Dramatic changes in the engine aftermarket are causing major concerns for aircraft investors

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Over the past 30-40 years, independent engine servicers have enjoyed a carte blanche in disassembling and maintaining engines. This 'free for all' has resulted in a highly competitive market and thus lead to substantially cheaper engine maintenance, albeit with implications for intrinsic maintenance value and, to a certain extent, reliability. This era appears to be coming to an abrupt end with profound implications for aircraft investors in particular.

Engine OEMs are rapidly gaining market share with their all-inclusive support packages. The complexities of these packages combined with their tightening grip on all areas of the aftermarket will, in our view, result in the collapse of those second tier investors and independent MRO's who don't adequately adapt their business models to meet these challenges.

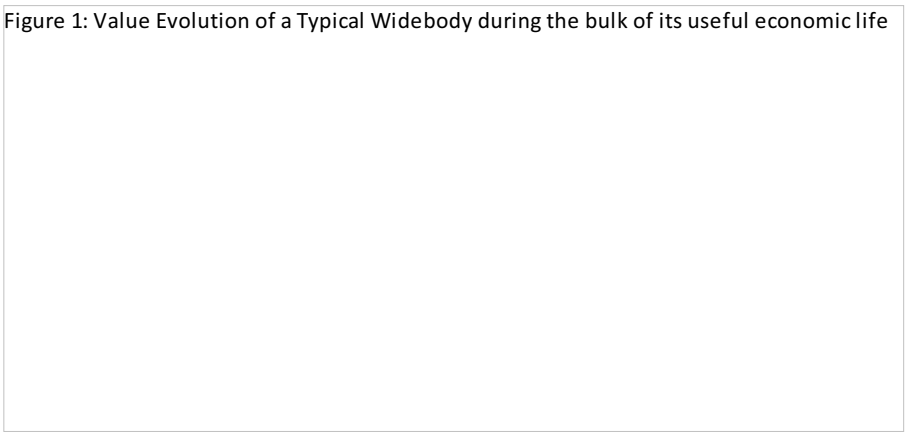
In this paper we explain the complexities of why this situation has arisen, what effect it is having on investors in aircraft and how it is likely to develop with the advent of the various new technology engines.

Engine values are extremely important for aircraft investors because for any given aircraft, the relative value of the installed engines increases from about 20% of the total value at new to 90-100% at age 20-25. The cost of maintaining engines is heavily stacked towards the second decade of an engine's life so investors are very sensitive to the cost burden of maintaining mature engines: the forecast of intrinsic maintenance value is a key element in investors evaluation of residual values during the life of the aircraft.

Figure 1 below illustrates the evolution of the value of a typical widebody over a 20 year operating life, with half-life base values adjusted for intrinsic maintenance value. The sudden jumps in value are mainly associated with engine shop visits which increase in amplitude as an aircraft ages.

If current trends continue, the value of certain engines may be depleted to close to zero at any point after 12 years old, making the negotiations with lessee's concerning compensation payments for usage one of the only avenues to recover some loss in residual value.

Figure 1: Value Evolution of a Typical Widebody during the bulk of its useful economic life



Traditionally, investors have collected engine maintenance reserves as a collateral against future maintenance cost obligations during the

entire life cycle of 20 years or so, referred to as 'Life-Based'rates.

In this way investors protect the asset value against the risk of lessee default and eliminate any requirement to subsidize engines transferring from one lessee to another by keeping the engine synthetically at full life throughout its operating lifetime.

This sensible market practice has been receding over the past few years, affected by the shift by many airlines from traditional 'time and material' maintenance contracts to all-inclusive engine service agreements.

Concurrently, engine OEMs – who are said to routinely sell new engines at a loss in order to win deals – are moving to control more of the aftermarket and increasingly winning new engine sales by guaranteeing the lowest flight hour cost for the airline placing the order.

These all-inclusive support packages have grown dramatically in the past decade and are now estimated to cover nearly 50% of all new aircraft delivered.

All-inclusive packages have been around for many years and take many forms – designed principally to address the cost and timing uncertainties inherent in the traditional 'time and material' contracts where an unscheduled engine removal event caused much angst in the planning, operations and financial departments of an airline.

Most OEM packages share a common feature which affects investors universally: regular cash collection for continuous support that in most circumstances forces investors to forfeit valuable engine related maintenance reserve cashflows.

Generally speaking, airlines have been the main drivers of the full support packages from OEMs: they have become more comfortable paying a premium to cover uncertainties on future engine costs.

OEMs are best placed to cover this risk - given their intimate knowledge of their products – and have been able to support this by positioning themselves with extensive MRO capabilities.

The OEM all-inclusive support package is now routinely pushed with new aircraft campaigns and is being sold in ever-greater volumes at the 'point of sale'. These packaged deals appear to be a superb deal from the airlines perspective – often at exceptionally cheap all-inclusive rates when compared to maintenance reserve rates quoted by investors or indeed the airlines' own engine maintenance cost data for their legacy fleets.

Crucially, these flight hour contracts are often priced on the first – significantly cheaper – decade of an engine's life, what is known as a 'Term-Based' agreement.

This jostling for market share has resulted in increasingly complicated agreements which are difficult for airlines or investors to decipher and analyze.

Questions such as exactly what coverage is included (documentation, engine management, spares coverage, hardware upgrades etc), how to disentangle pricing for individual elements, what rights or hardware is assignable to an investor, what happens if the utilization profile changes, etc. have a big influence on risk and values but are not easy to simulate.

Apart from the above mentioned security issues and cashflow losses, the major concern for investors has shifted to the growing effects such packages are having on aircraft residual values.

During aircraft type selection, few airlines have established exactly how they will finance the purchase. At this point, they are for the most part focused on the absolute lowest capital cost and operating costs. On the other hand, investors are generally far more sensitive to residual issue implications.

Despite being truly all-inclusive deal vis-à-vis the operator, many of these packages are Term-Based covering the initial 10 or 12 years of an engines maintenance life. For many engine types, this period generally consumes 30% of so of total lifetime maintenance costs so the offered rates can be discounted by up to 40% compared to Life-Based rates.

At the end of this period, the OEM is not fully covered for the second decade of the engine operations and typically need to charge a

substantial 'buy-in' fee or similar cost recovery mechanism in order to compensate for the initial discount, which investors view as a sales subsidy.

Figure 2 below illustrates the maintenance reserve shortfall this situation can cause for a typical narrow-body engine that has been on a discounted Term-Based rate for the first 10 years.

In many respects financiers and investors are happy that engine OEMs are providing all-inclusive packages– they give a lot more comfort that their asset is being maintained to the highest standards and there is no question mark about the pedigree or intrinsic maintenance value.

The outcome of the widely discussed 'PMA part' debate seems to confirm that most investors don't want any such non-OEM parts installed in their owned engines.

Currently, the most direct concerns about all-inclusive packages - as seen from the perspective of lenders and investors - relates to security and the treatment of paid-up amounts in the case of lessee default or earlier-than-expected termination from the agreement.

The payment mechanism of these steadily growing all-inclusive packages means that financiers and investors are being inadvertently exposed to increasing credit risk vis-à-vis the OEM. In the unlikely event an engine OEM collapses, few investors would expect to fully recover payments held on behalf of multiple lessees as the claims on the bankrupted entity would stretch through their entire production and support network including maintenance shops, parts production facilities etc. This will at some point lead investors to start assessing OEM credit risk in addition to lessee and portfolio concentration risk.

The assignment of rights enabling an investor to step into a defaulting lessee's shoes without penalty is a key concern for many aircraft investors. This has been well addressed by Rolls-Royce ('RR') through their Opera program for investors – although one common observation is that these packages don't allow for any cash to be refunded at any point, only credits for future maintenance work will be provided.

CFM's PML product also appears to address this assignment requirement but a considerable amount of progress is yet to be made with OEMs to reach similar levels of protection.

OEMs have also become more alert to the erosion of the potential value of their aftermarket caused by third party MRO's and have made concerted efforts to close this potential revenue leakage – now an essential part of their business plan to recoup new engine development costs.

In this respect, Rolls Royce is in a league of its own, having moved to address this situation ten years before the other OEMs.

By our definition, today there are no truly independent MRO's servicing Trent engines whereas there are 30 or so entities competing in the CFM56 marketplace.

The three nominally independent MRO's maintaining Trent's are fully aligned with the RR manuals and practices and neither develop independent repairs nor install any used material.

In other words, they compete on the very marginal man-hour rate whilst the bulk of the cost – 80% or so, relating to materials and repairs - is fixed.

The GE90-115B fitted to the 777-300ER shares a similar OEM domination issue, GE appears to be in total control of all shop capacity and material repair schemes. However the 777-300ER fleet is younger than the A330 / 777-200 and the market has not yet witnessed many lessee transitions.

Several market participants expect the engine operating costs during the second decade of 777-300ER operations may be a brutal shock to many airlines and investors.

In our view the number of independent MRO's currently working on narrow-body engines will probably fall by at least half in the next decade. OEMs are more likely to prioritize their links with strategic airline partners.

Parts and spare engines are tending to become less tradable and the days of independent MRO's manufacturing PMA parts or developing their

own repairs seem to be rapidly reaching an end. Whether deliberate or not, technology, regulation and intellectual property protection will certainly help the OEMs to continue to increase their market share.

Alignment and partnership with the OEM's seem to be the most viable way forward, at least for the next generation of engines now under development.

If left unchecked over the long term, we believe there is a strong potential for this aftermarket to become a monopoly, particularly on single engine choice aircraft types: once an airline chooses its engines where it can only opt for an OEM support package, prices are bound to rise.

Engines now account for close to 50% of overall maintenance costs on aircraft, this portion is widely expected to increase.

The situation on Trent's and CFM56s has created a useful case study for comparison and may offer some clues as to how the market is likely to evolve.

It seems clear that excessive aftermarket competition leads to depressed asset values and potentially weakens OEM's revenue flow: this may adversely affect the ability of the engine OEMs to continue developing much-needed new technologies.

On the other hand, a situation where there is no aftermarket competition on any level, where the OEM controls all aspects – spares, replacement materials, repairs etc – kills off any interest in trading used engines.

Both scenarios cause market uncertainty and lead to heavy losses in value, affecting aircraft investors and, at some point, the OEMs themselves.

Many investors are well aware of these scenarios and by all accounts the majority tends to prefer to have a looser aftermarket which nurtures used engine trading rather a totally controlled market which neuters any attempts at reselling used engines or parts.

The Rolls Royce story is worth describing in detail: They are widely known to have near total control of their aftermarket for all in-production engines. According to RR, they cover over 80% of the Trent market through their TotalCare Agreement ('TCA') which provides for repairs, shop visits, optional spare engine coverage etc.

In doing so, RR generates enormous cash revenues and provides an excellent level of service and support.

Generally speaking, the RR Trent maintenance program is designed to use proportionally more new parts (rather than repaired or reconditioned) during shop visits – for instance much of the material in the 'hot section' is designed for a single repair interval. As a result, Trent engines have a reputation for expensive but top quality shop visits, keeping reliability high and with on-wing times substantially higher than the market average.

Their cost per flight hour is said to be very competitive compared to similar sized engines, particularly on Term-Based agreements.

In order to achieve this total control, RR has over the years managed to develop an apparently watertight system of exclusive repair licenses where all detailed support down to piece-part level is performed by RR.

As mentioned above, in our view there are no truly independent MRO's working on RR Trent engines as licenses and shop manuals are tightly controlled. As a result there are no parties
disassembling engines for parts, no independent tooling or piece-part repair facilities, no independent parts recertification agents and no market for used engine parts.

In short, today there is neither a market nor much scope for a market to develop in disassembling Trent engines.

At a certain point many investors would explore the market to sell or lease an engine as a spare.

However the TCA arrangements with near blanket coverage across all Trent's operators also generally provides for spares coverage. This has led to the situation where over the past 18 months there has been an accumulation of at least 8 investor-owned serviceable Trent-800 engines sitting idle with little or no chance to be leased or sold in the short or medium term, i.e. of little value today.

This near-total control of the Trent market has been in existence for several years but when combined with poor aircraft demand, it is only now becoming apparent how painful the implications can be for aircraft residual values.

This has come to light recently with the exceptionally weak demand for used RR powered A330s, A340-500/600s and 777-200s, several of which have been scrapped at age 12. The perceived overproduction of replacement aircraft may be the main culprit. In any event it is difficult to pinpoint exactly how much influence the relative lack of engine resale values is having on this used aircraft market but it is clearly not helping the situation.

Interestingly, whilst operators now have a steady preference for new Trent powered widebody aircraft, very few seem to want to touch 12 year old machines.

There is little doubt that airlines, as the operating and regulated entity, are the most appropriate signatories to all-inclusive support packages. Investors have mainly shied away from entering into direct arrangements with the OEMs as the perceived risk of liability is very high.

Perversely, the growth in allinclusive support packages has meant that airlines have rapidly shed valuable in-house engine experience. Although many carriers retain powerplant teams, their role has steadily reduced to managing the maintenance packages and warranty issues.

Ironically this may be one factor behind many airlines' current reticence to take used equipment – they may no longer have the skills and depth of evaluation to analyze future costs on used engines.

CFM has just introduced what appears to be the first fully investor-focused support package, called Portable Maintenance for Lessors (PML). In summary, PML is a Life-Based program covering the initial 20 years or so of operation for a typical CFM engine.

The main attraction for investors is that it allows them to keep collecting reserves directly from the lessee.

The principal obligation is for the lessee to send the subject engines to CFM shops during the entire lease, where they are guaranteed a relatively high minimum build standard.

In terms of mechanics, a master agreement is signed between CFM and the investor that specifies a total Life-Based rate, something the lessees generally do not see. The lessee(s) in turn enters into an 'Operator Agreement' directly with CFM covering the subject engine.

The rates cover nearly every event which may occur on an engine except for FOD repair (insured separately) and LRU replacement (repairs are covered) and can be transferred between lessees in 90% of jurisdictions in the world with no penalty or rate increase.

The main caveat concerns engines operating in a temperate environment being re-leased to an airline operating in a severe environment (sandy or heavily polluted). In this case CFM understandably increases the overall rate to account for the higher attrition and wear.

There are certain operating thresholds which dictate when an engine is considered at risk from a severe environment. A relatively small portion of the overall rate is designed to cover non-performance restoration visits, in other words, events which are generally not heavy enough to qualify for a drawdown in maintenance reserves.

This portion, is payable as a compensation if the engine exits the program prematurely (i.e. in the event of airline default or subsequent lessee's declining to participate).

As an alternative, the investor can step into the contract to continue paying for flight hours flown or revert to a 'time and materials' arrangement. Concerns about minimum physical return conditions driving unscheduled shop visits are addressed by the principal that all parties commit to work on trying to avoid this situation by minimizing nonscheduled borescope inspections and keep the engine on wing as long as possible.

In theory this should be seamless where subsequent lessee's carry on the PML program, however aircraft remarketing timescales don't necessarily coincide with engine redelivery planning so certain negotiations are bound to be required.

Importantly, for engines operating in a normal operating environment to a medium credit airline, the overall rate seems to be at a competitive level compared to typical investor-calculated Life-based maintenance reserve rates.

This is quite an impressive achievement given the extra coverage the PML program provides to the operator above the traditional 'time and material' rates. At this point one large investor has signed up to this program and two of their lessees are in process to join in the scheme.

This is a very slow success rate for this product which was launched 18 months ago. By many accounts the contracts are overly complicated and

the sheer workload to conclude may dissuade some investors to sign up.

Despite the various caveats, complexities and limitations of PML, we would expect this type of arrangement to win a lot more support from investors as time goes on: it clearly addresses many of the high level concerns of investors.

The two primary concerns for all aircraft investors are stability and predictability of residual values and security to cover for lessee default risk.

All prudent investors understand and try to account for risks which affect these two major aspects.

When all-inclusive packages first appeared, investors' primary issues related to coverage for lessee default: such packages are paid for as a form of insurance premium for ongoing usage whereas reserves are a buildup of collateral for future maintenance obligations.

This fundamental difference still exists and if anything has been steadily eroding against the interests of investors. In addition, there is a perennial concern for how lessees locked into such packages can meet minimum physical return conditions, penalties or access to credits in the event of default, program transferability between lessee's etc.

However these issues have recently been further compounded by the rise in Term-Based pricing and the increasing uncertainty in value and maintenance costs of mid or end-of-life engines.

Figure 3 below is a graph produced by Stratos' in-house lease simulator and shows how the cash reserves and condition evolves over a 20 year period for a typical investor in newish widebodies today.

The orange dashed line shows the effect that an all-inclusive package during the first 10 years has on reserve collection rates. The green 'full reserves' line is where investors ideally need to be, it is the 'synthetic full life' line which keeps the investor fully covered in the event of a lessee default.

The difference between these two lines is shown in the sub-graph, these are the cash levels ($m) potentially at risk if the initial lessee defaults: enough to wipe out any investor given the wrong combination of poor aircraft re-marketability, weak assignability rights under an all-inclusive engine package and a dysfunctional engine parts aftermarket.

When the demand for used aircraft falters, investors rely heavily on a functioning engine aftermarket and fully funded maintenance reserves to recover at least some of their losses.

Any market where the resale of parts and spares are controlled by a single entity is potentially catastrophic for investors in aircraft as there is no discernable floor for engine resale value.

If left unchecked, at some point investors will stop funding these assets. In this scenario OEMs will probably have no choice but to stabilize their own aftermarket, by say offering RVGs or engine buyback commitments.

In the meantime, aircraft investors are hoping that engine OEMs are taking note of the current used aircraft market situation and that the temptation to control the aftermarket will be tempered with the knowledge that such actions, when combined with poor aircraft demand, can kill residual values.

Some OEMs are taking some positive steps to address investor concerns on payment and security mechanisms but investors need to continue to push for their interests to be defended, particularly as it relates to aftermarket trading.

Hidden terms, heavy discounting and increasing sophistication of the all-inclusive packages make investors' evaluation of risk all the more difficult. The biggest losers in this situation are most likely to be the second tier aircraft investors; they need to tool up to analyze this risk or face extinction.

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Glossary: We have tried to keep industry jargon to a minimum, here are the main terms:

Base Values: Forecast baseline residual values, generally based on aircraft in half-life condition
FOD: Foreign object damage, generally caused by runway debris ingested into engines.
Hot Section: Portion in an engine operating at high temperatures including the combustor, turbine and exhaust system.
Half Life: Where an aircraft has half its maintenance potential consumed (i.e. half way between restorative maintenance visits). *Full life* means full maintenance potential available.
Investor: In the context of this article, an equity investor in aircraft or engines. i.e. an aircraft operating lessor.
LLPs: Life limited parts, a set of 30 or so high cost parts fitted in engines which have a not-to-exceed life
LRU / QEC kit: Line replacement units, quick engine chance kit. Components and structures that fitted externally on all engines, required to fit and operate turbofan engines on aircraft.
MRO or Servicer: Maintenance and repair organization
OEM: Original equipment manufacturer i.e. Rolls Royce, CFM, GE, Pratt & Whitney etc
PMA Part: engine parts which are certified through the FAA-controlled Parts Manufacturer Approval process where the manufacturer producing such parts is not affiliated with or licensed by the OEM.
RVG: Residual value guarantee
Time & Material: Traditional maintenance contracts where the client pays for man-hours and materials actually consumed during a maintenance check. The MRO does not take any risk of cost overruns.

