Airline Maintenance Cost Executive Commentary
Edition 2019

An Exclusive Benchmark Analysis (FY2018 data)
by IATA's Maintenance Cost Technical Group
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Preliminary remarks

The Maintenance Cost Technical Group (MCTG) – formerly known as Maintenance Cost Task Force (MCTF) – collects maintenance cost data from airlines worldwide on an annual basis. The goals of MCTG are to provide the tools, methodology and definitions to be able to determine how much it costs an airline to maintain its fleet and be able to use the data in cases of new fleet introduction or expansion, “make vs. buy” decisions, year-over-year trends, etc.

This report is exclusively distributed to airlines that provided data for 2018.

We are doing our maximum to present meaningful analysis and we encourage you to provide feedback on this report so we can enrich it again next year.

We regularly send out a survey to airlines in order to gather their advice on how to improve this report and its content.

MCTG data collection is open to all commercial airlines worldwide that would like to benchmark their cost to maintain their fleet. MCTG does not discriminate between IATA and non-IATA member airlines. MCTG does not discriminate between major, domestic, international, low-cost, regional airlines, etc.

The importance of data quality

It takes a fair amount of time for MCTG airlines to gather and submit data, and it takes a lot of effort to validate this data in order to deliver the most relevant benchmark analysis. We often need to contact airlines and ask for clarifications when numbers do not meet the quality checks set. For this initiative to remain viable and reliable, it is critical to focus on the best possible data quality. That’s why we would like to remind you of the importance of making sure your data are accurate before submitting it. For that purpose, built-in checks are included in the data collection form (on three tabs: Summary Tables, Summary Graphs and P&O Graphs) in order to help you get an idea of the main metrics (e.g. maintenance cost per flight hour, per flight cycle or per aircraft). Unscheduled events can cause dramatic impact on maintenance spend, that is why we need also as many comments to explain unusually high or low costs.
The importance of reporting operational data

The focus of MCTG is clearly on maintenance costs, however operational data (e.g. flight hours, cycles, ASK, fleet size and fleet age) and personnel & overhead data (e.g. number of mechanics and overhead staff, time breakdown, overhead costs, etc.) are very important to calculate unit costs and KPIs. We would like to draw your attention on the importance of reporting accurate cost data and operational data in order to get the best benchmark data and analysis possible for the benefit of the airline industry and your own airline.

The importance of data treatment

All the MCTG analyses presented in this report use maintenance cost data as they were provided by the airlines through the standardized IATA toolset. No attempt was used to normalize the data based on any parameters such as operational severity (hours to cycle ratio, utilization, harsh environment, etc.), aircraft ageing, fleet size and commonality, labor rate, etc. Additionally, it should be noted that the analysis is done in USD as most of the aircraft parts are marketed in USD; therefore, currency exchange rates may play a significant role in benchmarking maintenance costs, especially when substantial foreign exchange fluctuations and/or currency devaluation take place.

Finally, the aircraft delivery schedule and the periodicity of the maintenance program can strongly influence costs, especially when many aircraft were delivered within a short period of time.

The acceptance of data

This report analyzes and comments data from 54 airlines. Due to late submission, insufficient data and poor data quality, a few other airlines’ data was excluded from the analysis and report.
Data & Analysis Methodology

IATA's Maintenance Cost Technical Group (MCTG) collects maintenance cost data from airlines worldwide on an annual basis.

MCTG Airlines are the carriers which participate in the annual data collection. 54 airlines reported data for FY2018, however one airline was excluded from this report, because they submitted past the deadline and/or data that did not pass the quality checks and subsequent questions to clarify data.

The data are then coded (operators are de-identified) and used as reported (i.e. without any normalization) to create this benchmark report.

All airline data are consolidated and then analyzed considering aircraft type, fleet and engine size and models, fleet age, maintenance market segments (line, components, engines, heavy checks and MOD) and elements (labor, material, subcontracted work), flight hours, cycles and geography.

All data presented in this report are de-identified. The two-digit airline codes shown in this report are unique codes given to the participating airlines for de-identification purposes. Although some of these codes may match real IATA airline codes, this is merely a coincidence. If you do not know your airline’s code, please contact us at mctg@iata.org.

Typical metrics include: cost per flight hour, cost per departure, cost per aircraft. The cost data unit is US dollar, and the length unit is kilometer.

The goals of MCTG are to provide the tools, methodology and definitions to be able to determine how much it costs an airline to maintain its fleet and be able to use the data in cases of new fleet introduction or expansion, “make vs. buy” decisions, year-over-year trends, etc.
## Definitions & Acronyms

<table>
<thead>
<tr>
<th><strong>AC</strong></th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AFI</strong></td>
<td>Africa</td>
</tr>
<tr>
<td><strong>AFTK</strong></td>
<td>Available Freight Tonne Kilometers</td>
</tr>
</tbody>
</table>

**Aircraft Category**

NB, WB, RJ, TP (defined below)

**Aircraft Family**

Aircraft communalities (e.g. A320 Family includes A318, A319, A320, A321; 737 NG includes 737-600/700/800/900)

**Aircraft Sub-Category**

NB, WB2, WB3+, RJ, TP (defined below)

**AL**

Airline

**APU**

Auxiliary Power Unit

**ASK**

Available-Seat Kilometers

**AS PAC**

Asia Pacific

**Cost Elements**

Material, labor, engine life limited parts and outside repairs (or outsourced, used interchangeably)

**Cost Segments**

Line, base, component and engine maintenance

<table>
<thead>
<tr>
<th><strong>Currency</strong></th>
<th>All amounts in this report are in US$, unless specified otherwise.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DMC</strong></td>
<td>Direct Maintenance Costs</td>
</tr>
<tr>
<td><strong>ESV</strong></td>
<td>Engine Shop Visit</td>
</tr>
<tr>
<td><strong>EUR</strong></td>
<td>Europe</td>
</tr>
<tr>
<td><strong>FC</strong></td>
<td>Flight Cycle</td>
</tr>
<tr>
<td><strong>FH</strong></td>
<td>Flight Hour</td>
</tr>
<tr>
<td><strong>FLF</strong></td>
<td>Freight Load Factor</td>
</tr>
<tr>
<td><strong>FTK</strong></td>
<td>Freight Tonne Kilometers</td>
</tr>
<tr>
<td><strong>LATAM</strong></td>
<td>Latin America &amp; The Caribbean</td>
</tr>
<tr>
<td><strong>LG</strong></td>
<td>Landing Gear</td>
</tr>
<tr>
<td><strong>LLP</strong></td>
<td>Life Limited Part</td>
</tr>
<tr>
<td><strong>MCTG</strong></td>
<td>Maintenance Cost Technical Group</td>
</tr>
<tr>
<td><strong>MENA</strong></td>
<td>Middle East &amp; North Africa</td>
</tr>
<tr>
<td><strong>MR</strong></td>
<td>Maintenance Reserves</td>
</tr>
<tr>
<td><strong>MRO</strong></td>
<td>Maintenance, Repair and Overhaul</td>
</tr>
<tr>
<td><strong>MTBR</strong></td>
<td>Mean Time Between Removals</td>
</tr>
<tr>
<td><strong>NAM</strong></td>
<td>North America</td>
</tr>
<tr>
<td><strong>NB</strong></td>
<td>Narrow-body single aisle aircraft with more than 100 seats (excludes Embraer 190/195)</td>
</tr>
<tr>
<td><strong>PLF</strong></td>
<td>Passenger Load Factor</td>
</tr>
<tr>
<td><strong>Regions</strong></td>
<td>Africa (Sub-Saharan Africa), ASPAC (Asia Pacific), MENA (Middle East &amp; North Africa), Americas (North &amp; South America), Europe (includes CIS), N. Asia (China, Hong Kong, Macao, Taiwan, Mongolia)</td>
</tr>
<tr>
<td><strong>RJ</strong></td>
<td>Regional-jets up to 100 seats (includes Embraer 190/195)</td>
</tr>
<tr>
<td><strong>RPK</strong></td>
<td>Revenue-Passenger Kilometers</td>
</tr>
</tbody>
</table>

**Supply Chain**

Includes all maintenance activities performed by third party (also called “contract maintenance” or “outsourcing”) and the cost of material purchased to do work in-house

**Total Maintenance Costs**

DMC plus overhead costs

**Units**

K ($#,000) Thousand
M ($#,000,000) Million
B ($#,000,000,000) Billion

**Utilization**

Number of flight hours per aircraft per day (= FH / AC / 365 days)

**WACC**

Weighted average cost of capital

**WB**

Wide-body aircraft with more than one aisle or equivalent freighter, combination of WB2 and WB3+.

**WB2**

Wide body aircraft equipped with two engines

**WB3+**

Wide body aircraft equipped with three or more engines
Global Picture

1.1. Airline Industry Landscape in 2018
1.2. World Fleet
1.3. Maintenance, Repair and Overhaul (MRO) Market

Global Picture

This section provides some context to the MCTG analysis in other sections by presenting an overview of the airline industry, the world fleet count and the Maintenance, Repair and Overhaul (MRO) market for 2018.

The industry recorded a net post-tax profit of US$32 billion, decreasing by 14% compared to 2017.

In 2018, the world fleet count was 27,535 aircraft with 81% of the fleet manufactured by Airbus and Boeing. Globally, airlines spent $69 Billion on MRO, representing around 9% of total operational costs.
1.1. Airline Industry Landscape in 2018

Collectively, the airline industry had a net post-tax profit of US$32.3 billion, a 6.8% margin on revenues. The post-tax profit airlines generated this year was lower compared with previous year ($37.7 billion reported in 2017 with an 7.7% margin).

Jet fuel prices increased significantly during 2018. The average price of a barrel of jet fuel in 2018 was $86 per barrel (29% higher than in the previous year but still lower than average between 2011 and 2015).

RPKs between regions of the world grew at an accelerated rate in 2018, expanding by 6.5% from previous year (2017). The pick-up in the growth trend reflected increasing demand through improvements in the global economic backdrop. The available seat kilometers (ASKs) in 2018 increased by 6.1% compared to last year.

The passenger load factor this year (2018) has reached 81.9% increasing of 0.6% from last year.

Source: IATA WATS 2019
Fig. 3:
RPK Growth by Route Area
Source: IATA WATS 2019

AFI: Africa
ASPAC: Asia Pacific
EUR: Europe
LATAM: Latin America & the Caribbean
MENA: Middle East & North Africa
NAM: North America

WORLD 7.4%
LATAM 7.0%
AFI 6.1%
EUR 7.5%
ME 5.0%
ASPAC 9.5%
1.2. World Fleet

In FY2018, the world fleet count was 27,535 aircraft. This number includes all active aircraft in commercial operations. 81% of this fleet was manufactured by Boeing or Airbus. The combined share of the other manufacturers (like Bombardier, Embraer, Fokker, ATR and Bae) represented the remaining 19% of the world fleet.

In the last decade, airlines introduced 7,923 aircraft to their fleet, broken down as follows: 60% NB, 13% RJ, 21% WB, and 6% TP. TPs include only ATR42/72 and Q300/400.

Operator in Europe and the Americas own 59% of the world fleet in 2018, followed by ASPAC and North Asia with 31%, whereas MENA and Africa account for 10%.
A320 Family remains the most popular aircraft consisting of 7,679 AC and has a narrow lead before the 737 Family with 7,548 AC in FY2018.
The average utilization in 2018 was 7.68 hours/day (6.7% vs 2017, and 10.5% vs 2009). In FY2008, an aircraft flew on average 2,803 hours and 1,342 cycles.

PLF increased from 81.4% in 2017 to 81.9% in 2018. All figures in the table below are expressed in % change year on year, except for PLF and FLF which are the load factors for the specific month.

<table>
<thead>
<tr>
<th>World Share</th>
<th>December 2018 (% year-on-year)</th>
<th>2018 calendar year (% year-on-year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RPK (%-PT)</td>
<td>ASK (%-PT)</td>
</tr>
<tr>
<td>AFRICA</td>
<td>2.1%</td>
<td>2.1%</td>
</tr>
<tr>
<td>ASIA PACIFIC</td>
<td>34.5%</td>
<td>6.4%</td>
</tr>
<tr>
<td>EUROPE</td>
<td>26.7%</td>
<td>7.8%</td>
</tr>
<tr>
<td>LATIN AMERICA</td>
<td>5.1%</td>
<td>6.0%</td>
</tr>
<tr>
<td>MIDDLE EAST</td>
<td>9.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>NORTH AMERICA</td>
<td>22.4%</td>
<td>3.6%</td>
</tr>
<tr>
<td>TOTAL MARKET</td>
<td>100%</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

1 % of industry RPKs in 2018
2 Year-on-year change in load factor
3 Load factor level
1.3. Maintenance, Repair and Overhaul (MRO) Market

Global MRO spend in 2018 was valued at $69 Billion, excluding overhead. This represented 9% of airlines operational costs. With a 4.1% increase per annum, the market size is estimated to reach $103 Billion in 2028.
TRENDS AND MAJOR EVENTS IN 2018

Fleet evolution
Narrowbody aircraft will continue to dominate deliveries over the next decade. OAMs are offering re-engined aircraft for a better fuel efficiency (A320neo, 737 MAX) and developing versions of the narrowbody jets for longer hauls (A321 XLR).

Over the same period of time, the fleet of e-enabled aircraft is set to more than double.

IATA/CFMI Agreement
In July 2018, IATA and engine manufacturer CFM International (CFMI) have signed an agreement that will lead to increased competition in the market for maintenance, repair and overhaul services (MRO) on engines manufactured by CFM, a 50/50 partnership between GE and Safran Aircraft Engines.

Under the agreement, CFMI has adopted a set of “Conduct Policies” that will enhance the opportunities available to third-party providers of engine parts and MRO services on the CFM56 and the new LEAP series engines. More information can be found on MCTG webpage.

Top three savings for airlines
• Health monitoring and predictive maintenance driven by improved dispatch reliability, labor productivity
• Fuel cost savings
• Delay reduction through improved turnaround process

To improve productivity, lower costs, and gain additional asset utilization, airlines are considering technologies like the Internet of Things (IoT) to change the game.

Reasons for increasing MRO material costs
• Annual OEM material price increases
• OEMs restricting the direct sale of OEM designed parts

CHALLENGES AHEAD
Impact of Brexit on airline operations:
• Limits access to market
• Adds cost through complexity, inefficiency or administrative burden
• Potentially leads to extensive supply chain disruption, invalidation of aircraft used across the globe and planes being grounded

Potential options for managing UK regulatory framework after Brexit:
• UK seeks to become a Third Country member of EASA
• UK builds an independent regulatory framework, and/or seeks bilateral arrangements on safety and cooperation with other Third Countries

SOURCES
• Industry Statistics Fact Sheet – IATA (June 2019)
• A study of the effects of the United Kingdom leaving the European Union on airlines flying to and from the UK – IATA (October 2018)
• Aero-Engine Market Analysis - Oliver Wyman (May 2019)
• Exploring airline operation benefits of deploying IoT – Deloitte
• The MRO Market & Key Trends – ICF (January 2019)
FY2018 Snapshot — 54 Airlines

This section provides the overview of FY2018 data reported by 54 airlines worldwide. The 5-year trend analysis will be presented further in this report.

The MCTG airlines operated 4,717 aircraft in 2018, of which 92% were Airbus and Boeing aircraft. Technical Division spend totaled $19.78 billion, of which $16.94 billion were Direct Maintenance Cost and $2.85 billion Overhead Cost.
2.1. Fleet Overview

In FY2018, the MCTG fleet had 4,717 aircraft, which represented 17% of the world’s fleet. The fleet size of MCTG airlines ranged from 1 to over 600 aircraft with an average fleet age of 8.8 years. They flew a total of 15.5 million flight hours, and 6.4 million flight cycles. Nine airlines operated both passenger and freighter aircraft.

Table 2:
Fleet Distribution by Region
(FY2018 — 54 Airlines)

<table>
<thead>
<tr>
<th>Region</th>
<th>AL</th>
<th>AC</th>
<th>AGE</th>
<th>UTIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUROPE (includes CIS)</td>
<td>18</td>
<td>963</td>
<td>10.2</td>
<td>9.4</td>
</tr>
<tr>
<td>AMERICAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North &amp; South America</td>
<td>11</td>
<td>1,655</td>
<td>8.5</td>
<td>8.6</td>
</tr>
<tr>
<td>AFRICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>3</td>
<td>88</td>
<td>10.0</td>
<td>8.0</td>
</tr>
<tr>
<td>MENA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle East &amp; North Africa</td>
<td>8</td>
<td>621</td>
<td>6.8</td>
<td>10.4</td>
</tr>
<tr>
<td>ASPAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>10</td>
<td>1,012</td>
<td>8.9</td>
<td>8.4</td>
</tr>
<tr>
<td>N. ASIA</td>
<td>4</td>
<td>378</td>
<td>8.8</td>
<td>9.7</td>
</tr>
<tr>
<td>China, Hong Kong, Macao, Taiwan and Mongolia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AL: Airline
AC: Aircraft
Age: Average Fleet Age (years)
Util: Utilization (Hours / Day)
The MCTG fleet mix is slightly different from the world fleet. Boeing (including McDonnell-Douglas) and Airbus are overrepresented in MCTG fleet. They account for 92% of MCTG fleet vs 81% of worldwide fleet. On the contrary, Embraer, ATR and Bombardier have a combined share of 8% of MCTG fleet vs 18% worldwide. (Fig. 12)

As shown in Fig. 13, narrowbody aircraft (NB) were the most popular aircraft (56% of 54 MCTG airlines' fleet) with 3,089 flight hours per aircraft and 1,642 flight cycles per aircraft on average. In 2018, widebody aircraft represented 35% of the fleet with an average age of 8.8 years (8.9 years for NB). Each widebody aircraft (WB) flew on average 3,895 hours and performed 767 cycles (Table 2). Regional (RJ) and Turboprop (TP) fleets are underrepresented in the MCTG analysis because reporting carriers mostly have larger aircraft.

More details on MCTG fleet vs Worldwide Fleet in Annex I.
MCTG airlines operated 25 different aircraft families in 2018. Figure 3 represents only the Top 15 aircraft families with a minimum of 3 operators and 5 aircraft, and a total of 4,445 aircraft (94% of MCTG total fleet). Some popular aircraft types have been removed because they did not meet the ‘3 operators/5 aircraft’ rule. The rest of the fleet (not shown here) is mostly composed of mature to old fleet types that will be retired in a near future, and new entrants on the market.

<table>
<thead>
<tr>
<th>Aircraft Category</th>
<th>Aircraft</th>
<th>Airlines</th>
<th>Avg Age</th>
<th>Utilization</th>
<th>FH/AC</th>
<th>FC/AC</th>
<th>FH/FC</th>
<th>Dispatch Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB</td>
<td>2,649 A/C</td>
<td>50</td>
<td>8.9</td>
<td>8.5</td>
<td>3,089</td>
<td>1,642</td>
<td>1.9</td>
<td>98.56%</td>
</tr>
<tr>
<td>WB2</td>
<td>1,484 A/C</td>
<td>37</td>
<td>8.8</td>
<td>10.6</td>
<td>3,856</td>
<td>781</td>
<td>4.9</td>
<td>98.74%</td>
</tr>
<tr>
<td>RJ</td>
<td>225 A/C</td>
<td>13</td>
<td>7.5</td>
<td>6.9</td>
<td>2,529</td>
<td>2,048</td>
<td>1.2</td>
<td>98.81%</td>
</tr>
<tr>
<td>WB3+</td>
<td>182 A/C</td>
<td>7</td>
<td>8.8</td>
<td>11.5</td>
<td>4,215</td>
<td>655</td>
<td>6.4</td>
<td>97.89%</td>
</tr>
<tr>
<td>TP</td>
<td>176 A/C</td>
<td>13</td>
<td>7.8</td>
<td>4.8</td>
<td>1,747</td>
<td>1,939</td>
<td>0.9</td>
<td>96.96%</td>
</tr>
</tbody>
</table>
2.2. Maintenance Cost Analysis

In FY2018, MCTG airlines reported a total of $19.78B for their Technical Division spend: this is $16.94B for direct maintenance cost (reported by 54 airlines) and $2.85B for overhead (reported by 46 airlines).

$16.94B represent almost 24.5% of the world MRO spend (Fig. 7) for 17% of the world fleet. This may be explained by the fact that MCTG fleet is skewed towards higher gauge aircraft (35% WB in MCTG fleet vs 21% in world fleet).

2.2.1. Direct Maintenance Spend

The 54 MCTG airlines reported $16.94B for their direct maintenance costs, the average maintenance cost was $314M per airline, $1,089 per flight hour, $2,634 per flight cycle and $3.6M per aircraft.

Table 4:
Direct Maintenance Cost - Unit Costs
(FY2018 — 54 Airlines)

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Minimum</th>
<th>Average</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft/Airline</td>
<td>1</td>
<td>87</td>
<td>600+</td>
</tr>
<tr>
<td>Cost/Airline</td>
<td>$1.1M</td>
<td>$314M</td>
<td>$1,660M</td>
</tr>
<tr>
<td>Cost/Flight Hour</td>
<td>$43</td>
<td>$1,089</td>
<td>$9,882</td>
</tr>
<tr>
<td>Cost/Flight Cycle</td>
<td>$91</td>
<td>$2,634</td>
<td>$44,573</td>
</tr>
<tr>
<td>Cost/Aircraft</td>
<td>$0.0M</td>
<td>$3.6M</td>
<td>$15.7M</td>
</tr>
</tbody>
</table>

Abnormal values are the result of periodic maintenance effects, exceptional low utilization, redelivery costs, etc.

Engine and components remain the highest cost segments with respectively 47% and 22% of maintenance costs (Fig. 15).

For more information on Component Maintenance Cost Management go to the download section on the MCTG webpage.
Important note: For the third year, airlines were asked to report the LLP costs in a separate field, and we included them in the calculation of Engine Mtc costs. However, not all of them were able to isolate the costs and reported them either in their Material costs or subcontracted costs. We recommend exercising caution when interpreting this data, especially the share of LLPs.

Contract maintenance (indicated as ‘SubC’ for subcontracted) represented 73% of total direct maintenance spend (Fig. 16); two airlines subcontracted all their maintenance activities (Fig 17). As shown in Figure 18, the majority of airlines continue subcontract the entirety of their engine work. 0% mostly reflects the absence of any engine overhaul for FY2018.

The rest of this report is only available to participating airlines.

If your airline would to participate in the next maintenance cost data collection, please contact us at mctg@iata.org.