TURBULENCE AHEAD
DISENGAGE THE AUTOPILOT

2015-2025 GLOBAL FLEET & MRO MARKET FORECAST

Tuesday, October 13th 2015

Christopher Doan
Vice President
Oliver Wyman acquired TeamSAI and integrated the business into CAVOK, its aviation technical consulting and services practice.

~150 Dedicated CAVOK employees located in DFW and ATL (Supported by +250 Oliver Wyman aviation consultants)

+2,300 years of combined airline operations expertise

+70% of CAVOK staff hold FAA certification/license

Global Fleet & MRO Market Outlook
The global air transport jet and turboprop fleet will grow by more than 10,000 net new aircraft by 2025

2015-2025 Global Fleet Forecast by Aircraft Class

The growth outlook, however, varies widely from region to region.

Key Fleet Forecast Growth Rates

- Global fleet will grow on average 3.7% annually over the full forecast period
- Passenger fleet expected to grow at 3.8% annually
- Cargo fleet forecast to grow by 2.3% annually
- Narrowbody aircraft will lead the growth
- Regional jets will actually decline in the mix
A 5 pt spread in regional growth rates leads to a significant share shift over the decade ahead

<table>
<thead>
<tr>
<th>Region</th>
<th>2015 Fleet Size</th>
<th>10YR CAGR</th>
<th>2015-2025 Absolute Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>7,420</td>
<td>0.9%</td>
<td>722</td>
</tr>
<tr>
<td>Europe</td>
<td>6,131</td>
<td>2.8%</td>
<td>1,965</td>
</tr>
<tr>
<td>Latin America &amp; the Caribbean</td>
<td>1,720</td>
<td>4.7%</td>
<td>997</td>
</tr>
<tr>
<td>Africa / Middle East</td>
<td>2,204</td>
<td>5.5%</td>
<td>1,562</td>
</tr>
<tr>
<td>Asia Pacific / China / India</td>
<td>6,452</td>
<td>6.1%</td>
<td>5,235</td>
</tr>
</tbody>
</table>

The mature North American and Western European markets will continue to undergo significant refleeting efforts during the next 10 years.
A 5 pt spread in regional growth rates leads to a significant share shift over the decade ahead.

The mature North American and Western European markets will continue to undergo significant refleeting efforts during the next 10 years.

The mature North American and Western European markets will continue to undergo significant refleeting efforts during the next 10 years.
43% of all new aircraft deliveries will replace old technology aircraft over the forecast period.

The systematic elimination and replacement of older aircraft with new technology aircraft will drive significant change is the business for airlines and maintainers.
43% of all new aircraft deliveries will replace old technology aircraft over the forecast period.

The systematic elimination and replacement of older aircraft with new technology aircraft will drive significant change is the business for airlines and maintainers.
The result is a staggering change in fleet mix by 2025

The significant move towards late generation aircraft, in addition to improving airline costs, will undoubtedly impact MRO dynamics.
The fleet dynamics of the period result in a forecast that tops $100 billion by 2025, a 4.1% average annual growth rate.

Airframe Heavy Maintenance costs improve with the new technology while both Engine and Component sectors will take a larger share.
Shadowing the fleet trends, large differences in regional growth rates will lead to a significant shift in MRO demand over the decade ahead.

<table>
<thead>
<tr>
<th>Region</th>
<th>2015 MRO Spend ($USD)</th>
<th>10YR CAGR</th>
<th>2015-2025 Absolute Growth ($USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>$20.0</td>
<td>0.6%</td>
<td>$1.3</td>
</tr>
<tr>
<td>Europe</td>
<td>$17.9</td>
<td>3.3%</td>
<td>$7.0</td>
</tr>
<tr>
<td>Latin America &amp; the Caribbean</td>
<td>$3.2</td>
<td>7.3%</td>
<td>$3.3</td>
</tr>
<tr>
<td>Africa / Middle East</td>
<td>$7.5</td>
<td>5.5%</td>
<td>$5.3</td>
</tr>
<tr>
<td>Asia Pacific / China / India</td>
<td>$18.3</td>
<td>6.6%</td>
<td>$16.5</td>
</tr>
</tbody>
</table>

Asia Pacific / China / India will be challenged to build the necessary infrastructure capable of handling the volume of MRO the combined region will demand.
Shadowing the fleet trends, large differences in regional growth rates will lead to a significant shift in MRO demand over the decade ahead.

<table>
<thead>
<tr>
<th>Region</th>
<th>2025 MRO Spend ($USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>$21.3</td>
</tr>
<tr>
<td>Europe</td>
<td>$24.9</td>
</tr>
<tr>
<td>Latin America &amp; the Caribbean</td>
<td>$6.5</td>
</tr>
<tr>
<td>Africa / Middle East</td>
<td>$12.8</td>
</tr>
<tr>
<td>Asia Pacific / China / India</td>
<td>$34.8</td>
</tr>
</tbody>
</table>

Asia Pacific / China / India will be challenged to build the necessary infrastructure capable of handling the volume of MRO the combined region will demand.
European MRO Market Outlook
Passenger traffic is picking up; however, the fleet growth will be constrained over the next 10 years as half of all the new aircraft deliveries are slated to replace aging aircraft.

- **2015 PASSENGER TRAFFIC (RPK) GROWTH**: 6.8%
- **2015 CURRENT FLEET**: 6,131
- **2015-2025 FLEET CAGR**: +2.8%
- **2015-2025 AIRCRAFT DELIVERIES**: 4,100+
- **2015-2025 AIRCRAFT RETIREMENTS**: 2,100+
$2.9B in MRO from ’70s and ’80s vintage aircraft will be lost over the next 10 years; however, ’90s, ’00s and ’10s vintage aircraft will see a $9.9B increase

Top 10 European Aircraft Families in 2015

A320C/NEO
737NG/MAX
777
747
A330
A340
737CL
757
767
EJET

Top 10 European Aircraft Families in 2025

A320C/NEO
737NG/MAX
777
A330
787
A350
A340
A380
EJET
Oil prices have plummeted over the past year and could remain low over the short term. Many are concluding that this will cause airlines to alter fleet plans and drive an increase in MRO.

**Crude Oil Spot Price per Gallon**

<table>
<thead>
<tr>
<th>Spot Price per Gallon ($USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3.00</td>
</tr>
<tr>
<td>$2.50</td>
</tr>
<tr>
<td>$2.00</td>
</tr>
<tr>
<td>$1.50</td>
</tr>
<tr>
<td>$1.00</td>
</tr>
<tr>
<td>$0.50</td>
</tr>
</tbody>
</table>

**Aircraft Profitability Curve**

Current Generation vs New Generation

<table>
<thead>
<tr>
<th>Utilization in Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000</td>
</tr>
<tr>
<td>2,800</td>
</tr>
<tr>
<td>3,600</td>
</tr>
<tr>
<td>4,400</td>
</tr>
</tbody>
</table>

Jet-A Spot Price per Gallon ($USD)

New gen aircraft are more profitable than current gen

Our view: Long term, oil prices will likely recover, OEM order books will remain largely unaffected, and net fleet growth will progress as forecasted.
With just over half of the new deliveries forecast to replace older aircraft, the MRO forecast is constrained; however, a 3.3% growth rate is very healthy for what is largely a mature region.

**2015-2025 European MRO Market Forecast**

**by MRO Segment**

Despite the solid growth, aftermarket participants will likely still need to have an aggressive and innovative plan to maintain market share.
Fleet changes and technological advances will create turbulence for the MRO business

**OEM’s increased aftermarket presence**
- Increased aftermarket market share for the newest generation of aircraft

**New repair capabilities required**
- Decisions necessary enter new markets for each of airframe, engine and component repairs

**Less maintenance**
- Health monitoring and predictive maintenance will reduce overall time-on-tool requirements for individual checks with fewer repairs

**Increased use of data analytics**
- Critical new source of value to the aftermarket driven by those who design the best algorithms and most rigorous data management

Market participants will need aggressive and innovative plans for growth
Oliver Wyman’s 2015 MRO Survey identified a slew of new technologies that are poised to come to market.

**Most prominent new technologies by 2020 (All respondents)**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft Health Monitoring Systems</td>
<td>66%</td>
</tr>
<tr>
<td>Predictive Maintenance</td>
<td>66%</td>
</tr>
<tr>
<td>“Live” maintenance through wearable and mobile technology</td>
<td>57%</td>
</tr>
<tr>
<td>Composite repair capabilities</td>
<td>35%</td>
</tr>
<tr>
<td>New repair technology</td>
<td>26%</td>
</tr>
<tr>
<td>Additive manufacturing</td>
<td>25%</td>
</tr>
<tr>
<td>Artificial intelligence</td>
<td>6%</td>
</tr>
<tr>
<td>Drone-supported maintenance</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: Oliver Wyman’s 2015 MRO Survey
The collection, storage, aggregation and analysis of data will be key factors in aircraft health monitoring and predictive maintenance.

Who is best positioned within the industry to benefit from predictive maintenance?

- **Airlines**: 65%
- **OEMs**: 19%
- **Too early to predict**: 9%
- **MROs**: 7%
- **PMA Manufacturers**: 0%

Source: Oliver Wyman’s 2015 MRO Survey
However, digesting innovative change is not standard fare for the MRO industry...

Survey respondents completed this sentence: “The MRO industry innovates…”

- ... periodically: 39%
- ... sporadically: 27%
- ... primarily as a response to OEM innovation: 21%
- ... frequently: 13%

- Historically, little need to build internal organizations devoted to R&D, corporate strategy and product development
- Lack of regular disruptions decrease relative:
  - Devoted resources
  - Tried and tested review processes
  - Time and attention of executives
  - Clarity of ownership / leadership
  - Assessment infrastructure
- Internal ability to recognize, assess and prepare for change is not a core capability for the industry

Source: Oliver Wyman’s 2015 MRO Survey
...and though they have a vision, many organizations struggle with how to rapidly evaluate and bring innovative ideas to market

Positive survey responses

- **Top management has a clear, shared vision and strategy for growth in new business areas**
  - 76%

- **Use a strategic planning method to visualize areas of opportunity and identify the most promising prospects**
  - 68%

- **Our innovation process allows us to quickly translate identified opportunities into plans and get sign-off**
  - 43%

- **We quickly pilot ideas and roll out fast-to-market programs**
  - 33%

Source: Oliver Wyman’s 2015 MRO Survey
So what’s really inhibiting change in MROs?

The primary inhibitors of innovation at my organization are:

- Budget / capital availability: 50%
- Inability to prove innovative process / product / service will offer margin benefits over current techniques: 44%
- Total cost / lack of clear payback: 44%
- Organization resistance: 35%
- Review and approval process: 32%
- Lack of personal capability: 21%
- Implementation difficulties: 21%
- Lack of need for change: 6%

How can you eradicate these barriers within your own organization?

Note: Responses to the question: “The primary inhibitors of innovation at my organization are:”, Percent of MRO responses per inhibitor (multiple selections possible per category). Not shown “Other” responses from a total of 9% of respondents; Source: Oliver Wyman’s 2015 MRO Survey
New technologies will reshape our perception of MRO aftermarket commercial offers.

Advances could cut or redistribute 15 to 20 percent of MRO spend, but also spawn new business models and revenue streams.
Take the controls and make strategic investments now:
Technologies will likely come online faster than anticipated

**Additive Manufacturing (3D Printing)**
- Quickly gaining traction
  - A350 will feature 3D-printed plastic and metal brackets
  - GE will introduce 3D-printed fuel nozzles in its CFP LEAP engine
  - Out-of-production parts can be printed “on-demand”

**Aircraft Health Monitoring (AHM) and Big Data**
- Expected to be a significant driver of innovation over the next five years
  - Boeing recently invested $100M into expanding AHM
  - A 787 flight can generate 500GB of data

**Augmented Reality and Automated Inspection Tech**
- Augment reality allows for live audio and visual communication with OCC
  - Robots used for visual inspections and non-destructive testing
    - Highly efficient
    - Highly accurate

© Oliver Wyman
Is your corporate Auto Pilot engaged?

- Focusing solely on business as usual is a risky strategy in the coming years
- Relying on current commercial offers, sales practices, resources, will challenge an MRO’s future business
- Advances could cut 15-20% of MRO spending from the aftermarket
- But also spawn new business models and revenue streams
- Amounts to a reduction or redistribution of $10-15B among current industry players & new competitors
- MROs and operators must actively choose technologies to develop and exploit
- Those that fail will end up as innovation takers, ceding further aftermarket control to competitors
The future is now
In closing …

• Our survey insights come directly from the industry and we value your insights as they help shape the future.

• If you’re interested in shaping our 2016 Survey in January, send us an email to MROsurvey@oliverwyman.com.

• Just include a subject line with the phrase “count me in” and you’ll receive the survey upon its release.

Thank You!