MRO Market Forecast & Trends

3 November 2015 - Singapore

Presented by:
David Stewart
Vice President, ICF International
david.stewart@icfi.com
MRO Market Forecast

Trends

Takeaways
Agenda

MRO Market Forecast & Trends

MRO Market Forecast
Of the 27,500 global fleet, 25% is located in Asia Pacific where the share of turboprops and regional jets is much smaller.

2014 Global Fleet

- Narrowbody Jet: 51%
- Regional Jet: 14%
- Widebody Jet: 17%
- Turboprop: 18%

2014 Asia Pacific Fleet

- Narrowbody Jet: 56%
- Regional Jet: 6%
- Widebody Jet: 23%
- Turboprop: 16%

Source: ICF International
The Asian fleet will see a large growth over the next decade and the second fastest growth globally of 4.7% CAGR; +4,200 A/C

**Air Transport Fleet Growth 2014–2024**

- **Asia Pacific**: ~7,150 (25%) growth, ~11,350 (30%) retirements
- **CAGR**:
  - Africa: 4.8%
  - Middle East: 5.3%
  - South America: 3.8%
  - Europe: 2.7%
  - Asia Pacific: 4.7%
  - North America: 1.4%
  - 3.2% Average

**Highlights**
- Air travel growth of ~3.8%
- ~19,000 aircraft deliveries
- ~8,600 aircraft retirements

Source: ICF International, ACAS September 2014
The current air transport MRO market is $62.1B; Asia Pacific accounts for ~27% of global demand (~$16.9B)

2014 Global MRO Demand

By MRO Segment
- Engines: 40%
- Airframe: 15%
- Line: 17%
- Components: 22%
- Modifications: 6%

By Region
- Asia Pacific: 27%
- North America: 29%
- South America: 7%
- Middle East: 6%
- Europe: 27%
- Africa: 4%

Source: ICF International
Forecast in 2014 $USD, exclusive of inflation
The global MRO market is expected to grow to **$90B by 2024**, at 3.8% per annum.

**Global MRO Spend 2014–2024 ($B)**

- **Average growth is forecast to be 3.8% CAGR**
- **The strongest drivers of growth are the engine and component markets**
- **Reduced labor intensity of airframe heavy checks as the fleet renews and increased intervals**
- **Aircraft upgrades (e.g. interiors, winglets) drive high modifications growth**

Source: ICF International
Forecast in 2014 $USD, exclusive of inflation
Over the next decade, MRO growth will be 3.8% with Asia Pacific and China driving this growth.

**2014-2024 Annual MRO Spend By Region**

- **Highlights**
  - Highest % growth rates are the Middle East and China regions
  - Highest absolute growth (in $ terms) in Asia Pacific and China
  - 2024 annual spend in China and Asia Pacific combined $12B higher than in 2014

Source: ICF analysis
Forecast in 2014 $USD, exclusive of inflation * absolute growth in annual spend
Agenda

MRO Market Forecast & Trends

Trends
The aftermarket has evolved from being an *afterthought* to a market of significant *importance* and a *revenue* opportunity.

**The aftermarket has evolved from a cost centre to a highly competitive market**

### TRENDS

<table>
<thead>
<tr>
<th>1980 – 2000</th>
<th>Post-2000s</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Airlines</strong></td>
<td><strong>OEMs</strong></td>
</tr>
<tr>
<td>▪ Maintenance mainly a cost centre</td>
<td>▪ LCC’s drive new approach to managing maintenance - increased outsourcing</td>
</tr>
<tr>
<td>▪ Limited focus on aftermarket; Rolls-Royce ahead of the game</td>
<td>▪ Significant growth of point-of-aircraft sale MRO contracts by OEMs to recover design/development costs</td>
</tr>
<tr>
<td>▪ Supply mostly in-house – few large airline MRO suppliers and hugely fragmented independent sector</td>
<td>▪ Growth of integrated component services</td>
</tr>
<tr>
<td></td>
<td>▪ Globalization of demand</td>
</tr>
</tbody>
</table>

ICF International | icfi.com © ICF 2015
**Engine OEMs** have the most mature and strongest OEM position across the main air transport aftermarket segments

---

**Air Transport Supply (2015)**

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Engine overhaul</th>
<th>Component O&amp;R</th>
<th>Airframe Heavy</th>
<th>Line maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-OEM MRO</td>
<td>25%</td>
<td>40%</td>
<td>54%</td>
<td>18%</td>
</tr>
<tr>
<td>Airline in-house</td>
<td>20%</td>
<td>25%</td>
<td>44%</td>
<td>82%</td>
</tr>
<tr>
<td>OEM</td>
<td>55%</td>
<td>35%</td>
<td>2%</td>
<td>0%</td>
</tr>
</tbody>
</table>

---

**Highlights**

- OEMs tend to have the strongest share in the more material intensive markets (e.g. engine overhaul)
- Component OEM market share lower than engine OEMs
- Aircraft OEMs have an almost non-existent position in the airframe-related aftermarket

Source: ICF International
The ramp up and introduction of new generation aircraft creates the opportunity to change the aftermarket supply chain.

### Highlights

- New aircraft with higher reliability, lower manhours and complex technology change the business case for establishing MRO capability.
- ...especially with greater airline focus on financial returns.
- This is a catalyst to change the MRO supply model....
- Creating new opportunity for OEMs and aftermarket providers.

Source: ICF International
ICF believes there are three key trends that are defining the future of the Aftermarket:

1. Control of operational data
   Critical to success in market participation and in gaining operational feedback for design and reliability improvement

2. Control of the Workscope
   Critical to success in driving parts choice and aftermarket margins

3. Control of the Assets
   Critical to success in growing integrated service market
A key challenge for aviation stakeholders is how best to realize value from the terabytes of data being generated.

### Number of AHM Parameters
- **767**: 10,000
- **A320**: 15,000
- **787**: 100,000

### Transmittable Data (MB/Flt)
- **777**: < 1MB
- **787**: ~ 28MB

### Aircraft Data Generation (TB/Year)
- **2012**: ~ 11TB
- **2022**: ~ 137TB

~1,100% increase

Data ownership versus data access and use are of great concern to operators, and data processing business models are unproven (except at engine OEMs?).

Source: ICF Analysis
Aircraft OEMs are vying to use their leverage to become the arbiters of data for the connected airline...

**Boeing View of AHM System Architecture**

- **“Services by Airbus”:** Including E&M e-solutions
- **“Airbus Smarter Fleet” partnership with IBM:** integration of e-solutions

**Boeing EDGE:**
- Boeing EDGE: “Information Services”, the Digital Airline and Gold Care brands
- Notable Aircraft Health Management (AHM) successes

**Aircraft OEMs believe that their scale and position in the market make them a natural middleman for data aggregation and analysis**
Control of workscope is key to input decisions – hence the historic focus on this by engine OEMs and the former PMA “War”

**Typical Aftermarket Cost Breakdown**

- **Engine**
  - Labour: 20%
  - Materials: 80%

- **Components**
  - Labour: 45%
  - Materials: 55%

- **Airframe**
  - Labour: 80%
  - Materials: 20%

- **Line**
  - Labour: 85%
  - Materials: 15%

**Insight**

- For engine and component activity *“Whoever controls the workscope controls the parts decision”* – this is a key driver behind related OEM aftermarket strategies
- Use of PMA, repairs and surplus are important alternatives to OEM new parts

Source: ICF International
The share of integrated programs in component support is set to increase

Component Support Buying Behaviour

Integrated Component Programs Penetration

<table>
<thead>
<tr>
<th></th>
<th>777</th>
<th>787/A350</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004 Penetration</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2014 Penetration</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>2024 Penetration</td>
<td>80%</td>
<td>&gt;50%</td>
</tr>
</tbody>
</table>

Growth Drivers

- Small fleet size
- Perceived technology risk
- Improved ROIC
- Maintenance no longer core
- Predictable outgoings
- Attractive value propositions
- Lower investment, less infrastructure

Control of assets enables aftermarket players to support integrated programs more effectively – The more inventory held by a supplier, the lower the inventory cost per aircraft supported

Source: ICF International
Agenda

MRO Market Forecast & Trends

Takeaways
Today, airlines have strong ownership/control of their destiny, but do they make the most of it?

<table>
<thead>
<tr>
<th>Who controls the operational data?</th>
<th>Who controls the workscope?</th>
<th>Who controls the assets?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eng Comp Airframe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Airlines, as a buyer of aircraft and the owner of the operational data, should push the aftermarket supply chain...to benefit from better, more cost efficient solutions

Source: ICF International
The Airframe and Component OEMs – who have the most to gain – will be very active and focused on MRO moving forward

**TAKEAWAYS**

**CURRENT POSITION IN MARKET**

**WHO HAS MOST TO GAIN** *(example benefits)*

- Higher reliability (e.g., predictive maintenance)
- Lower costs (fuel, maintenance, less inventory)
- Operational data for feedback into design loop
- Increased revenue & margin
- Operational data for feedback into design loop
- Increased revenue & margin
- Reduce costs and improve competitiveness
- Market access

Source: ICF International
Large airline integrator MROs are well positioned – in contrast to independent MROs

**Takeaways**

- For Airline MROs, significant scale is a must for engine and component markets
- The business case for small airline MROs will erode significantly moving forward
- Independent MROs have to become the lowest cost producer and/or align with the large airlines or OEMs
TAKEAWAYS

In summary...

- Airlines have the opportunity to drive efficient solutions and competition into the aftermarket

- Airframe and Component OEMs will invest more and increase their focus on aftermarket especially on integrated component packages

- (Large) Airline MROs can and need to protect their market position versus the OEMs

- Scale and scope of assets under management is vital
**Last but not least**, it is very important not to forget the MRO market for current aircraft is large and growing.

**TAKEAWAYS**

...And the supply chain and competition for this current generation of aircraft is not changing so dramatically and is well served by all MROs.

**2014 Asia Pacific MRO Demand**
- Current Generation: 73%
- Old Generation: 24%
- New Generation: 3%
- Total: $16.9B

**2024 Asia Pacific MRO Demand**
- Current Generation: 73%
- Old Generation: 22%
- New Generation: 5%
- Total: $29.1B

Source: ICF International
Forecast in 2014 $USD, exclusive of inflation
Thank you!

For questions regarding this presentation, please contact:

David Stewart
Vice President
Aerospace & MRO Advisory

+44 (0)7770 410011
david.stewart@icfi.com

icfi.com/aviation
ICF International’s Aviation advisory services include the following:

- M&A Commercial Due Diligence
- MRO Market Research & Analysis
- Aerospace Manufacturing Strategy
- Aviation Asset Valuations & Appraisals
- MRO Cost & Performance Benchmarking
- MRO Information Technology (IT) Assessment
- MRO Strategic Sourcing Support
- Supply Chain Management
- LEAN Continuous Process Improvement
- Military Aircraft Sustainment