MRO Forecast and Market Trends

Presented by:
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Today’s Agenda

- Follow the Money
- MRO Forecast
- Impact of New Technology Aircraft

Trends to Watch:
- *The Mod Squad*
- *March of the Middle East Titans*
- *Amazon the Disrupter*
- *Training 2.0: Virtual Reality*
Follow the Money
Airlines are achieving historically high return on invested capital (ROIC) levels, and clearly correlated with the drop in fuel costs.
Driven by the significant drop in fuel costs and consolidation, the airline industry is achieving record profitability.

These are good days for some, but not all…

Source: IATA, ICF analysis

Global Airline Profitability, 1996 - 2016F

Latin Am. / Africa = $0.3B
Middle East, $1.7B
Asia Pacific, $6.6B
Europe, $8.5B
North America, $19.2B

$36.3B
However, profit margin improvement has been largely limited to carriers in North America and Europe.

Source: IATA, ICF Analysis
Four external macro-economic forces are having a significant impact on the aviation industry.

### Fuel Costs

**U.S. Gulf Coast Jet Fuel Price per Gallon**

- **Graph:**
  - Y-axis: $ USD
  - X-axis: Year
  - Trends show a significant decline (~66%)

### China’s Economic Slowdown

**China GDP Year-on-Year Growth (%)**

- **Graph:**
  - Trends show a decline in growth from 16% to 5%

### Currency Exchange Rates

**Global Currency Exchange Rates vs USD**

- **Graph:**
  - % Value Change, April 2014 – April 2016
  - **The “CRABS”**

### Global Commodity Prices

**Dow Jones Commodity Indices (DJCI)**

- **Graph:**
  - Indexes from January 2011 indexed to 100
  - Trends show a significant decline (~54.0%)

*Source: ICF analysis*
The dramatic increase in oil & gas market supply and reduced demand for commodities has led to a strong US Dollar

**FOREX Impact**
- Partially offsets the positive impact of low fuel costs for operators
- Increases the cost of dollar based flight hour agreements (and parts/material in general)
- Cost of labor for in-country MROs is cheaper driving up margins for US dollar based contracts
- Buying/leasing aircraft becomes more expensive

**The “CRABS”: Countries with economies that are heavily dependent on commodity exports**

Global Currency Exchange Rates vs USD
% Value Change, April 2014 – April 2016

- Russian Ruble -87.1%
- Brazilian Real -62.2%
- S. African Rand -35.8%
- Can Dollars -23.6%
- Aus Dollars -20.4%
- Euro -16.9%
- British Pound -15.5%
- Indian Rupee -10.3%
- Japanese Yen -9.0%
- Chinese Yuan -4.8%

Source: Oanda historical exchange rates, ICF analysis
Airlines with the highest net income are concentrated in North America.

Source: Airline Weekly, Airline Monitor, ICF Analysis
Excludes Special Items

Top 5 Profitable Airlines by Net Profit (2015) & by Global Region
Airlines with the highest profit margins tend to be LCCs

Top 5 Profitable Airlines by EBIT Profit Margin (2015) & Global Region

Source: Airline Weekly, Airline Monitor, ICF Analysis
Airlines are investing their newly found profits in three primary areas:

1. **Capex ~ 49%:**
   - Fleet renewal,
   - Airport facilities & lounges
   - Cabin modifications, etc.

2. **Investors ~ 34%:**
   - Debt repayment
   - Stock buybacks
   - Dividends

3. **Employees ~ 17%:**
   - Profit sharing
   - Wage increases & bonuses
   - New hiring

Source: ICF Analysis
The current commercial air transport fleet consists of over 27K aircraft.

**2015 Global Commercial Air Transport Fleet**

- **27,114 Aircraft**
  - Narrowbody Jet: 53% (14,440)
  - Widebody Jet: 19% (5,226)
  - Regional Jet: 14% (3,832)
  - Turboprop: 14% (3,832)

**By Aircraft Type**

- **27,114 Aircraft**
  - North America: 31% (8,389)
  - Asia Pacific: 27% (7,501)
  - Europe: 25% (6,897)
  - Latin America: 8% (2,173)
  - Middle East: 5% (1,356)
  - Africa: 5% (1,356)

**By Global Region**

Source: CAPA 2015
Current air transport MRO demand is $64.3B; Asia Pacific is now equivalent to North America and Europe.
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

<table>
<thead>
<tr>
<th>Region</th>
<th># Aircraft (2025)</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>5%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Middle East</td>
<td>8%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Latin America</td>
<td>25%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Europe</td>
<td>23%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>32%</td>
<td>5.2%</td>
</tr>
<tr>
<td>North America</td>
<td>26%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

Source: ICF International, CAPA 2015
The global MRO market is expected to grow by 4.1% per annum to $96B by 2025.

Source: ICF International; Forecast in 2015 $USD, exclusive of inflation
Over the next decade, China and Asia Pacific region will drive absolute MRO spend growth.

Difference in MRO Spend, 2025 vs. 2015 – By Global Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Difference</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia Pacific (excl China)</td>
<td>$6.4</td>
<td>71%</td>
</tr>
<tr>
<td>China</td>
<td>$7.9</td>
<td>93%</td>
</tr>
<tr>
<td>Middle East</td>
<td>$5.2</td>
<td>103%</td>
</tr>
<tr>
<td>North America</td>
<td>$3.2</td>
<td>17%</td>
</tr>
<tr>
<td>Latin America</td>
<td>$2.6</td>
<td>73%</td>
</tr>
<tr>
<td>Eastern Europe (incl CIS)</td>
<td>$2.2</td>
<td>72%</td>
</tr>
<tr>
<td>Africa</td>
<td>$2.0</td>
<td>85%</td>
</tr>
<tr>
<td>Western Europe</td>
<td>$1.2</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: ICF International; Forecast in 2015 $USD, exclusive of inflation
Among the top ten airframe MRO providers, two Asia based MROs account for 50% of heavy airframe check man-hours performed in 2014.
Impact of New Technology Aircraft
In the next decade, the global fleet of new generation aircraft fleet will grow by approx. 531% to nearly 19,000 aircraft.
Over the next decade, MRO spend on new technology A350 & Boeing 787 aircraft will double every three years.

10-Year MRO Spend for New Technology A350 & 787 Aircraft

$ USD Billions

- RoW
- North America
- Europe
- Middle East
- Asia Pacific

Source: ICF International; Forecast in 2015 $USD, exclusive of inflation, includes Boeing 787 and Airbus A350.
New technology aircraft challenge traditional MRO sourcing strategies

Return on investment challenges:
- Facilities
- Tooling & Equipment
- Training
- IT Systems

Cost Savings: ~65% fewer routine airframe heavy maintenance man-hours drives an estimated savings of ~$3.5M

Asset Utilization: ~90 additional available flying days enables increased revenue generation potential

*Based on 4,000 FH/yr utilization
767 C-check = 18mo, 4C = 72mo; 787 C-check = 36mo, 4C = 144mo
Assumed industry standard labor man-hour rate
Aircraft out of Service (AoS) calculated for C/4C/8C checks assuming industry standard MRO hangar productivity
Challenge: How best to realize value from the disparate terabytes of data generated by new technology aircraft

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

Number of AHM Parameters
- A320: 15,000
- B787: 100,000
- 767: 10,000

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

A/C Data Generated (TB/Year)
- 777: ~ 28MB
- 787: ~ 11TB
- B787: ~ 1100%
- A320: ~ 137TB

Source: ICF Analysis
Trends to Watch...
Modifications growth is driven by airlines seeking differentiation in the cabin and customer experience.

MRO modification market growth drivers include:

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

Modifications demand includes labor and material spend:

*Passenger-To-Freighter Conversions
**Airworthiness Directives / Service Bulletins
Source: ICF analysis, constant 2015 US$

### Commercial Air Transport Modifications Forecast

<table>
<thead>
<tr>
<th>Year</th>
<th>AD/SB**</th>
<th>PTF Conversions*</th>
<th>Painting</th>
<th>Avionics Upgrades</th>
<th>Interiors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>$0.3</td>
<td>$0.4</td>
<td>$0.4</td>
<td>$0.6</td>
<td></td>
<td>$2.7</td>
</tr>
<tr>
<td>2025</td>
<td>$0.5</td>
<td>$0.4</td>
<td>$0.5</td>
<td>$1.1</td>
<td></td>
<td>$7.4B</td>
</tr>
</tbody>
</table>

CAGR:

- AD/SB**: 3.6%
- PTF Conversions*: 0.0%
- Painting: 3.7%
- Avionics Upgrades: 6.9%
- Interiors: 5.9%
- Total Average: 5.3%
Cabin “densification” has emerged as an effective strategy for airlines to increase capacity and drive bottom line growth.

The Mod Squad!

2015 - 2025 Capacity Bridge

<table>
<thead>
<tr>
<th>2015 ASMs</th>
<th>2025 ASMs</th>
</tr>
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<tbody>
<tr>
<td>6.2T</td>
<td>8.8T</td>
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Fleet Growth: 84%

Longer Stage Lengths: 8%

Increased Seat Density: 8%

Example: Delta A320 Interior Modification Program

- Total = 150 Seats
  - 12 Seats
  - 18 Seats
- Total = 164 Seats
  - 16 Seats
  - 18 Seats
  - 120 Seats
  - 130 Seats

New seats, outlets, IFE, overhead bins

Space-saving galley to add a row of seats

Source: ICF analysis, delta.com
After positive signs in 2014, Air cargo capacity continues to outpace freight growth.

Amazon is investing in airplanes - takes ownership stake in two North American cargo carriers; Atlas Air & ATSG.

Source: IATA, ICF Analysis
Middle East carriers have been very effective in capturing valuable secondary airport traffic from Europe to Asia.

Lufthansa’s Frankfurt hub has lost nearly a 3rd of its market share on routes between Europe and Asia since 2005, with more than three million people now flying annually from Germany to other destinations via Gulf hubs – The Economist.

Source: OAG Data, ICF International Analysis
ICF believes that virtual reality (VR) technology will be as disruptive to MRO training as 3D-printing is to parts manufacturing.
THANK YOU!

For questions regarding this presentation, please contact:

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