PART I.
CIVIL ENGINES
CFM56

LEAP TRANSITION

Olivier ANDRIÈS
CEO, Snecma
### LEAP – BEST IN CLASS -

<table>
<thead>
<tr>
<th>Fuel efficiency</th>
<th>NOx</th>
<th>Noise</th>
<th>Reliability</th>
<th>Maint. cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>15% better vs. CFM56</td>
<td>50% lower vs. CAEP 6</td>
<td>New regulation compliant (chapter 14)</td>
<td>99.98% Departure reliability</td>
<td>Same as CFM56 ... best in industry</td>
</tr>
</tbody>
</table>

- **Technology**
- **Materials**
  - New Composites
  - New Alloys
- **Experience**
- **Execution**

- **Performance & reliability**
- **Potential for Improvement**

- New Composites
- New Alloys
LEAP – MARKET SHARE

As of February 29, 2016

CFM LEAP
- A320neo 1,571 a/c (55% m.s.)
- 737 MAX 3,129 a/c
- C919 517 a/c
- 5,217 a/c

PW1000G Series
- A320neo 1,264 a/c (45% m.s.)
- C Series 403 a/c
- MC-21 176 a/c
- 1,843 a/c

CFM LEAP
- 5,217 AC
- 74%

PW1000G
- 1,843 AC
- 26%
100 CUSTOMERS, ALL AROUND THE WORLD

A320neo
1,571 AC announced
29 customers

737 MAX
3,129 AC announced
67 customers

C919
517 AC announced
21 customers
## LEAP – RIGHT ON TRACK

<table>
<thead>
<tr>
<th>Year</th>
<th>LEAP-1A (Airbus A320neo)</th>
<th>LEAP-1B (Boeing 737 MAX)</th>
<th>LEAP-1C (Comac C919)</th>
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<tbody>
<tr>
<td>2012</td>
<td>Design freeze</td>
<td>Design freeze</td>
<td>Design freeze</td>
</tr>
<tr>
<td>2013</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; engine to test</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; engine to test</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; engine to test</td>
</tr>
<tr>
<td>2014</td>
<td>FTB</td>
<td>FTB</td>
<td>FTB</td>
</tr>
<tr>
<td>2015</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; flight</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; flight</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; flight</td>
</tr>
<tr>
<td>2016</td>
<td>EIS</td>
<td>EIS</td>
<td>EIS</td>
</tr>
<tr>
<td>2017</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td></td>
<td></td>
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</table>

### Engine development schedule unchanged for 5 years!
LEAP – A THOROUGH TESTING PROGRAM

- **9,100 hours and 19,500 cycles of Engine testing**
  - Fan Blade Out, Ingestions (birds, water, hailstones, ice slabs), Icing, Block test, Cross wind, Vibration endurance, HP and LP Module Aeromechanics…

- **2,000 Engine Flight Hours accumulated**
  - Flying Test Beds
  - A320neo/A321neo
  - 737 MAX

Proven Performance
LEAP-1A

Program Execution
- Engine testing (1A/1C): 5,300 hours, 13,900 cycles
- A320neo First Flight in May 2015
- A321neo First Flight in Feb 9, 2016
- Flight test campaign: 3 aircraft, more than 220 flights and 550 flight hours, excellent engine behaviour

Performance
- Engine certified: Nov 2015
- Performance at spec @ EIS

Agenda
- Entry Into Service mid 2016
LEAP-1B

Program Execution

- Engine testing: 3,800 hours, 5,600 cycles
- 737MAX flight test campaign: 2 aircraft, first flights on Jan 29 and March 4, 2016
- 35 flights and 89 flight hours already accumulated, excellent engine behaviour

Performance

- Performance at spec @ EIS

Agenda

- 737 MAX flight test campaign supporting 2017 EIS
LEAP-1C

Program Execution

- Engine testing (1A/1C): 5,300 hours, 13,900 cycles
- C919 roll-out Nov 2, 2015

Performance

- Performance at spec @ EIS

Agenda

- C919 first flight: expected 2016
LEAP – RAMP UP

- CFM56 production record level in 2016
- LEAP production will reach a 30% higher rate
- Everything in place to manage a smooth transition and ramp-up
- Large volumes and steep ramp-up are an opportunity to get costs down faster

**NUMBER OF ENGINES PRODUCED**

<table>
<thead>
<tr>
<th>Year</th>
<th>LEAP</th>
<th>CFM56</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>1,612</td>
<td></td>
</tr>
<tr>
<td>2016e</td>
<td>1,650+</td>
<td></td>
</tr>
<tr>
<td>2017e</td>
<td></td>
<td>2,000+</td>
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<td>2018e</td>
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<td>2019e</td>
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<td>2020e</td>
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<td>2021e</td>
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<tr>
<td>2023e</td>
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</tr>
<tr>
<td>2024e</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Full transition in 4 years
LEAP – RAMP UP

➔ 100% of suppliers are well known vendors and aero suppliers – 80% are common with CFM56

➔ Redundancy and/or buffer stock for 100% of parts

➔ 85% of parts are double sourced

➔ Suppliers Selection - based on three main criterias: Supply Chain performance, Growth capacity (including financial criteria) and economic performance

➔ Leveraging Safran, GE and worldwide suppliers footprint

➔ Developing brand new plants for new technologies, Lean Manufacturing built in

Strong plan and actions in place to manage ramp-up
## LEAP – RAMP UP

### EXTENDING THE FOOTPRINT

**SNECMA INTERNAL SHOPS EXTENSION**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SIZE</th>
<th>COUNTRY</th>
<th>SPECIALISATION</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gennevilliers</td>
<td>1,500 m²</td>
<td>France</td>
<td>Precision forging</td>
<td><img src="launched.png" alt="launched" /></td>
</tr>
<tr>
<td>Le Creusot</td>
<td>4,000 m²</td>
<td>France</td>
<td>Turbine disk machining</td>
<td><img src="achieved.png" alt="achieved" /></td>
</tr>
<tr>
<td>Commercy</td>
<td>27,000 m²</td>
<td>France</td>
<td>3D composites RTM</td>
<td><img src="achieved.png" alt="achieved" /></td>
</tr>
<tr>
<td>Villaroche</td>
<td>40,000 m²</td>
<td>France</td>
<td>Logistics for assembly and spares</td>
<td><img src="achieved.png" alt="achieved" /></td>
</tr>
<tr>
<td>Suzhou</td>
<td>19,000 m²</td>
<td>China</td>
<td>Machining and assembly</td>
<td><img src="launched.png" alt="launched" /></td>
</tr>
<tr>
<td>Querétaro</td>
<td>31,000 m²</td>
<td>Mexico</td>
<td>3D composites RTM and assembly</td>
<td><img src="launched.png" alt="launched" /></td>
</tr>
<tr>
<td>Rochester</td>
<td>31,000 m²</td>
<td>USA</td>
<td>3D composites RTM</td>
<td><img src="achieved.png" alt="achieved" /></td>
</tr>
<tr>
<td>Rzeszow</td>
<td>9,300 m²</td>
<td>Poland</td>
<td>Turbine blade and booster spool machining</td>
<td><img src="achieved.png" alt="achieved" /></td>
</tr>
</tbody>
</table>

Over 162,000 m² of extensions and new buildings in Europe, Asia and Mexico between 2012 and 2016
EXTENDING THE FOOTPRINT

<table>
<thead>
<tr>
<th>SIZE</th>
<th>COUNTRY</th>
<th>SPECIALISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>60,000 m²</td>
<td>France</td>
<td>Part &amp; Blade Machining, Bearings, Casting</td>
</tr>
<tr>
<td>50,000 m²</td>
<td>Europe</td>
<td>Part Machining &amp; Casting</td>
</tr>
<tr>
<td>75,000 m²</td>
<td>USA</td>
<td>Casting &amp; Equipment</td>
</tr>
<tr>
<td>40,000 m²</td>
<td>Mexico</td>
<td>Composites, Equipment, Blade Machining</td>
</tr>
<tr>
<td>20,000 m²</td>
<td>Japan</td>
<td>Blade Machining</td>
</tr>
<tr>
<td>50,000 m²</td>
<td>China</td>
<td>Part Machining</td>
</tr>
</tbody>
</table>

Close to 300,000 m² of extensions and new buildings worldwide from 2015 to 2018
LEAP – SAFRAN PULSE LINE

Concept similar to CFM56 assembly (operational since 2009)

- 3 parallel assembly lines composed of 5 working stations / 1 shift of lead time per station
- Latest technologies including engine rotation (Safran patent)

Main milestones

- Suppliers’ selection: Feb 2015
- Design freeze: Sept 2015
- 1st Line delivery: July 2016
- 2nd Line delivery: Jan 2017
- 3rd Line delivery: 2019

3 lines, capacity of 450 engines / year / line
LEAP – RAMP UP

A ROBUST PRODUCT AHEAD OF EIS

• ROUTE TO SERIAL MODE
• SPI
• SPRED
• RUN@RATE
• TECHNOLOGIES MATURATION

ROUTE TO SERIAL MODE:
A DEDICATED PROJECT TO ASSESS AND MITIGATE GLOBAL RISKS FOR LEAP RAMP UP (SINCE 4Q2012)

- 220 suppliers Tier 1 and 25 Tier 2
- 10 Safran locations
- 50 Safran shops
- 6 Centres of Excellence including Quality Teams
- 1,200 parts numbers per engine model
- 250 baselines (refreshed every 6 months)

ROUTE TO SERIAL MODE
- Global control
- Risk consolidation from In House and suppliers analysis including CFM56/LEAP transition leading to an action plan
- Complete coverage through analysis of 59 families of parts
- Risk abatement Plan Monitoring

LEAP internal rate readiness

LEAP supplier rate readiness

INTERNAL SUPPLY CHAIN

EXTERNAL SUPPLY CHAIN

- Up to 60 dedicated people worldwide, common methodology and tool to all suppliers and Safran Shops, common dashboard
- In place up to end of ramp up to reach full rate
LEAP – RAMP UP

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- ROUTE TO SERIAL MODE
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- TECHNOLOGIES MATURATION

BASELINE CONTENTS

Right to left planning

Load capacity analysis

Action plan

Outputs

Risk analysis

INDUSTRIALIZATION MONITORING

- SPI: standard milestones based on critical parameters and statistical analysis
- All parts and all sources covered, 25 milestones

MANUFACTURING CONCESSION CONTROL

- SPRED: Reduction of concession rate through blue print revision and process improvement
- Expected production capability already reached, ahead of the ramp up
WHAT IS RUN@RATE?

- Running at future production rate today
  - Five sets/week for 2 weeks in 2015
  - Will conduct annually for four years… repeating at next higher rate each time

- Used within CFM & with Suppliers
  - 70 sites total in 2015

- Designed to stress the system

- Applies to all facets… materials, production line, logistics

- Designed to make us look ahead
  - Mitigate risks we will face in the future
  - Implement lessons learned

Simulating future production rate during early ramp-up
LEAP – RAMP UP

A ROBUST PRODUCT AHEAD OF EIS

• ROUTE TO SERIAL MODE
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• SPRED
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• TECHNOLOGIES MATURATION

3D Woven Carbon Fiber Composite Fan blades and Fan case

Improved alloy: Titanium Aluminide LPT blades

Improved alloy: Rene65 LPT disks

3-D printed Fuel Nozzles

Ceramic Matrix Composite HPT shrouds

LEAPER – RAMP UP

A ROBUST PRODUCT AHEAD OF EIS

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• SPRED
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LEAP – RAMP UP

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LEAP – RAMP UP

A ROBUST PRODUCT AHEAD OF EIS

ROUTE TO SERIAL MODE
SPI
SPRED
RUN@RATE
TECHNOLOGIES MATURATION

EXEMPLE OF MATURATION FOR NEW TECHNOLOGIES:
3D WOVEN CARBON FIBER COMPOSITES FAN BLADE

→ **1990’s**: Technology and process evaluation

→ **2000-2003**: Joint Technical Development Program with our partner Albany IP
  * Goal: test and validate the technology to make a reliable and cost effective Fan Blade
  * Materials, mechanical properties and process capability

→ **2004-2006**: coupons, partial part and engine test performed with an aero design
  * 7 Bird strike tests done with woven Fan Blades

→ **2007 - 2012**: Mature Technology in a lab with Albany to improve robustness of process and design compliance

→ **2012 - 2015**: Construction of two new plants dedicated to 3D woven Carbon Fiber Technology

→ **2014 - 2015**: Delivery of first production parts and LEAP-1A Certification

→ **2016**: LEAP ramp up starts, construction of an additional manufacturing plant in Mexico

Over 2,500 3D woven carbon fiber fan blades produced for maturation ahead of production ramp up
MORE THAN 40 LEAP CUSTOMERS IN SERVICE WITHIN THE NEXT 3 YEARS

Rigorous preparation:

- Extensive work with airframers to leverage the Flight Test Campaign
- Documentation / Engine Shop Manual ready
- Tooling validated
- Expert FSE (Field Support Engineers) Program
- Dedicated EIS readiness program with each Customer, including comprehensive training
- EIS support stress tests with LRU (Line Replaceable Unit) providers
- MRO network ready

Ready to support our customers
CFM56 - LEAP AFTERMARKET

François PLANAUD
Executive Vice President Services and MRO, Snecma
CFM INSTALLED BASE EVOLUTION

- **CFM fleet in service to grow by 4%+ annually over the next decade**
  - 25,000 CFM56 engines in operation today
  - More than 27,000 CFM56 engines will be in operation in 2018

- **New generation LEAP engines will relay CFM56**
  - LEAP brings additional fleet growth potential

- **By 2025, 11,000+ engines expected to be added to the fleet in service**

![CFM Fleet in service](chart.png)

- **Nb of engines**
  - CFM56 Gen1
  - CFM56 Gen2 (5B/7B)
  - LEAP

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CMD’16 | March 14, 2016
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CFM56 GEN 2 FLEET STILL VERY YOUNG

CFM56 Engine Fleet as of 2015
Age distribution

➔ **In 2015:**
  - 50% of CFM56 fleet is below 10 years
  - Average age of CFM56 Gen 2 fleet in service is **below 8 years**

➔ **In 2025:**
  - Average age of CFM56 Gen 2 fleet in service remains **below 15 years**
CFM56 GEN 2 MAINTENANCE ACTIVITY STILL GROWING

As of 2015
- 19,000 + Gen 2 in service

As of 2020
- 22,000 + Gen 2 in service

As of 2025
- 18,500 + Gen 2 in service

- No shop visit performed on engine
- One shop visit or more

→ 2015: more than 60% of CFM56 Gen 2 in service have never had a shop visit

→ 2025: the proportion is still close to 25%
SPARE PART CONSUMPTION FORECAST MODEL

- Engine deliveries
- Fleet aging

- Statistical laws
- Technical events
- Life limited parts
- Airworthiness

Product technical expertise

- Fleet evolution
- Market analysis
- Airline activity and perspectives

Customer data

Engine in service

Shop visit

- Workscope
- Module exposure
- Scrap rate

Shops experience

Maintenance contracts

Customer data

- Specific SV schedule
- Maintenance strategy

Spare parts usage

A comprehensive combination of technical and market inputs
Deterministic parameters strong drivers for first shop visit

Technical data

Customer / Market data

Major model output
CONTINUALLY ADAPTING THE SPARE PART CONSUMPTION FORECAST MODEL

- More than 30 parameters statistically analyzed
- Customer base segmented into 10 categories

Segmentation updates since 2013, driven by market evolution:

- Some North American airlines, exiting Chapter 11 and benefiting from low fuel prices moved from low profitability to established legacies
- High level of orders, deliveries and traffic growth in China lead to a specific forecast and analysis
- Redistribution of BRICs airlines across existing segments
SHOP VISIT OUTLOOK

- Maximum shop visit activity on CFM56 around 2025
- CFM56 Gen 2 shop visit activity will grow by 50%+ over the next ten years

Worldwide CFM fleet shop visits

<table>
<thead>
<tr>
<th>Year</th>
<th>CFM56 Gen 2</th>
<th>CFM56 Gen 1</th>
<th>LEAP</th>
<th>Total</th>
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<tbody>
<tr>
<td>2012</td>
<td>500</td>
<td>200</td>
<td>100</td>
<td>800</td>
</tr>
<tr>
<td>2013</td>
<td>550</td>
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<td>2025</td>
<td>1150</td>
<td>850</td>
<td>750</td>
<td>2750</td>
</tr>
</tbody>
</table>
TIMELINE OF SPARE PARTS CONSUMPTION

Most spare parts consumption on CFM56 Gen 2 engines is generated in the first 18-20 years of operation.

Fleet-wide analysis: lifetime consumption profile for CFM56 Gen 2 engine
CFM56 SHOP VISIT RANK DISTRIBUTION

- **2015**: shop visits #1 and #2 are the main drivers, representing more than 80% of CFM56 Gen 2 maintenance activity.

- **2025**: shop visits #1 and #2 will still represent 2/3 of activity.
Main contributors to spare parts consumption are now Gen 2 engine models.

In 2016, consumption is expected to have doubled since 2010, supported by a very favorable environment in 2014 and 2015:
- Oil price decrease
- Traffic growth

Trend grows faster and peaks higher than 2013 view, mainly due to greater CFM56 success in recent years.

Forecast model confirms growth outlook for CFM56 spare parts.
Used parts

- The spare part forecast model anticipates the increased use of Used Serviceable Material
- CFM Materials (a Snecma & GE joint venture) is prepared to address the future availability of used material for CFM56 Gen 2 engines
- Used material is also an opportunity to reduce material costs in RPFH service agreements
MARKET TRENDS:
RATE PER FLIGHT HOUR SERVICE AGREEMENTS

- An increasing customer driven evolution towards “per hour” long-term service agreements
  - Airlines favor predictable operating costs and long term visibility

- Services product portfolio evolution
  - 10% of CFM56 fleet covered by RPFH* contracts from Safran, expected to remain stable
  - On LEAP, 22% of orders to date include a CFM RPFH contract
    - Assumption: 50 to 60% of the fleet to be supported under RPFH agreement
    - Possible reversion to Time & Material maintenance in the second part of engine life, and later in the program

- Gradual transition
  - LEAP fleet will represent ~18% of combined CFM fleet by 2020

- Opportunities for the engine OEM as an MRO provider
  - Maintenance cost & reliability key parameters in LEAP engine design and proven architecture choice
  - Deep knowledge of the engine and its maintenance costs over time through customer support activities
  - Continuous maintenance costs improvements over program life

Active installed fleet of CFM engines (estimate)

*RPFH = Rate per flight hour contracts
RPFH SERVICES CONTRACT MANAGEMENT

OFFERS
• Enhanced pricing model
• Operators proximity

CONTRACTS
• Contract expertise
• Responding to customer demand with bespoke offers

EXPERIENCE
• Contract management & evolution
• Cost optimization
• CFM56 and GE90/GP7200 RFPH contracts background

EXECUTION
• OEM Product expertise
• Fleet management and time on wing optimization
• Cost effective workscopes & repair development
• Extended industrial capabilities

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