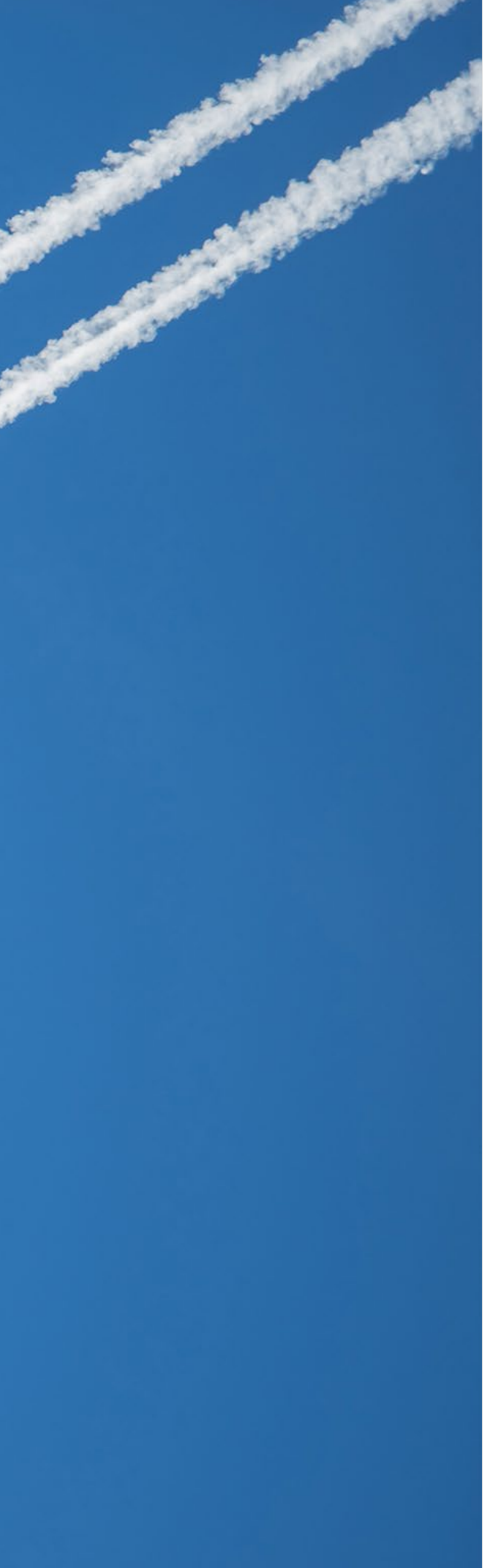
AIRLINE MAINTENANCE COST EXECUTIVE COMMENTARY

An Exclusive Benchmark Analysis (FY2017 data)
by IATA's Maintenance Cost Task Force

PUBLIC VERSION

MCTF
November 2018



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Preliminary remarks

Maintenance Cost Task Force (MCTF) collects maintenance cost data from airlines worldwide on an annual basis. The goals of MCTF 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 2017 to give them an overview of the MRO market and the opportunity to benchmark against other airlines.

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

We will send out a survey for you to provide feedback on this report and help us improve its content.

MCTF data collection is open to all airlines worldwide that would like to benchmark their cost to maintain their fleet. MCTF is open to IATA and non-IATA member airlines. MCTF is open to major, domestic, international, low-cost, regional airlines, etc.

THE IMPORTANCE OF DATA QUALITY

It takes a fair amount of time for MCTF 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 overview 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 MCTF 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 MCTF analyses presented in this report use maintenance cost data as they were provided by the airlines through the standardized IATA toolset. No attempt was made 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 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 49 airlines. Due to late submission, insufficient data and poor data quality, a few other airlines' data were excluded from the analysis and report.

Data & Analysis Methodology

IATA's Maintenance Cost Task Force (MCTF) collects maintenance cost data from airlines worldwide on an annual basis.

MCTF Airlines are the carriers which participate in the annual data collection. 53 airlines reported data for FY2017.

The data are then coded (operators are de-identified) and used as reported (i.e. without any normalization) to create this benchmark report. Ratios and/or aggregate numbers are used as needed to prevent data identification.

All airline data are consolidated and then analyzed considering aircraft type, engine model, fleet size and 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 mctf@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 MCTF 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

AC
Aircraft

AFI
Africa

AFTK
Available Freight Tonne Kilometers

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

ASPAC
Asia Pacific

Cost Elements
Material, labor and outside repairs (or outsourced, used interchangeably)

Cost Segments
Line, base, component and engine maintenance

Currency
All amounts in this report are in US$, unless specified otherwise.

DMC
Direct Maintenance Costs

ESV
Engine Shop Visit

EUR
Europe

FC
Flight Cycle

FH
Flight Hour

FLF
Freight Load Factor

FTK
Freight Tonne Kilometers

LATAM
Latin America & The Caribbean

LG
Landing Gear

LLP
Life Limted Part

MCTF
Maintenance Cost Task Force

MENA
Middle East & North Africa

MR
Maintenance Reserves

MRO
Maintenance, Repair and Overhaul

MTBR
Mean Time Between Removals

NAM
North America

NB
Narrow-body single aisle aircraft with more than 100 seats (excludes Embraer 190/195)

PLF
Passenger Load Factor

Regions
Africa (Sub-Saharan Africa), ASPAC (Asia Pacific), MENA (Middle East & North Africa), Americas (North & South America), Europe (includes CIS), N. Asia (China, Hong Kong, Macao, Taiwan, Mongolia)

RJ
Regional-jets up to 100 seats (includes Embraer 190/195)

RPK
Revenue-Passenger Kilometers

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

TP
Turboprops

TR
Thrust Reversers

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

1 Global Picture

1

Global Picture

This section provides some context to the MCTF 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 2017.

The industry recorded a net post-tax profit of US$38 billion, increasing by 11% compared to 2016.

In 2017, the world fleet count was 25,870 aircraft with 80% of the fleet manufactured by Boeing or Airbus. Globally, airlines spent $76 Billion on MRO, representing around 11% of total operational costs.

1.1. Airline Industry Landscape in 2017

Collectively, the airline industry had a net post-tax profit of US$38 billion, a 7.5% margin on revenues. The post-tax profit airlines generated this year was higher compared with previous year ($34.2 billion reported in 2016 with an 8.5% margin).

Jet fuel prices increased significantly during 2017. The average price of a barrel of jet fuel in 2017 was $67 per barrel (24% higher than in the previous year but still much lower than average between 2011 and 2015).

RPKs between regions of the world grew at an accelerated rate in 2017, expanding by 7.6% 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 2017 increased by 6.3% compared to last year.

The passenger load factor this year (2017) has reached 81.4% increasing of 0.9% from last year.

Source: IATA WATS 2018

Fig. 1:
Industry Net Profits
Source: IATA WATS 2018

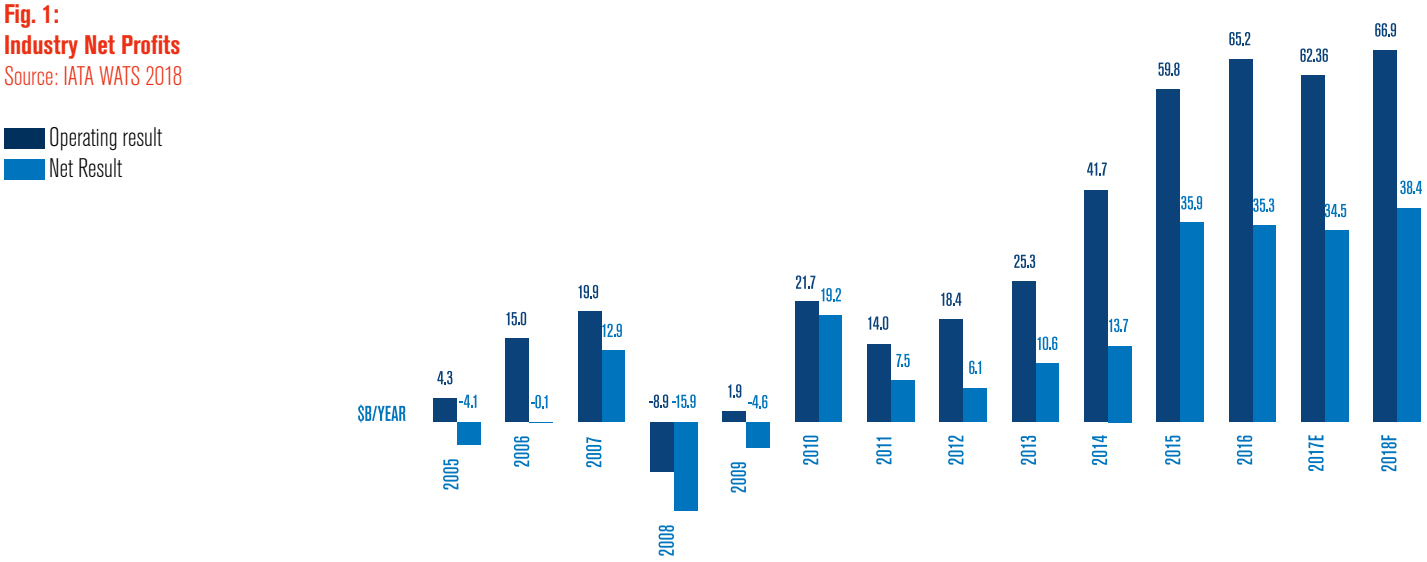


Fig. 2:
Jet Fuel Price per Barrel
Annual average
Source: IATA WATS 2018

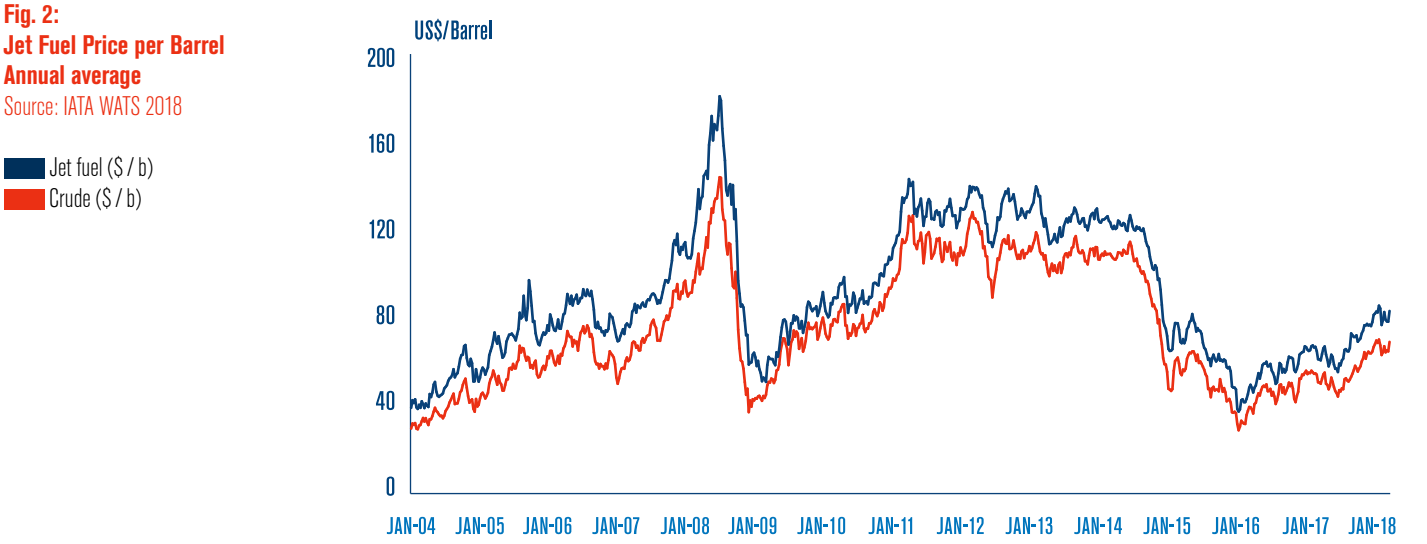
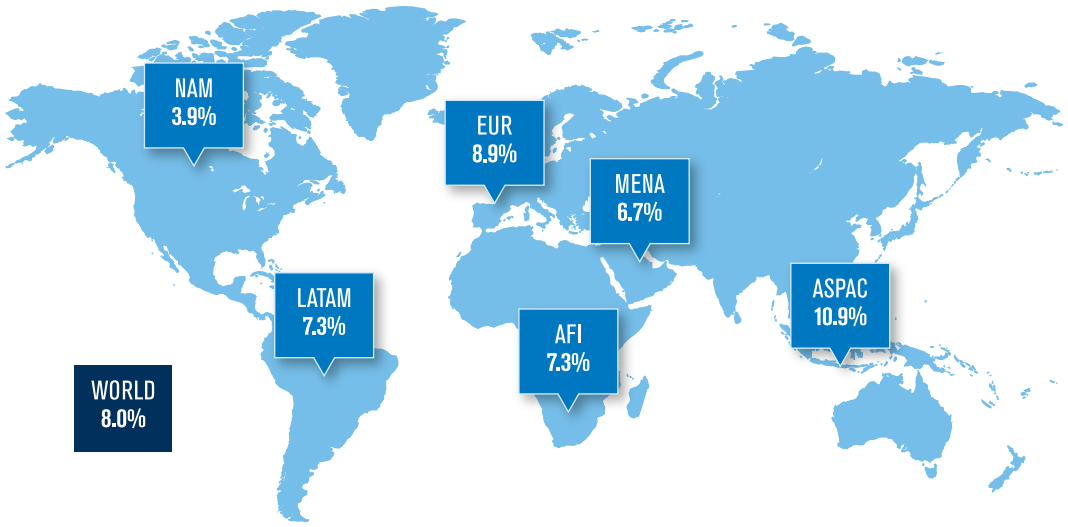


Fig. 3:
RPK Growth by Route Area
Source: IATA WATS 2018



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

1.2. World Fleet

In FY2017, the world fleet count was 25,870 aircraft. This number includes all active aircraft in commercial operations. 80% 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 20% of the word fleet.

In the last decade, airlines introduced 6,996 aircraft to their fleet, broken down as follows: 59% NB, 13% RJ, 21% WB, and 7% TP. TPs include only ATR42/72 and Q300/400.

Fig. 4:
World Fleet by Manufacturer (2017)
Source: FlightGlobal

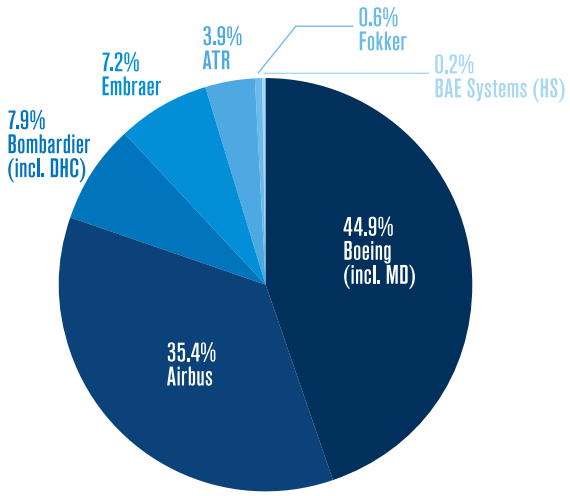


Fig. 5:
World Fleet by Aircraft Category (2017)
Source: FlightGlobal

Fig. 6:
World Fleet by Region (2017)
Source: FlightGlobal

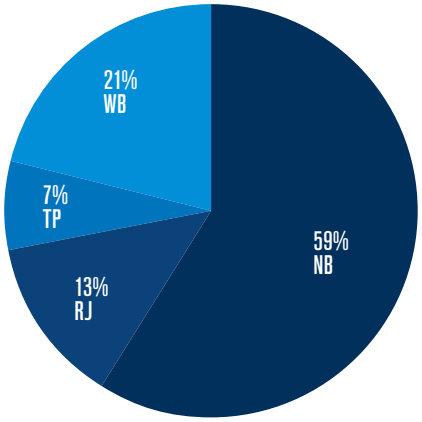


Fig. 5

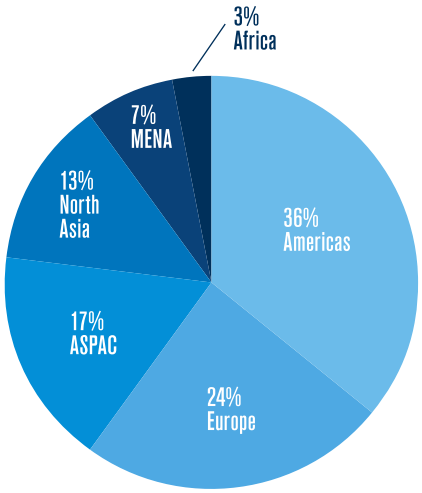
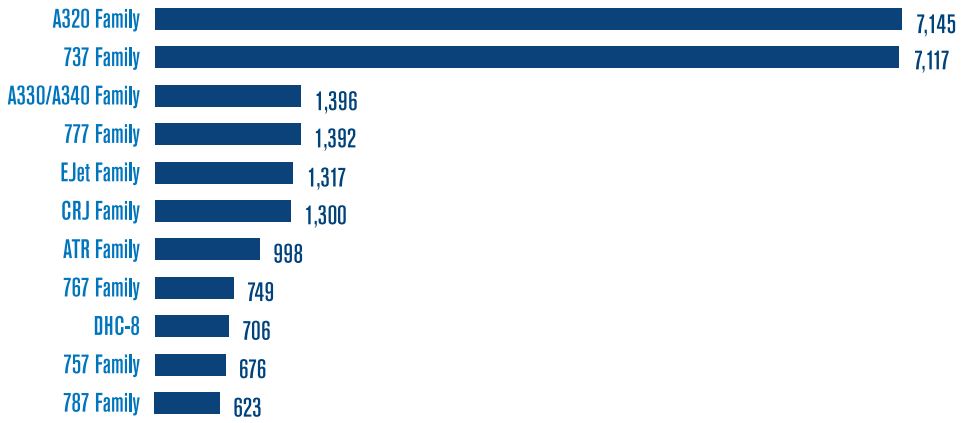


Fig. 6

NB: Narrowbody Jet
WB: Widebody Jet
RJ: Regional Jet
TP: Turboprop

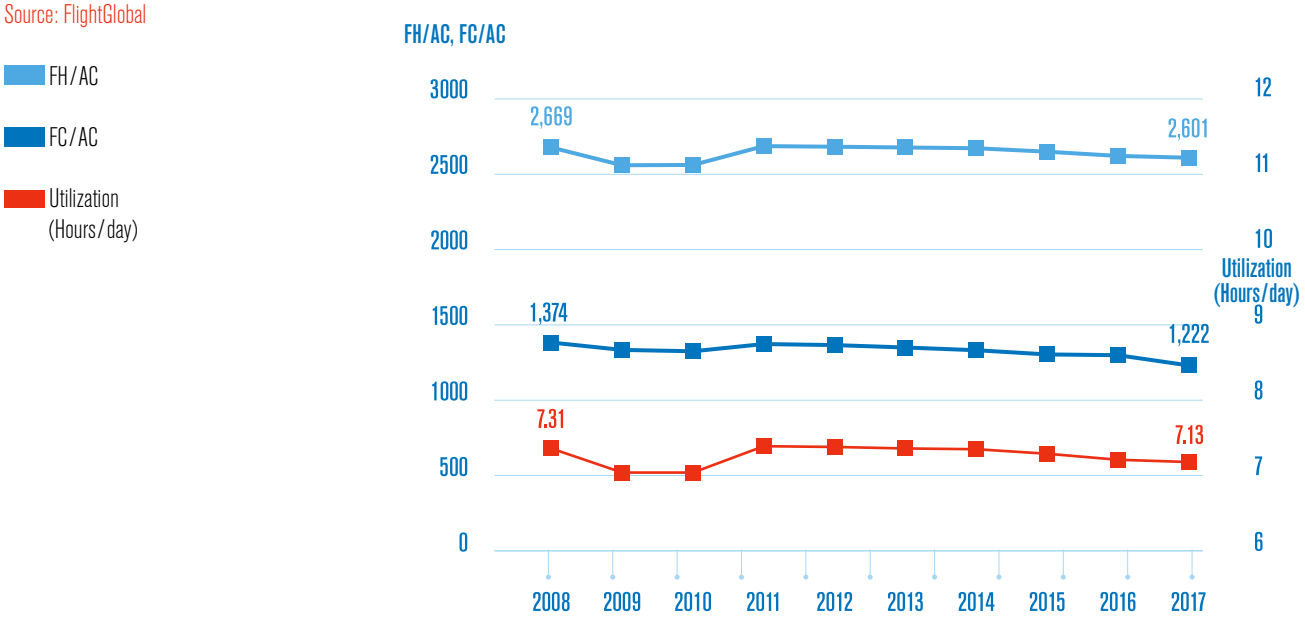
Operators in Europe and the Americas own 60% of the world fleet in 2017, followed by ASPAC and North Asia with 30%, whereas MENA and Africa account for 10%.

Fig. 7:
Top 10 Most Popular Aircraft Families (2017)
Source: FlightGlobal



A320 Family remained the most popular aircraft family (7,145 AC) and had a narrow lead over the 737 Family with 7,117 AC in FY2017.

Fig. 8: World Fleet Statistics (2008 - 2017)
Source: FlightGlobal



The average utilization in 2017 was 7.13 hours/day (-1.1% vs 2016, and -2.5% vs 2008). In FY2017, an aircraft flew on average 2,601 hours and 1,222 cycles. PLF increased from 80.5% in 2016 to 81.4% in 2017.

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 1:
Airline Financial Monitor (Dec 2017)
Source: IATA Economics

		December 2017 (% year-on-year)				2017 (% year-on-year)			
	WORLD SHARE[1]	RPK	ASK	PLF (%-PT)[2]	PLF (LEVEL)[3]	RPK	ASK	PLF (%-PT)[2]	PLF (LEVEL)[3]
AFRICA	2.2%	3.4%	2.6%	0.6%	72.1%	6.3%	2.9%	2.3%	70.9%
ASIA PACIFIC	33.7%	9.1%	8.3%	0.6%	81.1%	10.1%	8.4%	1.3%	81.0%
EUROPE	26.5%	6.1%	4.4%	1.3%	81.5%	8.2%	6.2%	1.5%	83.9%
LATIN AMERICA	5.2%	5.4%	5.0%	0.3%	81.5%	7.0%	5.5%	1.2%	81.8%
MIDDLE EAST	9.5%	3.4%	5.7%	-1.7%	75.5%	6.4%	6.5%	-0.1%	74.5%
NORTH AMERICA	23.0%	4.0%	4.2%	-0.2%	82.7%	4.2%	4.1%	0.1%	83.6%
TOTAL MARKET	100%	6.2%	5.8%	0.3%	80.7%	7.6%	6.3%	0.9%	81.4%

[1] % of industry RPKs in 2017 [2] Year-on-year change in load factor [3] Load factor level

1.3. Maintenance, Repair and Overhaul (MRO) Market

Global MRO spend in 2017 was valued at $76 Billion, excluding overhead. This represented around 11% of airlines operational costs.

With a 4.6% increase per annum, the market size is estimated to reach $118 Billion in 2027.

Fig. 9:
World MRO Spend by Segment (2017)
Source: ICF International Global MRO Forecast

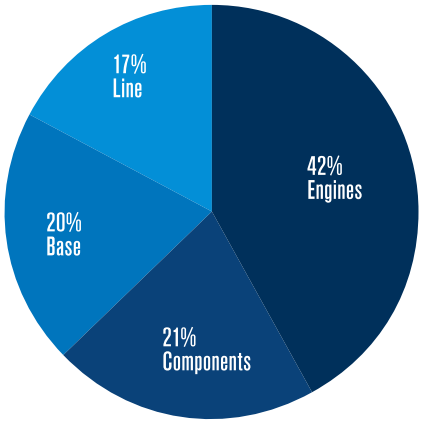


Fig. 10:
World MRO Spend by region (2017)
Source: ICF International Global MRO Forecast

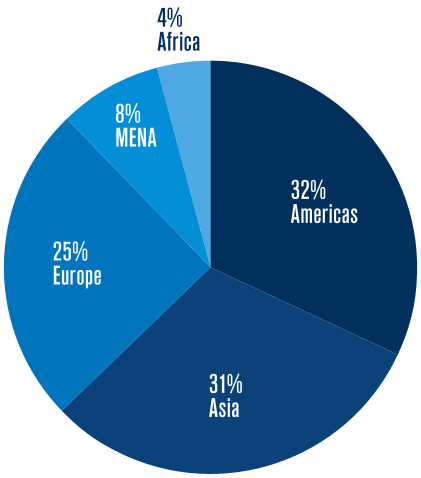
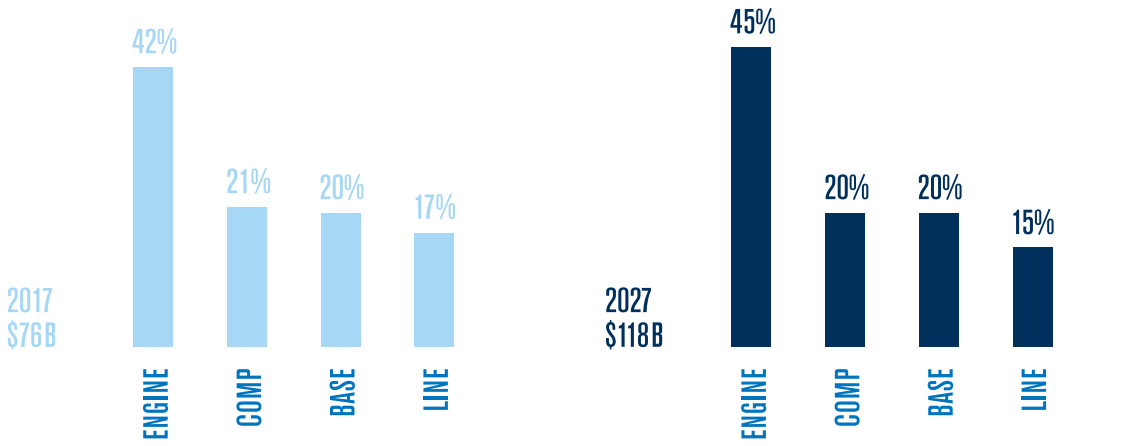


Fig. 11:
World MRO Market Forecast (2017-2027)
Source: ICF International Global MRO Forecast



TRENDS AND MAJOR EVENTS IN 2017

E-enabled aircraft bring the promise of increased efficiency for airlines, new services for passengers and enhancement in AHM.

Airbus and Bombardier announced on October 16, 2017 a partnership on the CSeries program called CSALP (CSeries Aircraft Limited Partnership).

Focus on cabin

- Latest lie-flat seats are now the minimum standard for long haul busyness class
- Wi-fi, on-board connectivity
- Capacity (ASM/K) increase ("Cabin Densification")

Emerging markets

- India market is the fastest domestic market in terms of RPK growth (driven by network and economic expansion).
- Market share of Middle Eastern airlines decreased for the first time since 1997, the RPK growth rate went down from 11.5% in 2016 to 6.6% in 2017.

CHALLENGES AHEAD

Increased airline costs

- Aircraft financing
- Fuel costs
- Labor costs
- MRO flight hour agreement escalations

Overwhelming presence of OEMs on the aftermarket, especially engine and component manufacturers

Skills shortage

- Technicians are in high demand causing a global wage inflation in hope to retain them
- MRO providers and universities have to work together to address the need for specialized training skills

Potential for increase in aircraft delivery deferrals (backlog risk)

Impact of geopolitics on global trade and the aviation industry:

- Renegotiations of trade agreements and tariff escalations put a strain on economic relationships worldwide. The uncertainty could impact cargo and demand for business travel.

Possible increase in aircraft delivery deferrals (backlog risk)

Impact of geopolitics on global trade and the aviation industry:

- Renegotiations of trade agreements and tariff escalations put a strain on economic relationships worldwide. The uncertainty could impact cargo and demand for business travel.
- Brexit: As the negotiations are ongoing, there is a high level of uncertainty on any Brexit implications for airlines.
- More on Brexit:
  - IATA report on Brexit & Air Transport Issues
  - Brexit is Coming – How Will It Affect Aircraft Parts?

Sources

Air Passenger Market Analysis – IATA (December 2017)
Report on Brexit & Air Transport Issues – IATA (2018)
MRO Market Update & Industry Trends – ICF (January 2017)
Global MRO Commercial Fleet Dynamics & Trends – ICF (October 2017)
Industry Insights - Edition 1 – ICF (2017)
MRO Survey – Olivier Wyman (January 2018)
Brexit is Coming – How Will It Affect Aircraft Parts? - The Aviation Suppliers Association (2018)

2

FY2017 Snapshot

2

FY2017 Snapshot – 53 Airlines

This section provides the overview of FY2017 data reported by 53 airlines worldwide. The 5-year trend analysis will be presented further in this report.

The MCTF airlines operated 4,706 aircraft in 2017, of which 93% were Airbus and Boeing aircraft. Technical Division spend totaled $20 billion, of which $17.16 billion were Direct Maintenance Cost and $2.84 billion Overhead Cost.

2.1. Fleet Overview

In FY2017, the MCTF fleet had 4,706 aircraft, which represented 18% of the world's fleet.

The MCTF airline fleet size ranged from 1 to over 600 aircraft with an average fleet age of 8.9 years. They flew a total of 15.7 million flight hours, and 6.1 million flight cycles. 13 airlines operated both passenger and freighter aircraft.

Table 2:
Fleet Distribution by Region (FY2017 – 53 Airlines)

AL: Airline

AC: Aircraft

Age: Average Fleet Age (years)

Util: Utilization (Hours/Day)

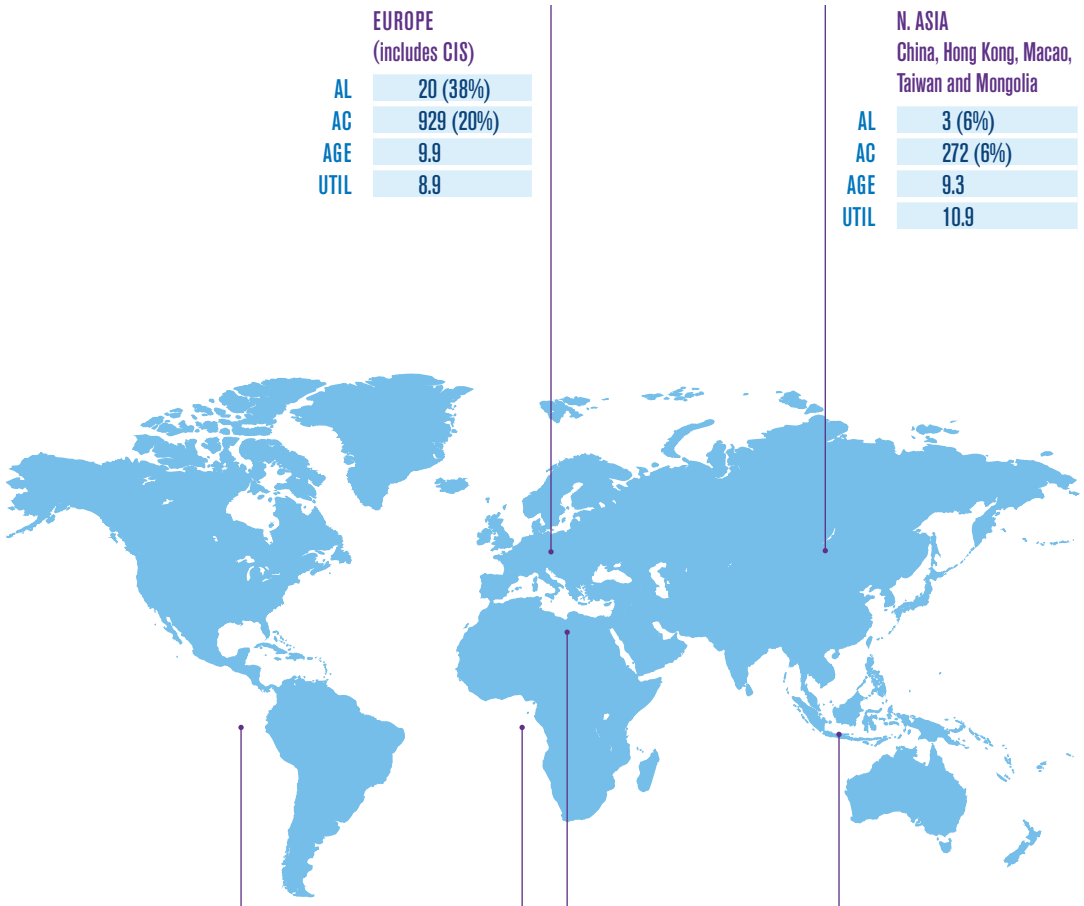


Fig. 12:
Fleet Distribution by Manufacturer (FY2017 – 53 Airlines)

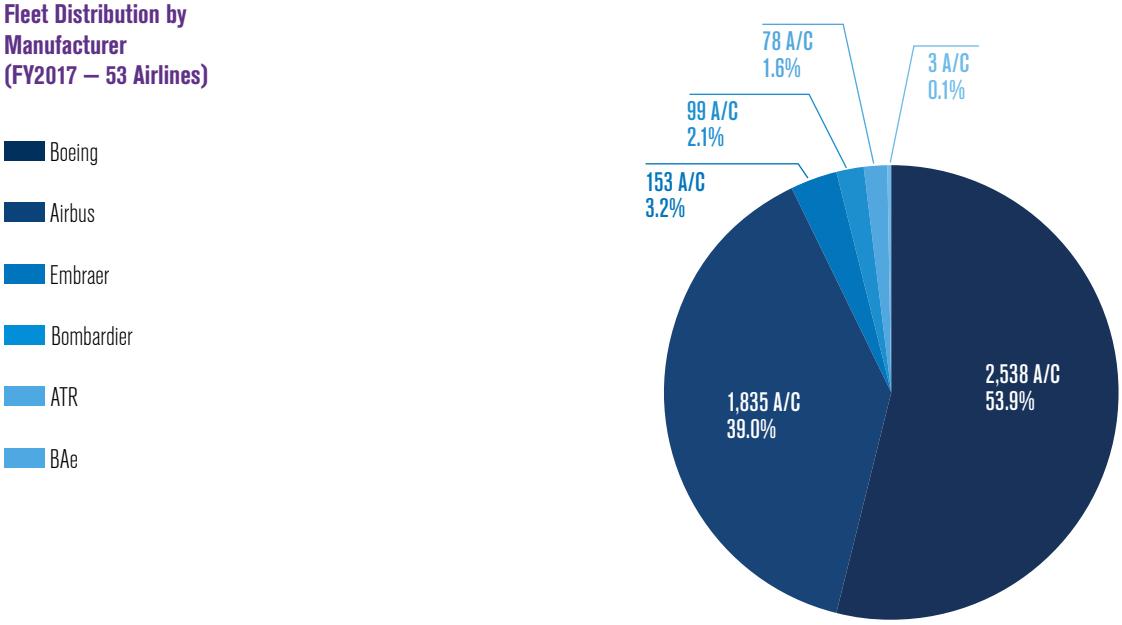
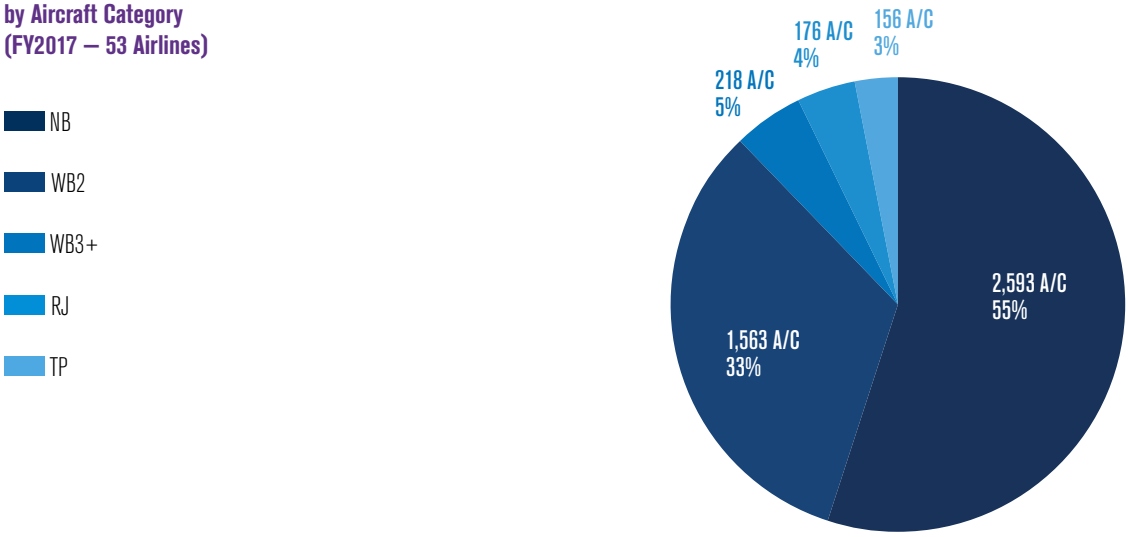


Fig. 13:
Fleet Distribution by Aircraft Category (FY2017 – 53 Airlines)



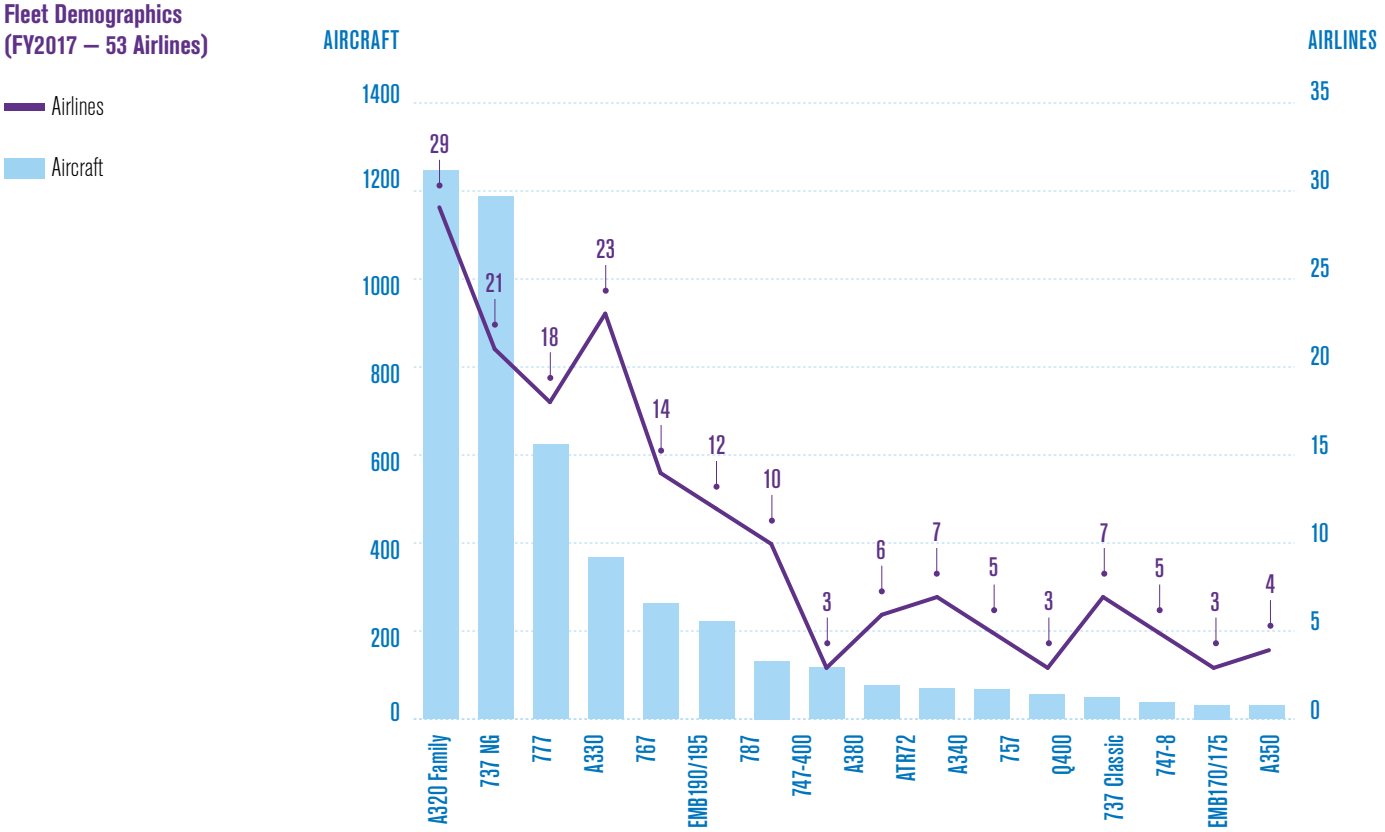
The MCTF fleet mix is slightly different from the world fleet. Boeing (including McDonnell-Douglas) and Airbus are overrepresented in MCTF fleet. They account for 93% of MCTF fleet vs 80% of worldwide fleet. On the contrary, Embraer, ATR and Bombardier have a combined share of 7% of MCTF fleet vs 19% worldwide. (Fig. 12)

As shown in Fig. 13, narrowbody aircraft (NB) were the most popular aircraft (55% of 53 MCTF airlines' fleet) with 3,039 flight hours per aircraft and 1,608 flight cycles per aircraft on average. In 2017, widebody aircraft represented 38% of the fleet with an average age of 8.7 years (9.1 years for NB).

The widebody aircraft (WB) flew on average 3,971 hours and performed 765 cycles (Table 2). The Regional (RJ) and Turboprop (TP) fleets are underrepresented in the MCTF analysis because reporting carriers mostly have larger aircraft.

More details on MCTF fleet vs Worldwide Fleet in Annex I.

Fig. 14:
Fleet Demographics
(FY2017 – 53 Airlines)



MCTF airlines operated 26 different aircraft families in 2017. Figure 14 represents only the Top 16 aircraft families with a minimum of 3 operators and 5 aircraft, and a total of 4,581 aircraft (97% of MCTF 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 3:
Operational Data
by Aircraft Category
(FY2017 – 53 Airlines)

Aircraft Category	Aircraft	Airlines	Avg Age	Utilization	FH/AC	FC/AC	FH/FC
NB	2,593 A/C	48	9.1	8.3	3,039	1,608	1.9
WB2	1,563 A/C	37	8.8	10.8	3,935	787	5.0
WB3+	218 A/C	7	7.9	11.6	4,233	605	7.0
RJ	176 A/C	13	7.6	6.5	2,388	1,762	1.4
TP	156 A/C	13	7.5	5.2	1,913	2,129	0.9

2.2. Maintenance Cost Analysis

In FY2017, MCTF airlines reported a total of $20B for their Technical Division spend: this is $17.16B for direct maintenance cost (reported by 53 airlines) and $2.84B for overhead (reported by 44 airlines).

$17.16B represent almost 23% of the world MRO spend (Fig. 18) for 18% of the world fleet. This may be explained by the fact that MCTF fleet is skewed towards higher gauge aircraft (38% WB in MCTF fleet vs 21% in world fleet).

They employed a total of 34,448 mechanics (reported by 38 airlines) and 22,042 OH staff (reported by 44 airlines).

Staffing and overhead (OH) are analyzed separately in Section 2.2.3.

2.2.1. Direct Maintenance Spend

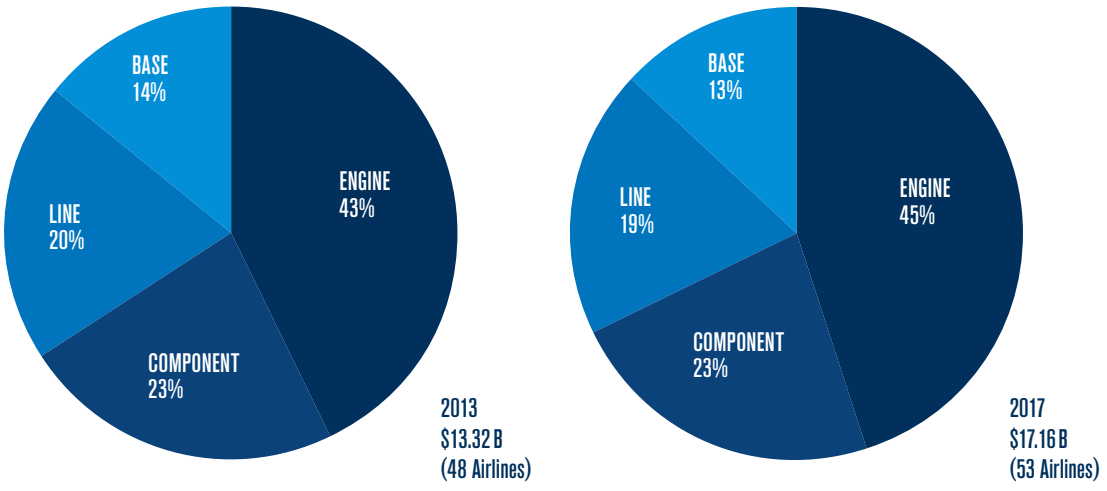
The 53 MCTF airlines reported $17.16B for their direct maintenance costs, the average maintenance cost was $324M per airline, $1,095 per flight hour, $2,780 per flight cycle and $3.6M per aircraft.

Table 4: Direct Maintenance Cost - Unit Costs (FY2017 – 53 Airlines)

	Minimum	Average	Maximum
Aircraft/Airline	1	89	600+
Cost/Airline	$0.9M	$324M	$1,501M
Cost/Flight Hour	$118	$1,095	$17,495
Cost/Flight Cycle	$186	$2,780	$110,802
Cost/Aircraft	$0,0M	$3.6M	$18.4M

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

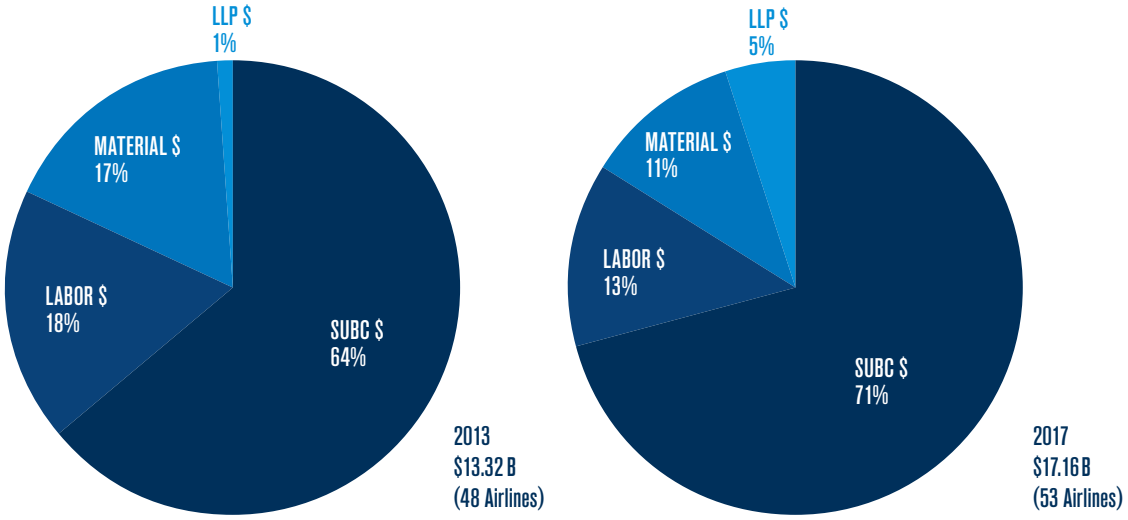
Fig. 15: Evolution of Direct Maintenance Cost Structure by Segment (FY2013 & FY2017)



Engine and components remain the highest cost segments with respectively 45% and 23% of maintenance costs (Fig. 15).

For more information on Component Maintenance Cost Management go to the download section on the MCTF webpage.

Fig. 16:
Evolution of Direct Maintenance Cost Structure by Element (FY2013 & FY2017)



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

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

www.iata.org/mctf

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