MRO Market Update & Industry Trends

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Today’s Agenda

Bizarro Aviation

- The “CRABS”
- Meet the Frackers
- These are the Good Old Days
- Follow the Money
- Amazon the Air Cargo Disruptor
- March of the Middle East Titans
- A New Golden Age of Aircraft Cabin Interiors

MRO & OEM Alternative Material Forecast
“Bizarro Aviation”
Four external macro-economic forces are having a significant impact on the aviation industry and the MRO supply chain.

**Fuel Costs**
U.S. Gulf Coast Jet Fuel

**China’s Economic Slowdown**
China GDP Year-on-Year Growth

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

**Global Commodity Prices**
Dow Jones Commodity Indices (DJCI) (September 2011 indexed to 100)

*The “CRABS”*

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

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

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

<table>
<thead>
<tr>
<th>Currency</th>
<th>Value Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian Ruble</td>
<td>-37.6%</td>
</tr>
<tr>
<td>Brazilian Real</td>
<td>-24.6%</td>
</tr>
<tr>
<td>S. African Rand</td>
<td>-19.1%</td>
</tr>
<tr>
<td>Can Dollars</td>
<td>-15.3%</td>
</tr>
<tr>
<td>Aus Dollars</td>
<td>-12.5%</td>
</tr>
<tr>
<td>Euro</td>
<td>-11.7%</td>
</tr>
<tr>
<td>Indian Rupee</td>
<td>-7.8%</td>
</tr>
<tr>
<td>Chinese Yuan</td>
<td>-7.8%</td>
</tr>
</tbody>
</table>

Source: USForex, ICF analysis
Commercial aircraft OEM production backlog remains at historical record levels driven by:

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

Source: CAPA, ICF Analysis
Low fuel costs appear to be reversing aircraft retirements trends

**Industry Impact:**

- **MRO Suppliers - Positive:** Increased spend on older airframes & engines
- **Surplus Market - Negative:** Reduced part-out “feed stock”
  - OEMs: Improved new part sales
  - Distributors: Improved used part values / pricing
  - Operators: Increased material costs

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Source: CAPA, Airline Monitor, ICF analysis
Airline return on invested capital (ROIC) is clearly correlated with the drop in fuel costs.

**Fuel Price as a % of Airline Operating Expenses**

<table>
<thead>
<tr>
<th>Year</th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>17%</td>
<td>22%</td>
<td>28%</td>
<td>30%</td>
<td>36%</td>
</tr>
<tr>
<td>2006</td>
<td>28%</td>
<td>30%</td>
<td>36%</td>
<td>28%</td>
<td>28%</td>
</tr>
<tr>
<td>2008</td>
<td>31%</td>
<td>33%</td>
<td>31%</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td>2010</td>
<td>32%</td>
<td>33%</td>
<td>33%</td>
<td>32%</td>
<td>28%</td>
</tr>
<tr>
<td>2012</td>
<td>31%</td>
<td>33%</td>
<td>33%</td>
<td>32%</td>
<td>28%</td>
</tr>
<tr>
<td>2014</td>
<td>31%</td>
<td>33%</td>
<td>33%</td>
<td>32%</td>
<td>28%</td>
</tr>
<tr>
<td>2016F</td>
<td>31%</td>
<td>33%</td>
<td>33%</td>
<td>32%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Source: IATA, ICF Analysis
Airline return on invested capital (ROIC) is clearly correlated with the drop in fuel costs.

Source: IATA, ICF Analysis
Driven by low fuel costs and consolidation, airline the industry is on target to achieve record profitability in 2016 of almost $40B USD.

These are the “good old days: - for some airlines…

Global Airline Profitability, 1996 - 2016F

Source: IATA, ICF analysis
However, profit margin improvement has been largely limited to carriers in North America.

...but not all – many airlines continue to struggle.

Global Airline EBIT Margin by Region

Source: IATA, ICF Analysis
Brexit has clearly had an impact on European airline stock performance; specifically UK based carriers.

Share Performance of European Airlines Since Brexit
23 June 2016 – 13 October 2016

<table>
<thead>
<tr>
<th>Airline</th>
<th>Share Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy Jet</td>
<td>-41.5%</td>
</tr>
<tr>
<td>IAG</td>
<td>-28.1%</td>
</tr>
<tr>
<td>Air France-KLM</td>
<td>-24.8%</td>
</tr>
<tr>
<td>Wizz</td>
<td>-23.2%</td>
</tr>
<tr>
<td>Norwegian</td>
<td>-16.5%</td>
</tr>
<tr>
<td>Ryan Air</td>
<td>-16.2%</td>
</tr>
<tr>
<td>Lufthansa</td>
<td>-15.2%</td>
</tr>
<tr>
<td>SAS</td>
<td>-6.3%</td>
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</table>

Source: Company websites
Follow the Money: Airlines are spending their hard earned profits in three primary areas

1. Labor ~ 20%:
   - Profit sharing
   - Wage increases

2. Capex ~ 38%:
   - Fleet renewal & cabin upgrades
   - Facilities, offices, lounges
   - Equity partner investments

3. Investors ~ 42%:
   - Stock buy-backs
   - Dividends
   - Debt repayment

Source: Company Reports, ICF Analysis
After positive signs in 2014, air cargo supply continues to exceed demand.

South Korea’s Hanjiin Shipping Co., one of the world's largest container shipping companies, has filed for bankruptcy protection.

Global Freight Traffic (FTK) and Capacity Growth (AFTK)

Year-Over-Year Percent Change

Traffic (FTK)
Capacity (AFTK)

Source: IATA, ICF Analysis
Amazon is very well positioned to lead a major disruption of the air cargo industry.

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

Amazon’s Growing Revenue & Shipping Costs

Source: Amazon SEC Filings
March of the Middle East Titans:

Middle East carriers have been very effective in capturing valuable business passenger traffic from European secondary airports.

“…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 via Gulf hubs” – The Economist

Source: OAG Data, ICF Analysis
Trend Watch: A New Golden Age of Aircraft Cabin Interiors
Modifications growth is driven by airlines seeking differentiation in the cabin and customer experience.

**MRO modification market growth drivers include:**

- Premium 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

**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>$2.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$4.4B</td>
</tr>
<tr>
<td>2025</td>
<td>$7.4B</td>
<td></td>
<td>$0.5</td>
<td>$0.4</td>
<td>$0.5</td>
<td>$4.9</td>
</tr>
</tbody>
</table>

\[ CAGR \]

- AD/SB**: 3.6%
- PTF Conversions*: 0.0%
- Painting: 3.7%
- Avionics Upgrades: 6.9%
- Interiors: 5.9%
- Total: 5.3% Avg.

Modifications demand includes labor and material spend

*Passenger-To-Freighter Conversions

**Airworthiness Directives / Service Bulletins

Source: ICF analysis, constant 2015 US$
Cabin “densification” has emerged as a cost-effective strategy for airlines to increase capacity and drive bottom line growth.

**Cabin Upgrades:**
- Slim seats
- Slim lavatories
- Slim galleys
- Slim coat closets

### 2015 - 2025 Capacity Bridge

- **2015 ASMs**: 6.2T
- **2025 ASMs**: 8.8T
- **Fleet Growth**: 84%
- **Increased Seat Density**: 8%

### Example: Delta A320 Interior Modification Program

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

**New seats, outlets, IFE, overhead bins**

**Space-saving galleys to add a row of seats**

Source: ICF analysis, delta.com
The current commercial air transport fleet consists of over 27K aircraft; over half are narrowbody aircraft.
The combination of strong air travel demand and the need to replace ageing aircraft will drive fleet growth at a healthy 3.4% annually.

Source: ICF analysis: CAPA 2015
Current commercial air transport MRO demand is $64.3B; with Asia equivalent to North America and Europe in market size.
The global MRO market is expected to grow by 4.1% per annum to $96B by 2025

- Engine and component MRO markets remain the largest segments
- Modifications market will see the strongest growth (e.g. interiors, connectivity)
- Airframe market slows due to reduced man-hour intensity and increased check intervals as new fleets are introduced

Source: ICF analysis; Forecast in 2015 $USD, exclusive of inflation
There are two primary reasons operators are aggressively seeking non-OEM supplied parts:

1. **Cost savings**
2. **Part availability**

### Three alternatives to purchasing OEM-supplied parts:

<table>
<thead>
<tr>
<th>Surplus</th>
<th>DER Repair</th>
<th>PMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three types of surplus material:</td>
<td>DER (Designated Engineering Representatives), FAA approved engineers who can approve technical data for repairs and modifications outside the CMM</td>
<td>PMA (Parts Manufacturer Approval) is approval granted by the FAA to a non-OEM manufacturer of aircraft parts</td>
</tr>
<tr>
<td>1. Used Serviceable Material (USM)</td>
<td>2. New Material</td>
<td>Two types of PMA:</td>
</tr>
<tr>
<td>3. Used, unserviceable material</td>
<td>4. Design Organization Approval (DOA), a blanket approval for an MRO organization to develop internal repairs</td>
<td>1. Licensed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Competitive</td>
</tr>
</tbody>
</table>

**Source:** ICF analysis
The alternative material market is concentrated on the back half of mature aircraft lifecycle (17-25 years old aircraft) and early sunset aircraft.

Bubble size proportional to MRO spend

Limited OEM Alternatives  Growth Phase  Healthy OEM Alternative Market

Source: ICF analysis

* New: CFM56-5B / V2500-A5 / PW6000
  Old: CFM56-5A / V2500-A1
In 2015, operators spent over $32B on OEM new parts and an additional $13B on alternatives.

“...the OEM’s increasingly tight grip on the aftermarket means Delta’s spares costs double about every seven years.”

“Without TechOps parting-out engines to bolster spares and coming up with other alternatives to OEM-supplied support, that increase could be even steeper...”

...“We’re pretty good at sourcing outside the OEMs...and we’re always working to develop those alternatives.”

- Richard Anderson
CEO Delta Air Lines
Keynote Speech, MRO Americas
April 2013
There are nearly 1.1 million total PMA parts that are FAA approved, of which over 75% are for Boeing aircraft.

Source: Federal Aviation Administration
The volume of PMA approvals has been steadily growing since 1990, with over about 440,000 new approvals granted since 2011.
Surplus material usage has risen sharply over the past few years, driven by tangible cost savings and minimal perceived risk.

“Surplus parts have increased the demand for component DER... because the unserviceable surplus parts must repaired. The biggest customer for DER is ourselves.”

- Major PMA / DER Supplier

Source: ICF analysis
Numerous regional factors influence operator PMA consumption to include:

- Fleet age
- Mix of lease vs owned aircraft
- Technical capability & experience
- Airline procurement historical practices and culture

Virtually every major carrier leverages PMA parts as an OEM alternative

*Estimated PMA Demand by Major Region*

Source: ICF analysis
In Summary…

- In order to control and reduce material spend, airlines must have a comprehensive OEM alternative strategy.

- PMA parts, DER repairs, and surplus material are valuable material sourcing solutions that drive tangible cost savings and improve part availability.

- Safety concerns with regards to OEM alternative material usage have demonstrated to be meritless; yet clearly perceptions of risk remain.

- As long as certain airlines continue to have restrictive PMA policies, Lessors will continue to include conservative language in their lease agreements.

- Continued education is the only solution.
THANK YOU!

For questions regarding this presentation, please contact:

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