CFM56 / LEAP TRANSITION AND AFTERMARKET

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CFM56 / LEAP TRANSITION

François BASTIN,
SAE Commercial Engines
LEAP: Technology, Experience & Execution

- COMPOSITE FAN BLADES & CASE: Lightweight & durable
- ADVANCED 3D AERO: Performance
- ADVANCED COOLING: Lightweight & temperature resistant
- LEAN COMBUSTOR: Low NOx, durable
- FAN MOUNTED AGB: Reliability, Maintainability
- DEBRIS REJECTION SYSTEM: Protection against erosion

It takes a suite of technologies to make a great engine

-50% vs CAEP6, margin to new regulations (Chap 14)
-15% lower fuel consumption and reduction in CO₂ emissions
LEAP: since CMD 2016

- **A320neo**
  - Entry into service in August 2016

- **737 MAX**
  - Entry into service in May 2017

- **C919**
  - Entry into service in August 2016

**LEAP-1A**
- First Flight in May 2017
- **ON TIME**

**LEAP-1B**
- Entry into service in May 2017
- **ON TIME**

**LEAP-1C**
- Entry into service in May 2017
- **ON TIME**

**ON SPEC**
- All performance, noise and emissions reduction objectives met

- **73** LEAP customers have accumulated more than **2.5 million** engine flight hours
LEAP: the customer’s choice

**Market shares, as of October 31, 2018**

- **737MAX**
  - CFM LEAP: 100%
  - Single source

- **A320neo**
  - CFM LEAP: 58%
  - PW 1000G: 42%

**Based on announced orders and selections**

- **CFM LEAP**: 8,171 AC (o/w ~7,500 AC to be delivered) 77%
- **PW1000G**: 2,509 AC 23%

**Investor’s choice: LEAP market share for A320neo lessors is 67%**
LEAP in service: supporting a fleet of more than 500 aircraft...

As of October 31, 2018

A320neo
288 aircraft

737 MAX
231 aircraft
Cornerstone

- Engine designed for reliability

Levers

- Digital advanced monitoring
- 3 call centers, 250+ field engineers
- On site support force operating 24/7 from 15 locations over the world
- 7 MRO shops up and running

Already 99.9% dispatch reliability and still improving!

World Class Utilization, matching CFM56 standard

Aircraft not flying (in % of fleet in service)
Source: Flightradar24

Flight hours (h) / Average daily utilization
Source: Flightradar24

…with unrivalled utilization

Safran - Capital Markets Day 2018 / November 29, 2018
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Unprecedented ramp-up underway

In 2016, 77 LEAP deliveries, on top of 1,693 CFM56’s

In 2017, 459 LEAP deliveries, on top of 1,444 CFM56’s

In 2018 on track to beat 1,100 LEAP engines deliveries, on top of more than 1,000 CFM56’s

LEAP weekly rate already hit CFM56 historical peak level
Leveraging our Production Management System

Extensive investment: added 3 new plants and pulled in a 3rd pulse line in 2018 alone

Fully active dual sourcing, adding 3rd or 4th when necessary (forged parts, frames)
  ● Examples: turbine disks, turbine rear vane

Winning the First Time Yield battle:
  ● Through design updates & process improvements
  ● Examples (2016 to now): OGVs (20 to 93%), fan blade leading edge (70 to 97%)

SWAT teams to tackle emerging issues at suppliers

Route to Serial Mode
  ● Systematic risk analysis & abatement

Watch item
  ● Forgings and Castings

150 suppliers
14 countries
### Safran plant development

<table>
<thead>
<tr>
<th>Location</th>
<th>Size</th>
<th>Country</th>
<th>Specialisation</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queretaro</td>
<td>6,000 m²</td>
<td>Mexico</td>
<td>Assembly</td>
<td>2019</td>
</tr>
<tr>
<td>Queretaro</td>
<td>31,000 m²</td>
<td>Mexico</td>
<td>3D composites RTM and OGV</td>
<td>2018</td>
</tr>
<tr>
<td>Rzeszow</td>
<td>5,000 m²</td>
<td>Poland</td>
<td>Compressor Blade machining</td>
<td>2018</td>
</tr>
<tr>
<td>Rzeszow</td>
<td>9,300 m²</td>
<td>Poland</td>
<td>Turbine blade machining</td>
<td>2018</td>
</tr>
<tr>
<td>Suzhou</td>
<td>19,000 m²</td>
<td>China</td>
<td>Machining and assembly</td>
<td>2018</td>
</tr>
<tr>
<td>Villarocche</td>
<td>40,000 m²</td>
<td>France</td>
<td>Logistics for assembly and spares</td>
<td>2017</td>
</tr>
<tr>
<td>Gennevilliers</td>
<td>1,500 m²</td>
<td>France</td>
<td>Precision forging</td>
<td>2016</td>
</tr>
<tr>
<td>Le Creusot</td>
<td>4,000 m²</td>
<td>France</td>
<td>Turbine disk machining</td>
<td>2015</td>
</tr>
<tr>
<td>Rochester</td>
<td>31,000 m²</td>
<td>USA</td>
<td>3D composites RTM</td>
<td>2014</td>
</tr>
<tr>
<td>Commercy</td>
<td>27,000 m²</td>
<td>France</td>
<td>3D composites RTM</td>
<td>2014</td>
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</table>

- **In production**

Over 173,000 m² of extensions and new plants in Europe, Asia and the Americas since 2013
Defining the state of the art of engine assembly

2016 2017 2018

- Engine pulse lines
- Fan rolling lines

● Generalizing the Pulse line concept
● Combining it with relentless innovation

All effective today… and more coming!

- 3 LEAP engine pulse lines, 3 fan module rolling lines
- Friendly engine cradles (4 axes, including +/- 110° engine axis rotation)
- Augmented reality
- Smart tooling
- In line image recognition control
- Collaborative automation (cobots)
- Zero-G handling
Cost reduction: right on track

Before 1\textsuperscript{st} engine delivery, CMD16 learning curve was expressed in terms of Cost of Production

As serial production has started, Cost of Sales metrics becomes more relevant

The achievement to date is in line with the 2020 objective
# LEAP Cost reduction: within our plants

<table>
<thead>
<tr>
<th>Levers</th>
<th>Examples</th>
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<tbody>
<tr>
<td><strong>Design updates for cost</strong></td>
<td>● 1B Turbine rear vane</td>
</tr>
<tr>
<td></td>
<td>● Removal of EEC blowers</td>
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<tr>
<td></td>
<td>● 1B Fan frame shroud</td>
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<tr>
<td><strong>Process Optimization</strong></td>
<td>● Closed door machining</td>
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<td></td>
<td>● Optimization of inspection times</td>
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<td></td>
<td>● Rework elimination</td>
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<tr>
<td><strong>Leveraging our low cost footprint</strong></td>
<td>● China: turbine shafts, disks &amp; module assembly</td>
</tr>
<tr>
<td></td>
<td>● Mexico: fan disks, blades, OGVs &amp; module assembly</td>
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</tbody>
</table>
Closed door machining: Le Creusot (France)

Traditional turbine disk machining
- Batch flow
- One machine for one operator
- Manual on line machine set up

Flexible assisted manufacturing system
- One piece flow
- 2 machines for one operator
- Centralized retooling
- Off line machine set up

Flexible automated manufacturing system
- 3 machines for one operator
- Automated loading
- Closed Door Machining
- Digital data collection

Labor efficiency:
Machining time: X2.5
-50%
LEAP Cost reduction: with our suppliers

3,000 part numbers
150 suppliers
4 levers
215 workshops
13,000 actions items

Levers
- Design to cost
- Lean manufacturing, value chain analysis, process reengineering
- Supply base footprint optimization including best cost country
- Rolling negotiations

Examples
- Cone torque metal coating removal, LPT shaft heat treatment optimization
- Turbine disk machining cycle time reduced from 120 to 43 days
- Extension of cost share in Morocco, Mexico, Portugal, Poland
- Contract renewal, market share or volume change, dual sourcing benchmarking
Looking back on 2.5 years and 2.5 million hours of operations, LEAP is already delivering on all its promises

- Performance (fuel, noise, emissions)
- Reliability
- Utilization

Historic ramp up is underway, supported by a strong production management system

Cost reduction is right on target
CFM56 / LEAP AFTERMARKET

François PLANAUD,
SAE Services and MRO
CFM56 / LEAP installed base growing

CFM56 / LEAP fleet in service to grow by 4.5% CAGR until 2025

- More than 38,000 CFM56 / LEAP engines will be in operation in 2025

Strong CFM56 installed base over the horizon

- 28,000 CFM56 engines (all models) in operation today
- 22,000+ in 2025

Sustained CFM fleet growth driven by LEAP deliveries

CFM Fleet in service

Source: CFM fleet data, agreed airframer LEAP rates

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Aftermarket business essentially driven by spare parts sales

> Large choice of Maintenance, Repair and Overhaul (MRO) providers for Airlines

Revenue drivers: shop visit volumes, workscopes (content), pricing

Increased customer demand for long term, rate per flight hour agreements

> Provides airlines for maintenance cost predictability

> 3rd party MRO network will develop over time

Profitability drivers: engine reliability, fleet management & maintenance cost optimization, additional services

Transitioning from spare parts model to long term contracts
CFM56: -5B/-7B fleet is still a young fleet

As of 2018 60% of CFM56 -5B/-7B in service have had 0 shop visit

CFM56 -5B/-7B fleet split by number of shop visits performed

- 2018e: 22,800 Engines
  - 60% with no SV
  - 30% with 1 SV
- 2020e: ~23,000 Engines
  - ~40% with 1 SV
- 2025e: ~20,000 Engines
  - ~50% with 1 SV

Source: CFM fleet data

Large maintenance activity ahead for CFM56-5B/-7B fleet
CFM56: Spare parts consumption model

Shop visit forecast

Long term trend

Fleet in service
- Engines in service
- Utilization, area of operation

Technical parameters
- Operating data (Flight leg, temperatures…)
- Hardware durability, Life Limited Parts, EGT…

Short term variations

Airlines strategy
- Fleet management
- Financial & operational situation

Spare parts usage at shop visit

Workscope
- Module exposure
- Rebuild standards, Life Limited Parts (LLP) replacement

Spare parts consumption
- Replacement rates
- Used parts availability and demand

Comprehensive spare parts forecast model
CFM56: -5B/-7B shop visit outlook

CFM56-5B/-7B shop visits to grow by ~5% CAGR until 2025

Peak over 3,000 shop visits per year expected around 2025

Higher peak level than in CMD16, due to additional CFM56 deliveries
CFM56: -5B/-7B shop visit rank distribution

Fleet-wide average timeline for spare parts revenue

Proportion of shop visits 1 & 2 within total of -5B/-7B SV/year

- 2018e: 75%
- 2025e: >66%

Shop visits 1 & 2 are main revenue contributors

Large proportion of shop visits 1 & 2
2017/2018 benefiting from tailwinds

- Positive global context:
  > Traffic growth and high fleet utilization
  > Airlines financial health
- Strong MRO activity & high-content workscopes

Higher perspective over the horizon

- Main contributor to civil aftermarket growth
- Year to year anticipated variations

Peaking in 2025

Stronger outlook for future CFM56 spare parts
LEAP: moving to Services with different type of offerings and contracts

<table>
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<th>Spare parts purchase</th>
<th>Rate Per Flight Hour</th>
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<tr>
<td>Time &amp; Material</td>
<td>ESPH* / ESPO**</td>
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</table>

**Spot Sales / Short term agreement**
- Spare parts sales to MRO shops or operators
- T&M overhaul agreements for an engine or a batch
- Workscope control by operator

**Cash at point of sale**

**ESPH: Engine Service Per Hour**
- Typically 8 to 12 years
- Agreement covering a defined fleet
- Additional services (Lease Engines, Engineering…)
- MRO provider manages Time on Wing and maintenance cost

**Cash per the hour (ESPH) or at shop visit (ESPO)**

**Long Term agreement**

**Increasing scope of services to address customers needs**

*ESP: Engine Service Per Hour  **ESPO: Engine Service Per Overhaul*
## LEAP: Long term contracts performance management

### Leveraging on our expertise

**OEM expertise**
- Wide range of services
- Engine design knowledge

**Fleet management & maintenance optimization**
- Shop visit schedule
- On wing/quick turns interventions

**Operational performance**
- Optimized workscoping
- State of the art MRO facilities

### Bringing digital tools and analytics

**Integrated Data Collection**
- Larger quantity of Engine data
- Environment (Weather, routes, …)

**Predictive maintenance**
- Continuous Remote Monitoring & diagnostics (e.g. advanced vibration analytics…)
  - Reduces physical interventions on engines
- Customized maintenance and inspections plans (e.g. Waterwash recommendations…)
- Dedicated teams developing advanced analytics

**Enhanced fleet management**
- Multi-parameters optimized engine removal plans

▶ A wide suite of levers to manage performance
ESPH and ESPO illustrative cash profile

- Engine Services Per Hour (ESPH)
- Engine Services Per Overhaul (ESPO)

Revenue: IFRS15 Sales  
Billings: Cash in  
Cash Flow: Net Billings less Costs  
Costs: Cash out

- Similar revenue patterns in both cases
- Improved cash profile for ESPH vs ESPO
LEAP: Rate Per Flight Hours agreements portfolio

To date, 28% of LEAP engine orders include a signed CFM Rate Per Flight Hour (RPFH) long term agreement

- Split between ESPH and ESPO: 25% ESPH / 75% ESPO

Within 3/5 years, expected RPFH agreements to represent 60-70% of LEAP installed fleet as further discussions are on-going with a large panel of LEAP customers

- Anticipated split between ESPH/ESPO to be similar for future contracts

We assume later switch to T&M or spare parts model as fleet matures and worldwide overhaul demand increases (typically 8/10 years after EIS)

RPFH agreements trending to 60-70% of LEAP installed fleet
LEAP worldwide shop visits

- Expect strong ramp-up of shop visits as a result of new engines deliveries profile
- ~1,000 shop visits in 2025

Maintenance activity for Safran

- Long term Services portfolio will translate into significantly higher industrial maintenance volumes (x3 vs CFM56)

Planned extension of current Safran maintenance network footprint

Preparing for LEAP MRO ramp-up
CFM56 and LEAP mix of aftermarket revenues

Distribution of CFM56+LEAP aftermarket revenues by nature

- **2017:**
  - 88% Spare parts and T&M
  - 12% RPFH

- **2022e:**
  - ~80% Spare parts and T&M
  - ~20% RPFH

- **2025e:**
  - ~70% Spare parts and T&M
  - ~30% RPFH

- Smooth and progressive ramp-up of RPFH contracts
- Spare parts and T&M will be the main revenue channel up to 2025+
Civil Aftermarket key messages

CFM56

- CFM56 spare parts keep driving civil aftermarket growth until 2025

LEAP

- LEAP Services will progressively ramp up and provide the relay for growth

High single digit growth for total CFM56 & LEAP aftermarket revenues