always have the best prospects. Late arrivals will have shorter remaining life and be less likely to meet future environmental standards.

This in turn means airlines with the best chance of realising good RVs are those with the younger fleets of a type, which sell into the secondary market early. This perhaps explains why SIA often realises good RVs for its used aircraft, since it is nearly always an early customer for a type and is the first to sell onto the used market.

Airlines that take aircraft in the latter part of production and sell at middle or old age, generally miss the best market opportunities. This is every time an aircraft comes onto the used market.

The MD-80 has many positive features. These include low-cost engine maintenance, twin-engine economics, a durable airframe and two-man flightcrew. The aircraft, however, has marginal Stage III performance and, more importantly, a limited secondary market. Values are expected to remain depressed once large fleets start to be retired.

The first 747-100s sold had trade values in the \$30-40 million range, while values fell fast when higher specification -200s flooded the market. The limited 747-100/-200 freight conversion market now means all -100/-200s have values of less than \$10 million. The majority of 747-100/-200s available or yet to be retired are unlikely to be converted. Their secondary market prospects are therefore virtually zero.

Early DC-10-30 trades saw transactions as high as \$35-40 million. Now that a substantial conversion market has not materialised, values are less than \$10 million.

This cascade, or 'food chain', of aircraft from first tier to second and then third tier operators will become harder to realise in the future. Airlines that normally take aircraft as second tier operators are more commonly taking new aircraft at unprecedented low lease rates from mega lessors, and so by-passing the 'food chain'. Low-cost financing also means that more factory-built freighters are being sold to airlines than previously.

Shortages and surpluses

Shortages of aircraft naturally drive up values and surpluses push values down. Surpluses occur in recessions due to a combination of falls in traffic coinciding with deliveries of new aircraft that were ordered a few years previously.

"The last downturn of the early 1990s saw the largest oversupply of new aircraft, due to the massive orders made in the late 1980s," says Doug Kelly, vice president of asset valuation at Avitas.

In a downturn the oldest aircraft are often parked first. Recessions also normally coincide with fuel price hikes, so the oldest types are parked. A higher proportion of older aircraft also tend to be fully depreciated. Airlines still have commitments to aircraft on lease, and so smaller numbers get laid down.

Kelly explains that the drop in values during recessions is disproportionate with age. That is, older aircraft suffer a higher percentage drop in value compared to younger types. "Value of older types fell by as much as 50-70% in the early 1990s," says Kelly "while younger types were not hit as hard." The current recession and downturn have already seen a similar parking of aircraft surplus to requirements. The availability of 727-



200s now exceeds 300, and there are about 200 737-200s available and 100 each of MD-80s and 737-300s. Unlike the early 1990s, the current downturn is characterised by there being a moderate overbooking of aircraft orders.

“Further to this, the massive scale of 727-200 parking was expected. Avitas was also expecting the MD-80 to get hit hard by the current downturn,” continues Kelly. “The MD-80 is marginally Stage III compliant and American and Delta had placed large orders with Boeing, meaning a large number of MD-80s were coming due for retirement. This process may now get accelerated.”

727-200/-200A

The US major airline fleets of 727-200s were all due to finally be retired over the next two or three years. This coincided with the drying up of the 727 freight conversion market. The availability of 727-200s was therefore destined to be several hundred aircraft.

Despite being a good freighter candidate, few 727-200 are expected to be converted. Values in recent months have dropped to less than \$1.0 million. “Values of 727-200s reached a low in the early and mid 1990s,” says Kelly. “This gave freight carriers a chance to buy aircraft for about \$2 million. Values climbed back to about \$4 million after 1995 when passenger carriers put aircraft back into operation.”

Values of 727-200s are not now expected to climb back again and will remain low. The surplus of aircraft will probably mean values dropping to scrap levels. The same applies to the JT8D engines, which have accounted for the majority of a 727's value.

MD-80

The MD-80 to date has proved to have robust values. The number of transactions has increased over the past few years. The aircraft has good twin-engine and two-man flight crew economics. The concentration of fleets could yet spell trouble for values.

Large fleets will be retired from five or six large operators over a short period. This problem will be exacerbated by the lack of any freight conversion market. The CIS and China are almost closed to used aircraft. It is likely that the number of available MD-80s in a few years could exceed the 727's current level. The MD-80 is also marginally Stage III compliant, and so will require modification to become Stage IV compliant.

Ultimately there will be large numbers of MD-80s available. The lack of any clear market and current glut of capacity has bought values of MD-80s to less than \$5 million. Higher specification MD-83s may return to closer to \$8-10 million with a recovery and shortage of Stage III aircraft.

Beyer also adds that the demise of MDC will also have a contribution in the MD-80's ailing values.

737-200

The 737-200 shares the same problems as the 727-200; that of oversupply. The 737-200 is too small to be attractive as a freighter for most airlines. There will therefore be a surplus of aircraft. The 737-200 is second highest in number of aircraft available, with 200 units. Other secondary market prospects have become limited by second and third tier carriers acquiring new aircraft. These

For many years it was expected large numbers of DC-10s would be converted. This market has failed to materialise, partly because of the MD-11 entering the freight conversion market early. The supply of DC-10-30s is expected to increase further, taking values down to the equivalent of the market value of its three engines.

same airlines have actually retired 737-200s earlier than expected.

Kelly does not expect the values of 727-200s, 737-200s and MD-80s to rebound with an upturn in traffic. “Their availability will still continue to rise regardless, and new aircraft deliveries will provide sufficient capacity.”

Overall, values of hushkitted narrowbodies and MD-80s are down in the \$1-3 million range in the current market.

DC-10-30

The DC-10-30 was once regarded as being a strong investment candidate. Values for aircraft in sale and leaseback transactions were as high as \$40 million in the late 1980s. The DC-10-30 had a niche of its own, since the L-1011 did not offer direct competition. This was first changed by the 767-300ER in the late 1980s, since it provided the first real alternative to the DC-10-30.

The quick rejection of the MD-11 by passenger carriers put downward pressure on the DC-10. Freight conversion of the MD-11 provided an aircraft with better capability than the DC-10. A large number of prospective airlines that would therefore be expected to take converted DC-10s bypassed it for the MD-11. With the exception of FedEx, Gemini Air Cargo and DAS Air Cargo fleets, all other DC-10-30F fleets have been small.

The supply of DC-10s was increased with the rapid retirement by American in the early 1990s, due to pressure from Airbus to take A300-600Rs. There has more recently been an increase in long-haul freight aircraft, including DC-8-70s, due to UPS taking A300-600Fs. The availability of DC-10-30/-40s is set to rise further still with Continental's and Northwest's fleets due to be retired.

DC-10-30 values are now estimated to be in the region of \$10 million; equal to the value of its engines. These values will fall even further, possibly to scrap level as availability rises. Even the latest built aircraft have fallen victim to the current surplus, with aircraft reportedly being offered for less than \$5 million.

The chart showing the DC-10-30's historical residual value (see, page 11) shows how its values peaked at the end of the 1980s, when the aircraft had little competition and operated in its own

niche. Values then started to fall away in the early 1990s as competition from the 767-300ER intensified and fell even further as the MD-11 ate into the DC-10's freight conversion market.

747-100/-200/-300

The 747 Classics have always been dogged by two main problems: that of a large number of specifications; and a limited secondary market. The only used market for the 747 has been freight conversion, but the number of aircraft always exceeded freight market requirements. The surplus of 747s has been exacerbated by the early arrival of the MD-11 in the freight sector.

The 747's woes have also been increased by the introduction of the A340, 777 and 747-400. Only a few of the highest specification 747-200s are likely to be converted when freight traffic growth resumes. One possible stay of execution for some 747-200s will be the exhaustion of the passenger MD-11s for freight conversion. By this time, however, the value of the oldest 747-400s may have reached a level that would make freight conversion viable. "The one factor in the 747-200F's favour is that it can offer the lowest ton-mile cost when its capacity is required," notes Kelly. "Aircraft built after 1978 may see their values strengthen again to more than \$20 million if there is demand for conversions."

Even the parting-out market for other models has been saturated. The values of most 747 Classics are therefore now at scrap level.

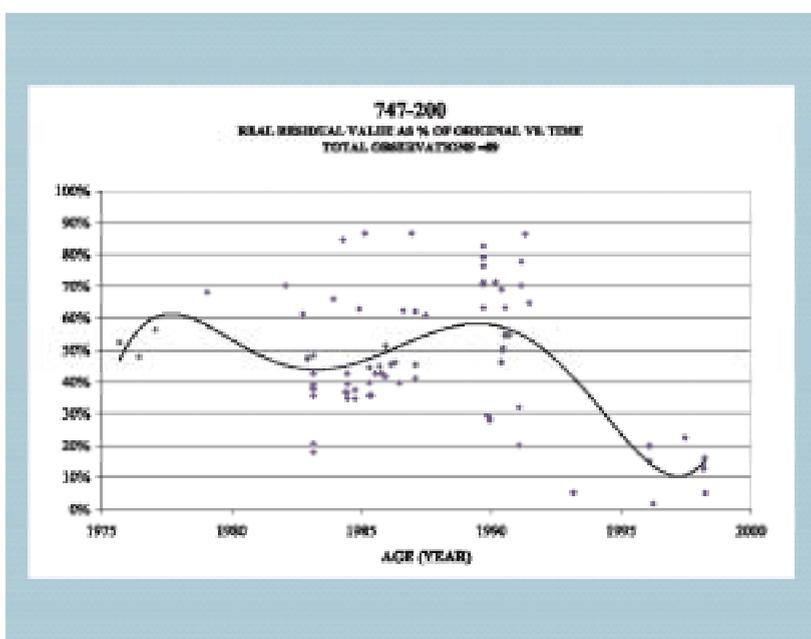
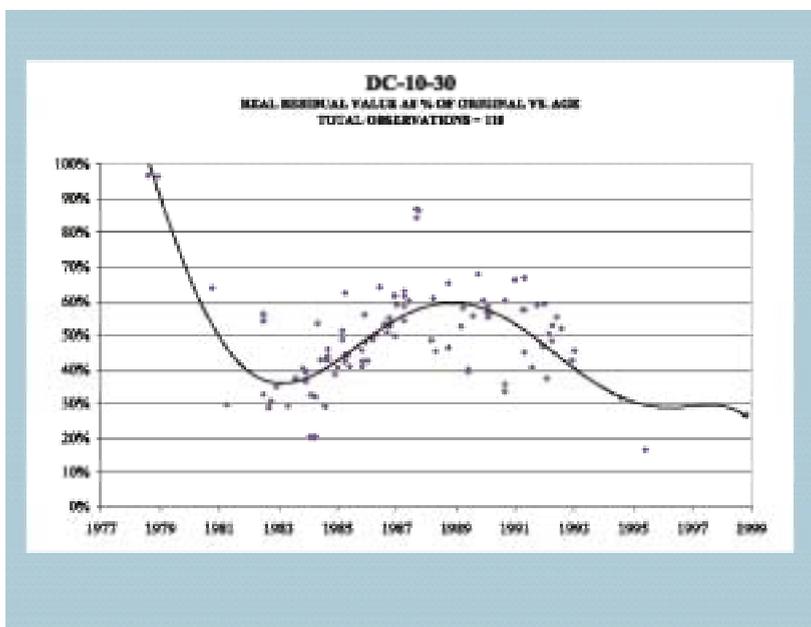
The 747-300 is in a similar situation. "Values were close to \$50 million in 1997," says Kelly. "The Asian crisis killed the market for 747-300s, and there were no transactions until SIA sold its aircraft in the region of \$12-15 million in 2000."

The chart (*see, this page*), shows how the 747-200's RVs have always been low compared to original purchase prices. This is explained by the limited secondary market opportunities the aircraft has. The sudden fall in the mid 1990s to as low as 10% of original purchase price shows how the diminishing freight conversion market collapsed the demand for used 747-200s.

MD-11

The rapid decline in MD-11 values surprised few. The aircraft underperformed and was quickly overshadowed by the A340 and then 777-200. MD-11 values were doomed from the start, and aircraft were converted at just four years old.

About 50 of the passenger aircraft built are yet to be earmarked for conversion in some form. This supply is constantly diminishing, which will erode



values further. Once converted, however, values will be enhanced and should remain stable. Like the DC-8, the MD-11 is a high quality aircraft and supply of MD-11Fs will remain tight.

737NG

Values of 737NGs are currently strong, but the type has only been in service since 1998. The 737NG has new technology and is also one of the few types to have a full family. These characteristics should help values remain stable. The 737NG is also a continuation of a long production run, and the 737 has been operated by virtually every airline in the world. There is also practically no possibility of any used aircraft becoming available on the market.

A large number of 737NGs, however, have been sold at purchase discounts as high as 33%. This factor alone will take pressure off owners to sell at high values. This has also damaged 737-300/-400 values. It is possible that the A320 family's later technology will overshadow the 737NG in later years. The 737NG could therefore be retired earlier than the A320, making the 737NG available in larger numbers before the A320.

A320 family

The A320 has been sold, as a family, to a large number of major airlines, and has among the highest levels of technology of any aircraft. Its remaining life potential is thus the highest of any aircraft.



The A320 family does have its weak members, however. Initial production A320s have low MTOWs and low thrust rated CFM56-5As or V.2500-A1s. The earliest A321s are marginally Stage III compliant, and will require expensive modification to meet Stage IV.

767-300ER

It is only in recent years that 767-300ER values have diminished. The 767-300ER was the aircraft investor's and financier's favourite. Values were high and aircraft difficult to acquire. This was expected to remain the case. Like the DC-10-30 in the 1970s and early 1980s, the 767-300ER enjoyed a virtual monopoly.

The arrival of the A330-200 in 1998, and the 777-200 before, weakened the 767-300ER's position. The 767-300ER's monopoly has therefore been ended, and there are now significant numbers of used aircraft available for the first time. Values are reported to be as low as \$25-35 million for 7-9 year old aircraft. This is a contrast to the values of \$64.5 million that were forecast in 1995 for a 1992 built aircraft in 2001. Beyer says that before the terrorist attacks the base value of this aircraft was \$54 million, but actual current market value is down to \$38 million. Avitas put the base value of the same aircraft at \$46 million prior to the terrorist attacks.

The 767-300ER has therefore not maintained a stable value as was expected.

RV policy

The two safest policies to protect from the risks of RV are either to: take

high specification aircraft and sell early after 8-12 years; or operate aircraft for many years after full depreciation to circumvent any risks of poor RV performance.

A policy between these extremes means selling aircraft after financing terms have been completed, for example, at 15 years. This is less risky with variants that have popular or high specifications. Aircraft produced later in a production run or with a less popular specification pose a greater risk of poor secondary market prospects. In hand with this, is the timing of sale. Airlines that exit a type early usually have the best market prospects, and those that sell later have the poorest chances.

Minimising risk of weak RVs therefore starts at the fleet planning level. Airlines that aim to take aircraft in the first half of a high technology type's production run, have the most popular specification and are one of the first to sell, will take the lowest risks and usually enjoy the highest RVs.

Minimising risk

With the potential pitfalls of lower than expected RV in mind, investors have to take strategies to reduce losses. "An operating lessor has to base a financing decision on several judgements, and so we look for aircraft with a broad and expanding customer base," says John Willingham, president at Boulliou Aviation. "We also invest in aircraft with up to date technology and that meet environmental standards with good margins. We also watch carefully at manufacturers' product strategies, and see if they are launching products which

The A320 is expected to have one of the best residual value retention performances of all types. The A320 family has the largest number of facets in its favour, including a large production run, wide geographical spread and market penetration, high emissions standards, high technology and good operating economics.

will make one of their previous aircraft types obsolete. As a consequence we have placed our investment emphasis on the 737NG and A320 families. These have the strongest customer basis of any aircraft in production, the best geographical spread and good emissions standards."

Willingham explains that minimising risk does not end with aircraft selection. "When structuring operating leases we also take care in what we buy, either from the manufacturers or the airlines. We analyse aircraft specification and organise leases so that we can monitor maintenance management and are specific about the aircraft's return conditions. This therefore requires technical expertise during leases to monitor how our aircraft are maintained during heavy hangar checks and follow the condition of the engines."

Off-loading aircraft is the testing time, and a careful re-marketing policy has to be made to realise the best possible RVs. "This affects our buying policy, since aircraft bought towards the end of a production cycle will mean they face competition from new models coming out when we sell them. We will therefore only buy aircraft if the purchase price makes the acquisition justifiable, which has to take consideration of the probable RV of aircraft 12-15 years after it has been bought, considering this was at the end of the production cycle.

"We do not actually have a strict age policy for selling, but take an opportunistic approach. There are three critical aspects to aircraft investment and these are the right people to manage the aircraft, the right aircraft type and being able to avoid selling aircraft when the market is in a downturn. Aircraft often get returned off-lease during a downturn, so we aim to re-lease for a short-term and not sell. We also manage our portfolio so lease expirations are spread out," explains Willingham. "The other half of the issue is lessee selection. We have to be careful, but we are in the business of supplying aircraft to airlines which cannot afford to purchase or get them financed themselves. We therefore examine how the lessee plans to maintain the aircraft before signing a lease, and also ask lessees to pay maintenance reserves."

