Today’s Agenda

- Industry Context
- MRO Market
- Trends To Watch
Industry Context...
Airlines are achieving historically high return on invested capital (ROIC) levels – there’s an evident correlation with changes in fuel costs.
Commercial aircraft OEM production backlog remains at historical record levels driven by:

- Emerging market growth
- High oil and commodity prices
- Introduction of new technology aircraft/engines
- Low interest rates

Source: CAPA, ICF Analysis
Continued low fuel costs are having, and will have, important repercussions for airlines, aviation and the MRO supply chain.
…such as an already visible drop in aircraft retirements

**Potential Impact:**

- Reduced part-out feed stock for surplus market
- Mature aircraft being placed with new operators
- Increase in airframe and engine MRO spend on older airframes
- Less pressure OEM new parts sales
- Higher used part values / pricing

**Commercial Air Transport Annual Aircraft Retirements**

- **# Retirements**
- **% Installed Fleet**

Source: Flight Global ACAS June 2015, CAPA, Airline Monitor, ICF Analysis
Thanks partially to these low fuel prices, airlines are anticipating record profits in 2016, especially in North America.

Source: IATA

Global Airline Profitability, 2004-2016
China’s seemingly insatiable demand for global commodities was a key driver of global economic growth...

...But now, after years of remarkable GDP growth, China’s economy has been steadily slowing.
China’s situation exacerbated the 54% fall in commodity prices in the past five years…

…which has had a dramatic impact on economies dependent on commodity exports

Source: Dow Jones Commodity Index
The increase in oil & gas market supply and reduced demand for commodities has led to a stronger US Dollar

**FOREX Impact**
- Partially offsets the positive impact of low fuel costs
- Increases the cost of dollar based parts and materials / flying hour agreements
- Buying/leasing aircraft becomes more expensive

Source: Oanda historical exchange rates, ICF International Analysis
These four industry factors are driving uncertainty…

But this has yet to impact the backlog materially - cancellations and deferrals will be vital harbingers of airline and supply chain confidence and outlook.
MRO Market
The current commercial air transport fleet consists of over 27K aircraft.
The combination of strong air travel demand and the need to replace ageing aircraft will drive fleet growth at 3.4% annually.

- Air traffic growth of ~4.1%
- Fuel costs in $55/bbl range
- ~19,600 aircraft deliveries
- ~8,800 aircraft retirements

**10 Year Global Air Transport Fleet Growth**

- **Africa**: 5% CAGR
- **Middle East**: 8% CAGR
- **Latin America**: 25% CAGR
- **Europe**: 31% CAGR
- **Asia Pacific**: 27% CAGR
- **North America**: 23% CAGR

**2015**
- 27,100 aircraft

**2025**
- 37,900 aircraft

**CAGR**
- Africa: 5.1%
- Middle East: 5.3%
- Latin America: 3.8%
- Europe: 2.5%
- Asia Pacific: 5.2%
- North America: 1.6%

Source: ICF International, CAPA 2015
Current air transport MRO demand is $64.3B; Asia Pacific is now equivalent to North America and Europe.
The global MRO market is expected to grow by 4.1% per annum to $96B by 2025.
The Asia Pacific fleet consists of nearly 7,300 aircraft, with 37% (approx. 2,700 aircraft) in China.
The Asia Pacific MRO market is expected to nearly double to approx. $32.2B by 2025, at 6.0% per annum.

Source: ICF International; Forecast in 2015 $USD, exclusive of inflation

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Over the next decade, China and Asia Pacific region will drive absolute MRO spend growth.

<table>
<thead>
<tr>
<th>Region</th>
<th>Difference in MRO Spend, 2025 vs. 2015 – By Global Region</th>
<th>$ USD Billions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia Pacific (excl China)</td>
<td></td>
<td>$7.9</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td>$6.4</td>
</tr>
<tr>
<td>Middle East</td>
<td></td>
<td>$5.2</td>
</tr>
<tr>
<td>North America</td>
<td></td>
<td>$3.2</td>
</tr>
<tr>
<td>Latin America</td>
<td></td>
<td>$2.6</td>
</tr>
<tr>
<td>Eastern Europe (incl CIS)</td>
<td></td>
<td>$2.2</td>
</tr>
<tr>
<td>Africa</td>
<td></td>
<td>$2.0</td>
</tr>
<tr>
<td>Western Europe</td>
<td></td>
<td>$1.2</td>
</tr>
</tbody>
</table>

Percent Change:
- Asia Pacific (excl China): 71%
- China: 93%
- Middle East: 103%
- North America: 17%
- Latin America: 73%
- Eastern Europe (incl CIS): 72%
- Africa: 85%
- Western Europe: 10%

Source: ICF International; Forecast in 2015 $USD, exclusive of inflation

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Trends To Watch
Challenge: Meeting customer needs across the lifecycle

Key issues:
- Managing changing operator MRO behaviour as aircraft mature
- Need to understand customer needs and develop value propositions to meet these needs
- Lessors play an increasingly important role and are considering the full lifecycle

Aircraft Lifecycle

Source: ICF International © ICF International 2016
Engine OEMs have been developing new value propositions

- Refinement of the cost per flight hour contract
- Trying to become more competitive in the mature phase
- Embracing surplus, module swaps, reduced workscopes

Example Engine OEM Aftermarket Products

- **TotalCare Life**
- **TotalCare Term**
- **TotalCare Flex**
- **Lessor Care**
- **Select Care**
- **MRO Services**

**Example OEM approaches:**

- Emphasising choice of service offerings and service providers
- Recognizing that customer needs change across the lifecycle
- Focusing on lessors, remarkability and residual values

**Example Engine OEM Aftermarket Products**

- **TrueChoice Flight Hour**
- **TrueChoice Overhaul**
- **TrueChoice Material**
- **TrueChoice Transactions**

- Various support options ranging from long-term fleet management programs to fixed price agreements to transactional services

Source: ICF Analysis
Trend Watch: New Technology Aircraft
In the next decade, the fleet of new generation aircraft fleet will grow by approx. 530% to nearly 19,000 aircraft globally, and by ~900% in Asia Pacific.
**Challenge:** How best to realize value from the disparate terabytes of data generated by new technology aircraft

**Stakeholder Battle:** Who will control and gain most from the operating data IP?
- Operators
- Lessors
- OEMs
- MRO Suppliers

### Aircraft Health Monitoring and Data Generation Outlook

<table>
<thead>
<tr>
<th>Number of AHM Parameters</th>
<th>Transmittable Data (MB/Flt)</th>
<th>A/C Data Generated (TB/Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>767: 10,000</td>
<td>&lt; 1MB</td>
<td>~ 11TB</td>
</tr>
<tr>
<td>A320: 15,000</td>
<td>~ 28MB</td>
<td>~137TB</td>
</tr>
<tr>
<td>B787: 100,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: ICF Analysis
For New Technology Aircraft MRO, there are three key battlegrounds

- This new world is already rapidly changing the competitive landscape
- The outcomes and winners in these battles will define the future “winning business models”

Implications of New Technology....

- Control of operational data
  - Critical to success in market participation and in gaining operational feedback for design and reliability improvement
- Control of the Workscope
  - Critical to success in driving parts choice and aftermarket margins
- Control of the Assets
  - Critical to success in growing integrated service market

Source: IATA
To win these in these battlegrounds, Big Data analytics is a key enabler

- Aircraft health monitoring
- Predictive maintenance
- Inventory optimization

Leading to...

- Improved aircraft availability
- Cost control

- GE is leveraging the Predix software platform, Rolls-Royce is partnering with Microsoft and Pratt & Whitney is working IBM

Big Data Analytics

Aircraft Health Monitoring

- Control of operational data

Inventory Optimization

- Control of the Workscope

Predictive Maintenance

- Control of the Assets
Airlines stand to benefit the most and they own the data…the challenge for MROs is whether and how to take a lead, and add value

- What technology to deploy and when?
- Which partners?
- What commercial and business model?
- Which solutions are going to win?

The Challenge…

AIRLINES own the data and have the most to gain e.g., improved reliability

ENGINE & AIRFRAME OEMs see themselves as the natural arbiter for leveraging the data

MROs with large fleets under management can leverage and benefit from Data Analytics

Other MROs risk losing the data access and “intelligence” to optimize performance and costs
Trend Watch: Aircraft Modifications
Modifications growth is being impacted by three mutually reinforcing drivers:

- **Low fuel prices** – airlines keeping older planes longer
- **New aircraft introduction** – need for commonality of customer offering across fleet
- **Airline determination to differentiate** via competitive (latest technology) on-board offer
Modifications growth is expected to be 5.3% per annum

- Latest lie-flat seats are now the minimum standard for business
- Premium economy
- Wi-Fi, on-board connectivity
- Coming soon: ADS-B Mod program
- Capacity (ASM/K) increase

Source: ICF Analysis, constant 2015 US$
Modifications demand includes labor and material spend
*Passenger-To-Freighter Conversions
**Airworthiness Directives / Service Bulletins
Cabin modifications including new slim line seats and fixtures - have enabled capacity up-gauging and cabin “densification”, driving lower unit cost and facilitating bottom line growth.
Trend Watch: Airframe OEMs
The Airframe OEMs have demonstrated the strength of their ambition to participate strongly in the aftermarket.

- Airbus Vision: 25% services by 2020
- Satair acquisition (2011)
- First FHS contract in 2008; multiple wins since
- Services by Airbus launched in 2015

- EDGE launched in 2012
- Major player in flight training, distribution, and consumables management
- Growing number of Goldcare contracts; SIAEC joint venture

Source: ICF Analysis, company web sites
Growing Airframe OEM presence in the aftermarket has created uncertainty and poses challenging strategic questions for each industry participant.

**Component OEMs**
- Which integrators to work with – the airlines and/or Airframe OEMs?

**Independent MROs**
- Which will survive?
- What niches to pursue?
- What partnership strategy?

**Airframe OEMs**
- Will Airframe OEMs succeed in establishing share and enduring success in the MRO market?

**Integrators**
- How best to secure capability on new platforms?
- Airframe OEMs – customer, supplier or competitor?
- Who best to partner with?
Implications
The Air Transport MRO market outlook remains robust with expected growth of 4.1% per annum

The Asia Pacific and China markets will see the largest growth in MRO spend at 6.2% per annum

OEMs and MROs are promoting new value propositions to better meet operator and lessor needs across the lifecycle (and signing new partnerships along the way)

Growth in New Technology Aircraft will bring change. With a new competitive ecosystem, MROs need to identify “how to win” and invest to maintain leadership

In Conclusion…
THANK YOU!  QUESTIONS?

MRO Forecast & Key Trends
Singapore – 26 September 2016
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