Redelivery expenditure –
minimising surprises and maximising cashflow

An analysis of average costs

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Critically what is frequently missing is the necessary level of communication between the Lessee’s departments that is required to maintain optimum control of costs. As IBA highlighted recently in ADVANCE (the UK magazine for Aviation, Defence, Security and Space Industries) an inefficient redelivery results in an average overpayment of $1.65m* per single aisle aircraft.

Given the number of returns per year – IBA’s JetData database recorded 895 lease returns in the last 12 months, 522 of them single aisle aircraft of the type analysed in this paper – and with most airlines still operating on single digit margins – the benefits from improvements are clear. It is IBA’s contention that the process of aircraft redelivery is frequently and significantly underestimated in terms of the cash, time and expertise that is required to be invested by the Lessee.

Increasingly, many of the stipulations required by Lessors through the negotiation of the redelivery conditions go beyond the standard requirements and airworthiness tasks that the manufacturer’s Maintenance Planning Document (MPD) typically requires and we contend that many industry estimates of Maintenance, Repair and Overhaul (MRO) costs are underestimating the quantity of actual work that is driven by operating leases.

With operating leases on the increase, IBA forecasts that the demand for MRO services related to end-of-lease reviews are currently underestimated by at least 10-15%.

The requirements detailed below are typical of a single aisle aircraft operating lease redelivery condition. IBA has combined and anonymised a selection of leases, then provided analysis and opinion of the likely additional costs associated with work involved to get an aircraft into contractual redelivery condition.

Our analysis refers to typical single aisle (737/A320) aircraft on a six year lease and identifies an additional cost of around $1.65m per redelivery. For a two engine twin aisle (777/A330) aircraft this cost is estimated to be over $3m. For turboprops and regional jets (ATR/ERJ) it is in the order of $0.5m per redelivery.

Average additional maintenance costs across typical leasing areas

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Engines</td>
<td>35.3%</td>
</tr>
<tr>
<td>Fuselage, windows and doors</td>
<td>8.8%</td>
</tr>
<tr>
<td>Landing gear</td>
<td>5.9%</td>
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<tr>
<td>APU</td>
<td>1.8%</td>
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<tr>
<td>Interior and carpet</td>
<td>1.8%</td>
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<tr>
<td>Corrosion</td>
<td>2.6%</td>
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<td>General</td>
<td>27.9%</td>
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<td>Components</td>
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In conclusion, tighter control on redelivery planning and costs will have a positive impact on cashflow. However, the control and planning required is often misjudged by the Lessee, in part purely as a result of the key date being far in the future. Indeed, IBA is

*All amounts are in US dollars
only half joking when, in response to the question: “When should we focus on redelivery?” we reply with “the day you negotiate the delivery”. However, millions of dollars can be wasted when a Lessee fails to properly manage the process and then incurs late redelivery charges.

Whilst this white paper shows that it is the engines that are a significant element of that additional cost, no area is left unchallenged. Structural repairs, modifications and component certification are other areas that often cause problems for the Lessee to adequately show compliance with the lease conditions.

The skillset required of airline maintenance and technical staff for a redelivery is slightly different to the day-to-day requirements of the airline and its regulatory authority. With Lessees focused on their core revenue generating, operational and airworthiness matters, it is prudent to seek additional opinions on the optimal processes relating to redelivery.

IBA recommend that operators review leases to fully understand the cost implications of redelivery and consider instructing external expertise to advise on lease negotiations, redelivery supervision and project management.

Conclusions from this white paper:

1. The estimates of global MRO expenditure appear to underestimate the real costs incurred by Lessees and, in some cases, Lessors since additional tasks are created by the operating lease redelivery process.

2. Many Lessees can do a more efficient job of the redelivery process but it requires greater focus and specialist resources.

3. The process of redelivery planning should start much earlier than is often the case and, in terms of the contractual requirement, actually start at the initial negotiation of the lease, not afterwards.

4. Accrued maintenance reserves may be used in part towards the additional costs shown below, however, the maintenance reserves negotiated may not relate adequately to the full cost. Those maintenance reserves should be compared to IBA benchmarks.

5. IBA’s process of “fly forward” analysis and maintenance planning reviews will provide the actual additional costs that will be incurred on a specific aircraft and lease combination.
Typical Operating Lease Redelivery Conditions for a 6 year lease of an A320/B737 type of aircraft:

The scene of most redeliveries is an MRO facility since the redelivery is usually timed around a scheduled heavy airframe check. In some cases this is the Lessee’s in-house facility or, increasingly, a third party MRO facility. In some instances the MRO has been involved with the maintenance management for many years, in other cases it is contracted solely to perform the redelivery or End of Lease check. Most of the contracts between Lessee and the MRO relate only to the physical work required rather than contracting the MRO to redeliver the aircraft as per the lease. That aspect is a commercial matter rather than a technical one and therefore requires the presence of the Lessee and Lessor’s commercial representatives.

The figures provided demonstrate an average additional cost of compliance. For example, perhaps one aircraft out of three requires additional work on engines so that cost is provided as an average figure per leased aircraft. (In some cases the costs can be many millions of dollars more and occasionally less than the average provided herein.) IBA can assess the lease to provide a robust estimate of additional cost.

We examine typical areas of a lease redelivery conditions below and have included those areas which may not create additional costs so that our analysis is considered to be complete and fair. Please contact IBA with any queries around these, or any additional areas of interest.

1.1 General Condition

The aircraft will:

(a) Be in good operating condition and be clean by scheduled passenger airline standards, and all structural damage shall have been repaired to a permanent standard.

Additional to MPD?
$150,000.

There is often disagreement regarding ‘good’ and ‘clean’. However, the aircraft redelivery is usually tied into an aircraft C-check and the airline should be performing the check to a standard that delivers a good/clean aircraft, irrespective of it being redelivered or placed back into airline service. Structural damage – the review of old repairs, the certification or lack of it often leads to delays and/or re-performance of repairs. A review of redelivery work packs averages this cost at $150,000 per aircraft to cover the additional OEM/MRO support, engineering, materials and manpower required.

(b) Have installed the full complement of equipment, components, accessories, furnishings and loose equipment as when originally delivered to Lessee and, the aircraft (including the aircraft Documents and Records) shall be in a condition suitable for immediate operations under EASA EU-Ops 1, or FAR Part 121.

Additional to MPD?
$50,000.

This is a relatively low contingent amount for this requirement. The combined requirement in this case of both EASA and US FAR is not recommended - it should be either one or the other. The dual requirement often leads to the need to change various equipment such as lifevests.

(c) Have in existence a valid Certificate of Airworthiness (C of A) (or if required by Lessor, a valid export certificate of airworthiness) with respect to the aircraft issued by the Air Authority;

Additional to MPD?
This requirement should not lead to additional costs. The export C of A can lead to additional costs and $25,000 should be budgeted.
Redelivery expenditure – minimising surprises and maximising cashflow. An analysis of average costs.

(d) Comply with the OEM’s original specifications as at the Delivery Date;

**Additional to MPD?**

$50,000.

This can be contentious when the Lessor takes a hard line regarding airline specific modifications. This can lead to the need to remove certain modifications and/or provide suitable modification certification (OEM Service Bulletin (SB) or Supplemental Type Certificate (STC), etc).

(e) Have undergone, immediately prior to redelivery, the next relevant C-check in block format so that all airframe inspections, falling due within the C-check interval, as defined in Manufacturer’s Maintenance Planning Document (if Lessee’s Maintenance Programme does not comply with the requirements of the Manufacturer’s Maintenance Planning Document), have been accomplished;

**Additional to MPD?**

$35,000.

There are usually some specific Lessee tasks within the Lessee program and/or requirements to re-align the current program to the MPD. Also many airlines operate an out of phase task list so requiring all tasks to fall within the C-check interval will add to the Lessee’s basic program.

(f) Have had accomplished all outstanding Airworthiness Directives (AD) affecting that model of aircraft issued by the Federal Aviation Authority (FAA) or European Aviation Safety Agency (EASA) which, if the aircraft were registered with the FAA or EASA, would have to be complied with during the term and for a period of 180 days after redelivery;

**Additional to MPD?**

$25,000.

This is a contingent amount and can vary considerably from type of aircraft and specific serial number and the components that are subject to Airworthiness Directive (AD) compliance.

(g) Have installed all applicable vendors’ and manufacturers’ SB kits received free of charge by Lessee that are appropriate for the aircraft and to the extent not installed, those kits will be furnished free of charge to Lessor;

**Additional to MPD?**

*Not often an issue*, therefore no additional costs are considered to be incurred at redelivery.

(h) Be in external livery as provided by the Lessor 90 days prior to redelivery to meet the next Lessee’s required paint scheme. If less than 90 days notice is provided, the aircraft will be redelivered with the fuselage and tail having been fully stripped, re-primed and painted white.

**Additional to MPD?**

$20,000.

This particular lease appears to have a relatively high cost imposed on the Lessee, perhaps to motivate the Lessee to perform the painting work. However, there is often some element of painting cost and repair of stencils that is over and above what an airline may typically perform.

(i) Have all signs and decals clean, secure and legible;

**Additional to MPD?**

*Can be an exposure but for this exercise no additional cost is considered.*

(j) Have no open, deferred, continued, carry over or placarded log book items.

**Additional to MPD?**

$120,000.

It would be hoped that an aircraft having a C-check would be in very good condition prior to re-entering service. However, it is more often the case that an aircraft exiting a heavy maintenance check will not be perfect having had so many components and systems disrupted as part of the check. To clear every defect will incur additional costs.
1.2 Components

(a) Each Flight Hour and Cycle controlled Hard Time Component (HTC) shall have not less than the 3,000 Flight Hours and/or the 3,000 Cycles of life remaining to the next scheduled removal, and shall be supported by appropriate certification documentation such as EASA Form 1 / FAA form 8130-3;

**Additional to MPD?**
$180,000.

There are often problems locating each and every piece of documentation in a timely fashion and of course, the imposition of the minimum hours and cycles will drive the replacement/repair of components of the aircraft that may have ordinarily stayed on the aircraft.

In addition to the comments below there is another point to consider that may escalate the costs significantly;

1) HTC – in general 99% of HTC are supplied with an EASA Form 1 / FAA 8130-3 that states Times Since New (TSN) and Cycles Since New (CSN), so these do not cause a problem.

2) On Condition or Condition Monitoring (OCCM) components – in general only 5% of OCCM are supplied with TSN/CSN information (they usually state ‘Unknown’).

(b) Each calendar-limited component including safety equipment will have not less than 12 months remaining to the next scheduled removal in accordance with the MPD.

It therefore becomes almost impossible for the airline to comply with this type of clause unless they install ‘NEW’ components, which adds significant costs to their operation.

**Additional to MPD?**
$30,000.

Many airlines will have a policy to ensure that difficult to remove items with calendar lives are replaced at a C-check. However, for many items such as evacuation slides, rafts, lifevests, fire extinguishers and oxygen cylinders are easily replaced during monthly, A-check or even nightstop maintenance. Therefore the removal, replacement of these items to simply conform to redelivery conditions drives premature shop visits and reduces the full-on wing life.

(c) Each ‘on-condition’ and ‘condition-monitored’ component will be serviceable;

**Additional to MPD?**
No additional cost is assumed here as we would expect these types of components to be serviceable.

(d) The installed components as a group will have an average of total flight time since new of not more than 110% of that of the Airframe;

**Additional to MPD?**
$50,000.

This clause is designed to prevent a relatively new aircraft being fitted with older components. This has become an issue especially where airlines have older aircraft in their fleet and/or outsource to component exchange companies that may be oblivious to the fact that older parts, even though fully repaired and airworthy may reduce the overall value of the aircraft. This clause drives component replacement at redelivery for those older components that do not comply.
1.3 Engines

Each engine will be installed on the aircraft and comply with the following:

(a) Each engine will have not less than 6,000 Flight Hours expected life remaining to the next scheduled removal and the life limited components shall have not less than the 6,000 Cycle life remaining. The expected life remaining will be determined by a review by Lessor and Lessee of the engine in-service operating history, in-flight monitoring (particularly in respect of Exhaust Gas Temperature (EGT) and any abnormal trends), workscopes accomplished during the Term (particularly EGT margin and borescope findings), such information to be utilised in reference to industry experience, the engine manufacturer and the average deterioration rate of similar engines in Lessee’s fleet in assessing the expected remaining life of the engine;

Additional to MPD?
$350,000.

Probably the most expensive and difficult to manage aspect of redelivery is the engine life. Firstly proving life remaining for an on-condition part can provoke disagreement given its predictive nature. Many leases are written on the basis of no more time since refurbishment than x000 hours or cycles, since that cannot be argued, but clearly Lessors like to be able to offer the next Lessee some certainty of what can be expected.

In many cases we find that engines are sent to the shop much earlier than they would otherwise be sent simply in order to provide more life at redelivery, therefore wasting the full life potential of the engine.

(b) Each engine shall have just completed a hot and cold section video borescope inspection, and a power assurance run performed in accordance with the Manufacturer’s maintenance manual.
Any defects discovered in such inspections which exceed the engine manufacturer’s in-service limits shall be corrected at Lessee’s expense. Lessee shall cause such borescope inspections to be performed and to be recorded on videotape by an agency selected by Lessor and shall provide Lessor with a copy of such videotape on the Return Occasion. No engine shall be on ‘watch’ for any reason requiring any special or out of sequence inspection. Each such engine shall comply with the operations specification of Lessee without waiver or exceptions. All items beyond the engine manufacturer’s in-service limits shall be repaired or overhauled.

Additional to MPD?
$250,000.

While typical, this clause is quite stringent upon the Lessee, it allows no leeway in terms of the engine condition. In normal service engines may continue to be airworthy despite being on watch, or having reduced borescope intervals, so this need for engines to be more than serviceable and airworthy drives early shop visits, hence costs.

(c) Each engine will be devoid of any defect which places less remaining life on its component parts pursuant to Manufacturer’s or the Air Authority’s Airworthiness requirements until removal.

Additional to MPD?
Not considered to add additional costs since this has already been taken into account in the other engine related categories.
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1.4 Fuselage, windows and doors

(a) The fuselage will be free of major dents and abrasions, loose or pulled or missing rivets and all structural repairs shall be permanent standard repairs performed in accordance with the SRM or Manufacturer’s Approved Data;

**Additional to MPD?**

$150,000.

Another contentious area given the need for manufacturer records and permanency. Some repairs have repeat inspections imposed and the repair files at some airlines are not concise and clear. Often requires rework or replacement of repairs.

(b) Windows will be free of crazing (except to the extent the Manufacturer’s maintenance manual establishes in-service limits, in which case such limits shall be observed) and will be properly sealed and any blemishes and delamination shall be within Manufacturer’s in-service limits; and

(c) Doors will be free moving, correctly rigged and be fitted with serviceable seals.

**Additional to MPD?**

**Not considered to be additional cost** since it is considered that such defects would be corrected in any case.

1.5 Wings and empennage

(a) Leading edges will be substantially free from damage and any repairs shall be to a permanent standard; and

(b) Unpainted surfaces will be polished, cleaned and protected by wax.

**Additional to MPD?**

$10,000.

There is often some debate over interpretation of ‘substantially free’, permanency and polishing of unpainted surfaces leads to additional cost over and above typical MPD tasks.

1.6 Interior and cockpit

(a) Carpets and seat covers will be in good condition, clean and free of stains and meet US fire resistance regulations.

**Additional to MPD?**

$30,000.

Another contentious area such as the fire burn certification is often missing for seat covers and cushions, and differences of opinion over ‘good condition’ or ‘cleanliness’ will add costs.

1.7 Landing gear; wheels and brakes

(a) The landing gear and wheel wells will be clean, free of leaks and repaired as necessary;

(b) Each installed landing gear shall have not less than the 10,000 Flight Hours and/or the 10,000 Gear Cycles and/or the 36 months Calendar Time (whichever is the more limiting) to the next scheduled removal in accordance with the MPD; and

(c) The wheels and brakes will have not less than half of their useful life remaining.

**Additional to MPD?**

$50,000.

Similar to above. Life limitations lead to early removal of wheels, tyres, brakes, driving and landing gears to the shop prior to their MPD life.
1.8 Return of Auxiliary Power Unit (APU)

(a) The installed APU will be in serviceable condition and will have no more than 1,000 APU Hours consumed since last Hot Section Inspection (HSI) (or equivalent repair).

Additional to MPD?

$30,000.

Early shop visits can be driven by this clause and cost many hundreds of thousands of dollars – this cost assumes approx. 1 in 12 leases will drive an early shop visit.

1.9 Corrosion

(a) The aircraft shall have been inspected and treated with respect to corrosion in accordance with the corrosion prevention and correction criteria requirements of the Approved Maintenance Programme (AMP) and/or the SRM (whichever is applicable);

Additional to MPD?

$45,000.

As previous, disagreements over ‘substantially free’ and ‘free’ can result in additional work and repairs over and above MPD/Corrosion Prevention Control Program (CPCP). In this example the clause specifically refers to a programme approved by the Lessor.

The above extracts are from a variety of typical leases and are for illustrative purposes only.
IBA is an independent aviation consulting firm founded in 1988 to advise owners, financiers, operators, leasing companies, agencies and governments on commercial and business aviation matters around the globe. Headquartered in the UK, the IBA Group has grown to become one of the leading aviation consultancies in the world, assisting the international aerospace community on a daily basis.

IBA’s aviation experience has been gained over almost 30 years of trading and ranges from asset inspections and valuations, repossessions, operator assessments, aircraft and engine management programmes, lease assistance, workout programmes, aviation asset appraisals, remarketing and sourcing projects, consulting and commercial services, technical and engine management, services for corporate aircraft and owners, industry and sector research and analysis, training and regulatory services.

IBA’s maintenance advisory team provide analysis, maintenance forecasting and maintenance cost benchmarking, as well as detailed studies on airframe, engine and parts costs supported by market intelligence.

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Furthermore, IBA can provide turnkey advisory services, including aircraft and route selection, evaluation, contractual support, source and inspection, delivery management services and in-service management.

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