THE MRO MARKET & KEY TRENDS

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Singapore

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Industry Context
Jet fuel price has remained low over the past couple of years...

U.S. Gulf Coast Kerosene-Type Jet Fuel Spot Price FOB Dollars per Gallon

~47% Decline

Source: EIA; ICF analysis
... This has helped the global airline industry as a whole to achieve record profitability of over USD35B in 2016

Global Airline Profitability, 1997 - 2017F

Source: IATA, ICF analysis
However, traditional airlines in Asia continue to face competition from three key areas:

1. **Middle Eastern Carriers**
   - Emirates
   - Etihad Airways
   - Qatar Airways

2. **Low Cost Carriers**
   - AirAsia
   - Jetstar
   - Spicjet
   - Nok Air
   - IndiGo

3. **Chinese Hub Carriers**
   - Air China
   - China Southern
   - China Eastern

Source: ICF Research, News reports
Restructuring in vogue as Asian carriers look to make profits amidst fierce competition…

- Announced restructuring following first loss in 5 years
- Set up Transformation Office to review all its business divisions and processes
- 56 initiatives to be rolled out to “grow revenue, rebase cost structure and enhance organisational effectiveness”

Source: News reports

• Announced restructuring in early 2017 after first loss in 8 years
• 3-year business transformation program
• Cutting of at least 600 jobs
• Targets to save HK$4B over 3 years

• Appointed new President-Director in April 2017 to restructure Garuda
• Working to improve aircraft utilization
• Deferring aircraft deliveries
• Restructuring its low-cost carrier, Citilink
• Targets to return to profit in 2018
Huge order books for the Asian LCCs mean more capacity will be added, putting further pressure on yields and profitability.

THE TOP 3 OPERATORS WITH THE LARGEST ORDER BOOKS IN APAC ARE LCCS

<table>
<thead>
<tr>
<th>Operator</th>
<th>No. of aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lion Air Group</td>
<td>444</td>
</tr>
<tr>
<td>IndiGo</td>
<td>416</td>
</tr>
<tr>
<td>AirAsia Group</td>
<td>399</td>
</tr>
</tbody>
</table>

DELIVERY OF THESE ORDERS WILL BE SPREAD OUT OVER THE NEXT 10 YEARS

<table>
<thead>
<tr>
<th>Year</th>
<th>Lion Air Group</th>
<th>IndiGo</th>
<th>AirAsia Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>70</td>
<td>78</td>
<td>11</td>
</tr>
<tr>
<td>2018</td>
<td>44</td>
<td>43</td>
<td>15</td>
</tr>
<tr>
<td>2019</td>
<td>101</td>
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<td>2020</td>
<td>101</td>
<td>21</td>
<td>19</td>
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<tr>
<td>2021</td>
<td>119</td>
<td>24</td>
<td>25</td>
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<tr>
<td>2022</td>
<td>125</td>
<td>24</td>
<td>24</td>
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<tr>
<td>2023</td>
<td>113</td>
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<tr>
<td>2024</td>
<td>46</td>
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<td>2025</td>
<td>46</td>
<td>18</td>
<td>47</td>
</tr>
<tr>
<td>2026</td>
<td>47</td>
<td>18</td>
<td>47</td>
</tr>
</tbody>
</table>

Source: CAPA
MRO Market
The current commercial air transport fleet consists of ~28,000 aircraft; ~7,900 are located in Asia Pacific.
The combination of strong air travel demand and the need to replace ageing aircraft will drive fleet growth at a healthy 3.2% p.a.

10 YEAR GLOBAL AIR TRANSPORT FLEET GROWTH

Region, CAGR

- Africa, 4.1%
- Middle East, 5.0%
- Latin America, 3.4%
- Europe, 2.4%
- Asia Pacific, 4.8%
- North America, 1.3%

Total: 3.2%

Source: ICF
The Asia fleet will grow as much as the rest of the world; China will account for ~50% of Asia growth

FLEET GROWTH: 2026 VS. 2016 – BY GLOBAL REGION

- **China**: 2,204 aircraft
- **Asia/Pacific (excl China)**: 2,553 aircraft
- **North America**: 1,187 aircraft
- **Western/Southern Europe**: 1,078 aircraft
- **Middle East**: 896 aircraft
- **Latin America**: 845 aircraft
- **Eastern Europe (incl CIS)**: 783 aircraft
- **Africa**: 641 aircraft

Source: ICF
2016 commercial air transport MRO demand is $67.6B; Asia Pacific has the largest MRO demand

2016 COMMERCIAL AIR TRANSPORT GLOBAL MRO DEMAND (CONSTANT 2016 US$)

BY MRO SEGMENT

<table>
<thead>
<tr>
<th>Segment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Engines</td>
<td>40%</td>
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<tr>
<td>Components</td>
<td>22%</td>
</tr>
<tr>
<td>Line</td>
<td>17%</td>
</tr>
<tr>
<td>Modifications</td>
<td>8%</td>
</tr>
</tbody>
</table>

BY GLOBAL REGION

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>27%</td>
</tr>
<tr>
<td>South America</td>
<td>26%</td>
</tr>
<tr>
<td>Middle East</td>
<td>8%</td>
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<tr>
<td>Africa</td>
<td>5%</td>
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<tr>
<td>Asia Pacific</td>
<td>~30%</td>
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</tbody>
</table>

Source: ICF
The global MRO market is expected to grow by 4.1% per annum to over $100B by 2026

10 YEAR GLOBAL COMMERCIAL AIR TRANSPORT MRO DEMAND (CONSTANT 2016 US$)

Source: ICF
Asia Pacific MRO spend exhibits strong growth, increasing by 5.6% per annum to ~$35.1B in 2026

10 YEAR ASIA PACIFIC COMMERCIAL AIR TRANSPORT MRO DEMAND (CONSTANT 2016 US$)

Category, CAGR
- Modifications 6.9%
- Airframe 5.2%
- Line 4.1%
- Component, 5.3%
- Engine, 6.2%
Total: 5.6%

Source: ICF
Trends To Watch
MRO Cost Reductions: Surplus Parts
Asian airlines can learn from US Airlines; For instance Delta is focused on managing costs and capacity discipline

- Delta expects to drive ~$1.5 billion of productivity savings in 2017, which will help mitigate cost pressures and fund investments in our business
  - Maintenance savings and productivity from new aircraft and materials purchases
  - Upgauging benefits continue
  - Further leveraging technology investments as well as our scale with suppliers to drive cost productivity

RONA driven airlines intently focus on costs:
- **Deferring maintenance**
- **Managing inventory**
- **Utilizing Used Serviceable Material**
- **Make vs buy**
- **Negotiating hard with suppliers**

Source: Delta Air Lines / J.P Morgan Aviation, Transportation and Industrials Conference, March 15, 2017
The surplus market continues to grow strongly, and is expected to reach ~$7.6B by 2026

**AIR TRANSPORT SURPLUS MARKET FORECAST (CONSTANT 2016 US$)**

<table>
<thead>
<tr>
<th>US$ Billion</th>
<th>2007</th>
<th>2016</th>
<th>2026</th>
</tr>
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<tbody>
<tr>
<td>$10</td>
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<tr>
<td>$9</td>
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<td>$8</td>
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<td>$4</td>
<td>$2.0</td>
<td>$4.5</td>
<td>$7.7</td>
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<tr>
<td>$3</td>
<td>$0.8</td>
<td>$1.6</td>
<td>$2.4</td>
</tr>
<tr>
<td>$2</td>
<td>$0.1</td>
<td>$2.7</td>
<td>$5.0</td>
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<tr>
<td>$1</td>
<td>$1.1</td>
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<tr>
<td>$0</td>
<td></td>
<td></td>
<td>$0.2</td>
</tr>
</tbody>
</table>

**2016-2026 CAGR**
- **Airframe, 2.7%**
- **Component, 4.1%**
- **Engine, 6.1%**
- **TOTAL: 5.2%**

**OBSERVATIONS**

- Surplus demand in 2007 was estimated at ~$2.0B, less than half of the 2016 demand of ~$4.5B
- The strong growth has led to increasing interest in surplus, leading to higher asset prices and an increase in the number of aircraft being torn down for spares
- As both surplus use and MRO demand continues to grow, the surplus market is expected to continue its growth at ~5.2% CAGR over the next decade
- Demand is expected to increase with growing acceptance of surplus parts and as airlines become more cost-conscientious

Source: ICF
9,300 aircraft will retire between 2017 and 2026, the majority are narrowbodies, providing potential part-out opportunities

- **A320 Family, 2,367**
- **737NG, 1,041**
- **737CL, 609**
- **767, 501**
- **CRJ-1/2/400, 510**
- **777, 299**
- **MD-80, 338**
- **ERJ, 344**
- **747-4, 229**
- **757, 248**
- **Others, 2,814**

**Total: 9,300 retirements**

**Observations**

- 9,300 aircraft are expected to retire between now and 2026, providing potential part-out opportunities.
- The majority of retiring aircraft are narrow bodies, primarily the A320 family and 737 variants.

Source: ICF
GA Telesis and ARI have opened the first aircraft tear-down facilities in China

- GA Telesis and Air China set up a joint venture (GAIC) in 2012, offering the first tear-down operations in China
- Part-outs are performed at Ameco facilities in Wuhan, Shandong, Beijing, Tianjin and Guangzhou
- ARI is setting up the first dedicated disassembly centre in Harbin, which is due to open in H2 2017. The facility (300,000sqm) would be able to handle up to 50 aircraft per year at full capacity
Continued MRO Expansion in Asia Pacific
Growing number of new aerospace clusters emerging in Asia which provides further MRO competition for existing players

**THAILAND**
- Planned revamp of U-Tapao Airport as MRO hub
- Airbus signed agreement with Thai Airways to evaluate MRO facilities’ development at the airport

**VIETNAM**
- Approval obtained to build mega airport at Long Thanh (est. capacity: 100 mppa)
- OEMs looking at setting up MRO facilities in Vietnam

**MALAYSIA**
- 100 sqkm development around KLIA
- Will involve 3 industry clusters: air cargo & logistics, aerospace & aviation services, and meeting & convention facilities

**PHILIPPINES**
- Roadmap developed to grow as an aerospace manufacturing hub
- Some OEMs, e.g. Moog & Honeywell, are already in country doing MRO

**SINGAPORE**
- Established aerospace cluster with many OEMs and MRO suppliers establishing presence there

Source: ICF Research
... and in China, aircraft production centres are evolving into comprehensive aerospace clusters

**TIANJIN**
- New development in an area of 102 sq km
- Close proximity to Beijing and Sea Port
- Airbus A320 assembly line (First Airbus assembly line outside Europe) & A330 completion centre
- Civil Aviation University of China
- Maintenance, repair and overhaul (MRO), logistics and manufacturing focused

**SHANGHAI**
- Covers an area of 40 sq km
- Busiest Chinese airport
- Airframe MRO anchored by Boeing-Shanghai and STARCO;
- UPS and DHL hubs
- COMAC ARJ21 and C919 final assembly line, with several component OEMs developing R&D, manufacturing and MRO hubs (e.g. Rockwell Collins)

**XI’AN**
- Xi’an is part of Shannxi FTZ that covers an area of 120 sq km.
- Xixian New Area will be merged into Xian in Apr 2017, and aerospace manufacturing and MRO are key pillars
- MA600/700 aircraft anchor manufacturing cluster
- Eastern Airline Technics is the largest MRO facility in Xi’an, with additional MRO partners developing MRO presence in Xi’an (Safran Landing Gears – China Eastern and Parker – AVIC JVs)

**ZOUSHAN**
- An aviation industrial park is being earmarked in the island city of Zhoushan, with focus on manufacturing and R&D
- As part of the aviation industrial park development, Boeing will set up a facility in Zhoushan, comprising a 737 completion centre (JV with COMAC) and a 737 delivery centre (fully owned by Boeing)
- The completion centre will install seats and IFE for 737s; Deliveries are scheduled to begin in end 2018
- Putuoshan Airport is undergoing a 750 million yuan ($108 million) expansion to become an international airport to accommodate manufacturing in Zhoushan
At the same time, Asian carriers are increasingly focusing the MRO market...

- **China Eastern** and **SAFRAN** landing gear MRO JV in Xi’an; construction began in 2017

- **AMECO** continues to expand its MRO capabilities, e.g. repair capabilities for B787 wheels & brakes

- **GAMECO** continues expansion to grow its business, e.g. board approval to build Phase 3 hangar complex at Guangzhou

- Leveraging on Nagpur MRO facility built by Boeing, **Air India Engineering** is targeting 50% of business from 3rd party work in 5 years

- **Thai Airways** MOU with **Airbus** to develop new MRO facility at U-Tapao Airport

- **ANA** set up MRO Japan to service smaller pax aircraft from domestic LCCs and foreign carriers

- **ANA** targets profits for MRO Japan in FY2020

- **Airbus** agreed to support development of **China Airlines’** maint, engineering & technical training capabilities

- **Singapore Airlines**
  - JV with **CAE** for pilot training
  - JV with **Airbus** for flight crew training
  - Collaboration with Boeing to provide aircraft maint. training

- **Lion Air**: Expansion of its Batam MRO facility to service 3rd party customers

Source: Secondary research
Aftermarket Battlegrounds
Aftermarket strategies vary across the aircraft lifecycle

**Revenue/Profit**

- **Aircraft OEMs**
  - 737CL
  - 757
  - 767
  - MD80
  - A300/310
  - 747
  - 747NG
  - CRJ
  - 737MAX
  - 787
  - A350

- **Component OEMs**
  - E2
eSeries
  - CSeries
  - MRJ
  - MS-21
  - A320neo
  - A380
  - E170/190
  - CRJ-7/9/-1000
  - A320 Family

- **Engine OEMs**
  - 747-8
  - 787
  - A360
  - A320

- **MRO Integrators**
  - A330

- **Independent MROs**
  - 777
  - 737NG
  - 767
  - 757
  - 747-400
  - MD80
  - A300/310

- **Surplus parts DER / PMA**

**Introduction**

**Growth**

**Mature**

**Sunset**

- Big Data & Connectivity
- Intellectual Property Protection

Source: ICF
Boeing and Airbus Continue to Expand into the Asian MRO Market

AIRBUS

**Airbus MRO Alliance**
Alliance with established MRO providers to provide high quality aftermarket services
- Current APAC partners are: China Airlines, GAMECO

**Eltra Services Beijing**
Location: Beijing
- Fully owned by Airbus
- Component MRO

**Sepang Aircraft Engineering**
Location: Kuala Lumpur
- Fully owned by Airbus
- Airframe maintenance

**Heavy Maintenance Singapore**
Location: Singapore
- JV with SIAEC
- Airframe maintenance and modifications

**Satair Airbus Singapore Centre**
Location: Singapore
- Spare parts hub for Airbus and component MRO

**Airbus Services Asia Pacific**
Location: Singapore
- Airbus’ Customer Support and Customer Services activities

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Boeing Shanghai Aviation Services
Location: Shanghai
- JV with Shanghai Airport Authority & China Eastern
- Maintenance, inventory management, end of lease services, training

Boeing Asia Pacific Aviation Services
Location: Singapore
- JV with SIAEC
- Total fleet maintenance solutions, including fleet technical management, inventory support solutions, aircraft maintenance

Aviall
Location: Singapore
- Spare parts hub for Boeing

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Airbus affiliated aftermarket facility
Boeing affiliated aftermarket facility

Source: Secondary research, ICF analysis
AFTERMARKET BATTLEGROUNDS

OEMs are focused on the aftermarket yet questions remain which provide challenges and opportunities...

**Airframe OEMs**
- Will Airframe OEMs succeed in establishing share and enduring success in the MRO market? Will it be profitable?
- Do they establish bricks and mortar and do more work themselves?
- What’s the value-add of the airframe OEM?

**Component OEMs**
- Which integrators, airlines and/or airframe OEMs to work with for best aftermarket growth?
- Intellectual property protection
- Surplus parts strategy
- Development of their own PBH programs
- Opportunities from M&A

**Engine OEMs**
- Capture PBH on new engine models
- Partnership strategy in growth regions
- Lifecycle solutions: capture more MRO on mature platforms and re-sign PBHs
- Participate in USM (particularly for mature engines)
Integrator MROs and Independents are defining their strategy in a more OEM-centric world

**Integrators**
- How best to secure capability on new platforms?
- Airframe OEMs – customer, supplier or competitor?
- Who best to partner with?
- How to differentiate in an increasingly commoditized market?
- Prepare for more work to be pushed down to the line
- Invest in new technology (e.g. big data / composite repair etc)
- Leverage their “make-buy” capability

**Independent MROs**
- Which will survive?
- Leverage USM / DER?
- What niches to pursue?
- What partnership strategy? OEMs?
- M&A opportunities?
Considerations
In Conclusion…

- The Air Transport MRO market outlook remains robust with expected growth of 4.1% per annum to reach ~$100B by 2026

- Asian carriers are pressured to look for new sources of cost savings; MRO continues to be an area of focus

- With a highly competitive aftermarket ecosystem, Airlines and MROs need to continually identify “how to win” and invest to maintain leadership
THANK YOU

For questions regarding this presentation, please contact:

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