Oliver Wyman’s Aviation, Aerospace & Defense practice is the largest and most capable consulting team dedicated to the industry.

**OUR EXPERIENCE**
- ~250 professionals across Europe and North America
- Deep aviation knowledge and capabilities allow the practice to deliver data-driven solutions and provide strategic, operational, and organizational advice
- Increased technical aviation expertise in Europe from 2017 acquisition of UK-based AVISA Aviation Safety Systems

**OUR CLIENTS**
We have worked with many of the industry’s Fortune 500 companies, including
- All major US airlines
- Leading airlines, MROs, OEMs, and independent parts manufacturers in the Americas, Europe, and Asia
- Dominant aerospace and defense firms

**OUR APPROACH**
- **Data-driven**: unbiased benchmarking and forecasting tools to establish problems and identify solutions
- **Innovative**: ideas that are forward-thinking
- **Actionable**: results-oriented recommendations
- **Collaborative**: an emphasis on working with our clients, alongside executives, management, and support teams
This presentation incorporates Oliver Wyman’s 2018–2028 Global Fleet and MRO Market Forecast and 2018 MRO Survey, both of which are available at oliverwyman.com.
1 Industry Overview
Asian operators continue to trend with global profitability through 2018

Continued growth in revenue from ancillaries and lower fuel costs are helping global operators offset the impact of shifting economics

Source: IATA
As oil prices rebound, operators will face new cost pressures, particularly with the older generation widebody aircraft.

**Crude Oil and Jet Fuel Spot Prices per Gallon**

*By year/USA$ BN*

![Graph showing Crude Oil and Jet Fuel Spot Prices per Gallon between 2010 and 2027.](image)

- **New gen widebody aircraft are more profitable than current gen**
- **New gen narrowbody aircraft are more profitable than current gen**

Source: U.S. Energy Information Administration, Oliver Wyman Analysis
Over the past year, status changes to 3,613 aircraft have led the global in-service fleet to experience a net growth of 939 aircraft, representing a 3.7% annual growth rate.

Year Over Year Changes to the Global Commercial Air Transport In-Service Fleet

By Transaction Type

- Transferred to a commercial operator: 3
- Transformed into a freighter: 8
- Converted into a freighter: 30
- Involved in an accident: 16
- Formal retirement: 113
- Sent to storage: 1,185
- Unknown prior exclusion: 6

Aircraft Additions:

- New aircraft delivery: 1,629
- Storage for conversion into a freighter: 4
- Converted into a non-commercial operator: 14
- Sent to storage for conversion into a freighter: 8

Aircraft Removals:

- Transferred to a non-commercial operator: 16
- Formally retired: 113
- Sent to storage: 1,185
- Involved in an accident: 16

2018 Global Commercial Air Transport MRO Market Forecast

By MRO Segment

- $12.8 BN Line
- $12.9 BN Component
- $19.0 BN Airframe & Modifications
- $32.7 BN Engine

Translating the changing fleet dynamics into MRO, the 2018 market is forecast to be $77.4 BN, with engine MRO continuing to be the driver of growth.
Though the global fleet & MRO market are expected to increase by nearly 50% by 2028, increasing costs (e.g., oil prices) and external market factors (e.g., interest rates) create considerable uncertainty for realized growth.

Increased global tariffs could drive the forecasts to the lower bounds and shave several years of growth off the industry’s potential.
The global fleet is forecast at an annual growth rate of 3.7%, while the MRO market is forecast to grow at an annual rate of 4.5%.

**Global Commercial Air Transport Fleet Forecast**
*By Aircraft Class/number of Aircraft*

Next gen narrow body aircraft will dominate the global fleet growth, while expensive engine shop visits associated with more fuel efficient technologies will drive the growth in the MRO market.

Source: Oliver Wyman Global Commercial Air Transport Fleet Forecast
Asia is forecast to experience average growth of 6.5%, reaching a fleet size close to 15,000 aircraft by 2028.

**Asia Commercial Air Transport Fleet Forecast**
*By Aircraft Class/number of Aircraft*

- **2018**: 7,825
- **2018–'23 CAGR**: 7.7%
- **'18–'23 CAGR**: 11.7%
- **'23–'28 CAGR**: 5.8%
- **2023**: 11,339
- **'23–'28 CAGR**: 7.2%
- **'18–'28 CAGR**: 8.8%
- **2028**: 14,751
- **'18–'28 CAGR**: 6.5%

**Asia Commercial Air Transport MRO Forecast**
*By MRO Segment/US$ BN*

- **2018**: $22
- **2018–'23 CAGR**: 7.0%
- **'18–'23 CAGR**: 9.5%
- **'23–'28 CAGR**: 5.3%
- **2023**: $31
- **'23–'28 CAGR**: 6.0%
- **2028**: $42
- **'18–'28 CAGR**: 6.5%

Asia excluding China and India (APAC) is expected to grow at a strong 4% in both fleet and MRO spend over the next ten years.

Source: Oliver Wyman Global Commercial Air Transport Fleet Forecast
Asia Pacific is forecast to experience average growth of 4.3%, reaching a fleet size close to 6,500 aircraft by 2028.

### APAC Commercial Air Transport Fleet Forecast

**By Aircraft Class/number of Aircraft**

<table>
<thead>
<tr>
<th>Year/Period</th>
<th>Narrow-body</th>
<th>Wide-body</th>
<th>Regional Jet</th>
<th>Turbo-prop</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>4,268</td>
<td>7.1%</td>
<td>0.5%</td>
<td>2.8%</td>
</tr>
<tr>
<td>'18–'23 CAGR</td>
<td>5.0%</td>
<td>3.0%</td>
<td>1.1%</td>
<td>1.6%</td>
</tr>
<tr>
<td>2023</td>
<td>5,452</td>
<td>5.0%</td>
<td>2.8%</td>
<td>2.4%</td>
</tr>
<tr>
<td>'23–'28 CAGR</td>
<td>3.5%</td>
<td>1.8%</td>
<td>0.5%</td>
<td>6.0%</td>
</tr>
<tr>
<td>2028</td>
<td>6,486</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'18–'28 CAGR</td>
<td>4.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### APAC Commercial Air Transport MRO Forecast

**By MRO Segment/US$ BN**

<table>
<thead>
<tr>
<th>Year/Period</th>
<th>Narrow-body</th>
<th>Wide-body</th>
<th>Regional Jet</th>
<th>Turbo-prop</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>$14</td>
<td>$4.8%</td>
<td>$5.3%</td>
<td>$0.7%</td>
</tr>
<tr>
<td>'18–'23 CAGR</td>
<td>$0</td>
<td>$6.6%</td>
<td>$5.0%</td>
<td>$3.3%</td>
</tr>
<tr>
<td>2023</td>
<td>$18</td>
<td>$3.7%</td>
<td></td>
<td>$0.7%</td>
</tr>
<tr>
<td>'23–'28 CAGR</td>
<td>$21</td>
<td>$3.4%</td>
<td></td>
<td>$3.7%</td>
</tr>
<tr>
<td>2028</td>
<td>$21</td>
<td>$4.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>'18–'28 CAGR</td>
<td>$14</td>
<td>$4.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

APAC MRO spend is expected to accelerate over the first five years before slowing to 2.8% over the second half of the forecast period, bringing the average annual growth to 4.1%.

Source: Oliver Wyman Global Commercial Air Transport Fleet Forecast
China is forecast to experience average growth of 8.8%, reaching a fleet size over 7,000 aircraft by 2028.

China Commercial Air Transport Fleet Forecast

By Aircraft Class/number of Aircraft

<table>
<thead>
<tr>
<th>Year</th>
<th>Narrow-body</th>
<th>Wide-body</th>
<th>Regional Jet</th>
<th>Turbo-prop</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>3,046</td>
<td>100%</td>
<td>10.4%</td>
<td>10.8%</td>
</tr>
<tr>
<td>'18–'23</td>
<td>100%</td>
<td>12.6%</td>
<td>6.5%</td>
<td>6.5%</td>
</tr>
<tr>
<td>2023</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>'23–'28</td>
<td>36.4%</td>
<td>6.8%</td>
<td>6.2%</td>
<td>7.3%</td>
</tr>
<tr>
<td>2028</td>
<td>7,090</td>
<td>7,090</td>
<td>7,090</td>
<td>7,090</td>
</tr>
<tr>
<td>'18–'28</td>
<td>8.8%</td>
<td>100%</td>
<td>9.7%</td>
<td>9.0%</td>
</tr>
</tbody>
</table>

CAGR:
- 2018–'23: 10.4%
- 2023–'28: 8.8%
- 2028–'28: 7.3%

China Commercial Air Transport MRO Forecast

By MRO Segment/US$ BN

<table>
<thead>
<tr>
<th>Year</th>
<th>Airframe and Mods</th>
<th>Engine</th>
<th>Component</th>
<th>Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>7</td>
<td>9.9%</td>
<td>8.8%</td>
<td>5.5%</td>
</tr>
<tr>
<td>'18–'23</td>
<td>9.6%</td>
<td>12.9%</td>
<td>16.9%</td>
<td>7.5%</td>
</tr>
<tr>
<td>2023</td>
<td>10.2%</td>
<td>10.2%</td>
<td>13.5%</td>
<td>8.6%</td>
</tr>
<tr>
<td>'23–'28</td>
<td>9.6%</td>
<td>10.2%</td>
<td>13.5%</td>
<td>8.6%</td>
</tr>
<tr>
<td>2028</td>
<td>$11</td>
<td>10.7%</td>
<td>13.5%</td>
<td>8.6%</td>
</tr>
<tr>
<td>'18–'28</td>
<td>10.5%</td>
<td>13.5%</td>
<td>13.5%</td>
<td>8.6%</td>
</tr>
</tbody>
</table>

CAGR:
- 2018–'23: 10.5%
- 2023–'28: 10.7%
- 2028–'28: 10.6%

China MRO spend is expected to grow double digits over the course of the forecast period, as the in-service fleet growth will drive the need for continuous maintenance spend.

Source: Oliver Wyman Global Commercial Air Transport Fleet Forecast
India is forecast to experience average growth of 8.7%, reaching a fleet size close to 1,200 aircraft by 2028.

The India in-service fleet will experience strong growth over the next 5 years, driven by narrowbody aircraft. India MRO spend will grow gradually over the next 10 years.

Source: Oliver Wyman Global Commercial Air Transport Fleet Forecast
2 Dealing with rising costs
This year’s survey indicates that 75%+ of respondents see OEMs as credible in their ambitions and expect them to gain market share over the next three years.

Do you think OEMs’ growth targets for their aftermarket business units are achievable within the next decade?

Distribution of total responses

- Yes: 12%
- No, but they will come close: 63%
- No, they will miss their goal by a wide margin: 24%

Compared to the market growth, OEMs’ share of the aftermarket over the next 3 years will...

Distribution of total responses

- Increase significantly more rapidly: 38%
- Increase slightly more rapidly: 40%
- Increase about the same: 7%
- Increase slightly less rapidly: 10%
- Increase significantly less rapidly: 5%
Almost all respondents report experiencing increasing material costs; not surprisingly, MROs and operators overwhelmingly attribute their material cost increases to OEM actions.

Have you experienced an increase in material costs?

Distribution of responses

- Yes: 97%
- No: 3%

Main drivers of material cost increases (for yes responses)

Weighted average of rankings (highest to lowest ranking, scale of 1–5)

- Annual OEM material price increases: 3.8
- OEMs restricting the direct sale of OEM designed parts: 2.6
- Next generation aircraft: 1.7
- Lack of availability of USM: 1.5
- Supply chain failures/issues: 1.2
- Other: 0.2
Though respondents have no single strategy to combat rising costs, many non-OEM respondents have included leveraging partnerships, USM or technology in their strategic plans.

What strategy or strategies have you adopted or are you considering to combat rising material costs?

<table>
<thead>
<tr>
<th>Strategy</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner with OEM to secure discounts</td>
<td>60%</td>
</tr>
<tr>
<td>Leverage data analytics, aircraft health monitoring and predictive maintenance to reduce material usage</td>
<td>51%</td>
</tr>
<tr>
<td>Increase overall usage of USM parts from any source</td>
<td>50%</td>
</tr>
<tr>
<td>Implement policy to use own USM rather than purchasing parts when able</td>
<td>47%</td>
</tr>
<tr>
<td>Implement policy to use alternative parts rather than purchasing OEM parts when able</td>
<td>41%</td>
</tr>
</tbody>
</table>
An increase in USM from a small base is expected; however, lack of supply and lack of a clear sourcing strategy are big inhibitors.

How will your USM change over the next 5 years?

- Increase rapidly: 29%
- Increase slightly: 47%
- Remain the same: 22%
- Decrease slightly: 1%
- Decrease rapidly: 0%

Is your use of USM inhibited?

- Yes: 15%
- No: 85%

Main factors inhibiting use of USM

- Lack of availability: 1.5
- Material sourcing strategy: 1.1
- Lessors/financiers: 0.8
- Other: 0.4
Wages in Asia remain competitive relative to W. Europe, but the gap is narrowing

1. Average estimate of current prevailing technician billed airframe rates for heavy airframe maintenance by region (in US$)

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3 | Cybersecurity
Every day and across every facet of life, hackers are increasingly bolstering capabilities to launch cyberattacks and disrupt industries.

Nature of cyber threats has evolved drastically over just the past decade.

Experts place the number of expert, professional hackers at over 300,000 globally.

Hackers use a variety of means to achieve a number of ends.

Global counter-hacking efforts and actual damages are estimated at half a trillion US$ annually – a sum that has been increasing every year.
67% of respondents indicate they believe that their companies are prepared, yet less than half had conducted a review of cybersecurity risk in operations and maintenance in 2017.

- Is your company well prepared to handle cybersecurity threats related to operations and maintenance?
  - Yes: 67%
  - No: 33%
  - Unknown: 19%

- Has your company conducted a review of your cybersecurity risk in operations and maintenance in 2017?
  - Yes: 34%
  - No: 47%
  - Unknown: 19%
The MRO industry has not yet had a major Target or Equifax level cyber-attack – are we next?
While the majority of companies show an appropriately elevated level of concern, the survey also reveals considerable variability in levels of preparedness, which creates the potential for weak links in the supply chain.

**Which cybersecurity safeguards has your company implemented?**

**% of total respondents who selected each response for each segment**

<table>
<thead>
<tr>
<th>Cybersecurity Safeguards</th>
<th>Overall</th>
<th>MROs</th>
<th>OEMs</th>
<th>Operators</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall cybersecurity strategy for the company</td>
<td>68%</td>
<td>64%</td>
<td>50%</td>
<td>50%</td>
<td>52%</td>
</tr>
<tr>
<td>Employee cybersecurity training program</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>Security standards for third party vendors</td>
<td>56%</td>
<td>56%</td>
<td>56%</td>
<td>56%</td>
<td>56%</td>
</tr>
<tr>
<td>Cybersecurity threat assessment</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
</tr>
<tr>
<td>Active monitoring of cybersecurity intelligence</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
<td>59%</td>
</tr>
<tr>
<td>Cybersecurity hardening of communication networks</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Unknown</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
</tr>
</tbody>
</table>

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To achieve a comprehensive, unified cybersecurity and risk management approach for the industry, MRO providers should consider a comprehensive approach:

1. **Evaluate current state cyber security programs to identify areas of improvement**

2. **Develop a clear framework for mitigating and managing cyber risks**

3. **Fortify information technology systems and create a security-minded culture across companies**

4. **Build and enhance a security minded culture and be fully prepared for when a major cyber incident happens**

While no solution is guaranteed to avert all attacks, developing a shared, holistic approach to cybersecurity risk management may give companies a huge advantage.
4 Conclusions
Conclusions

The global MRO business is currently valued at $77 BN and is anticipated to reach $115 BN by 2028.

OEMs are expected to continue their push into MRO services and anticipated to hit or come close to meeting their growth ambitions.

At the same time, MROs continue to battle higher material and labor costs:
- There are no easy answers
- MROs will need to use a number of countermeasures to become more efficient.

Further complicating matters, cyber threats are mounting and causing increasing disruption across industries:
- The MRO industry has significant work to do to ensure they are well-prepared to mitigate and manage cyber risks.
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