



Single aisle aircraft engines MRO

Strategic levers to address supply chain challenges

Executive Summary

At its peak in 2025, 648 aircraft powered by GTF engines (A320neo, A220, E190/195-E2) were grounded while awaiting engines shop visits, causing major disruption to airline operations. This was the result of an unprecedented ramp-up in new aircraft delivery targets, combined with a series of engines design maturity and production quality issues. These factors significantly reduced the engines Time On Wing (TOW) to well below industry expectations, in turn creating bottlenecks for engines shop visits.

Both the LEAP engines from CFM (*LEAP-1A for A320neo, LEAP-1B for 737 MAX, LEAP-1C for Comac C919*) and the Geared Turbo Fan (GTF) engines from Pratt & Whitney (*PW1100G for A320neo, PW1500G for A220, PW1900G for E-190/195-E2*) are set to continue their rapid expansion, with annual forecasted delivery targets near 2,500 LEAPs and 1,200 GTFs respectively. This ramp up, driven by the ambitious production rates of the 737 MAX and A320neo aircraft families, is unprecedented in the industry, and it has consequences.

The annual number of shop visits required through 2040 will increase further, reaching a peak of over 5,000 shop visits for the LEAP and 2,000 for the GTF respectively.

Engine MRO: Persistent Supply and Access Headwinds

Engine OEMs are expanding maintenance, repair, and overhaul (MRO) capacity either directly or through partner networks. However, ongoing disruptions in the supply of spare parts are limiting the impact of these measures, and engine shop turnaround times remain longer than normal.

Access by independent MRO providers has also been limited by new “all inclusive” PBH (*Power by the Hour*) engine service contracts frequently sought by airlines at the early stage of engine programs, restrictive commercial MRO licensing practices from certain OEMs, and insufficient production of piece parts.

This situation, combined with unprecedented new aircraft production rates has made the fleet particularly vulnerable to sudden spikes in maintenance demand, such as those triggered by the recent ‘powdered metal issue’ affecting HPT/HPC disks on GTF engines. This has resulted in severe shortages of serviceable engines, leading to unexpected (and extended) aircraft groundings (*for example, up to 28% of GTF-powered aircraft were grounded in March 2025¹*).

¹ Based on Emerton analysis of Cirium data. Similar values have been reported in the public domain. For example: <https://www.reuters.com/business/aerospace-defense/how-engine-shortages-sent-almost-new-airbus-jets-scrapyard-2025-10-20/>

Actions for Industry

Expected expansion in overall shop-visit capacity will ease the current shortages affecting engine MRO, but other levers exist to enhance resilience from such unexpected peaks in the future, and further support airlines operations:

1. Increase **engine parts availability** i) by accelerating the development and approval of new repair instructions to reduce scrap rates of unserviceable parts (*either through the OEMs or through regulatory approved instructions such as EASA Part 21 or FAA DER*), ii) by extending piece parts production capacity through OEM licensing manufacturing to third parties, and iii) also by facilitating wider access to used serviceable parts recovered from initial engine teardowns.
2. Ease the conditions for **fair market access for independent MROs** to accelerate new capacity development. For example, the Agreement signed between CFM and IATA in 2018 (“IATA-CFM Agreement”) and [renewed in January 2026](#) should be widely considered as an industry best practice in this regard.
3. Encourage both airlines and lessors, ahead of aircraft / engine acquisition, to **secure extended lifelong term access to pre-negotiated spare parts price catalogues** (e.g., LLPs, HPT, fan blades, etc.). This could include coverage for future part-numbers evolutions, and capped annual escalations (similar to the product support protection from Boeing PSAA and Airbus SSC applicable to airframe SFE components), with the ability to assign these terms to MROs of their choice, including independent providers. That way, lessors could share such key protections with their lessees and independent MROs.
4. Encourage all OEMs (not only engines OEMs, but also airframe components OEMs as well) to adopt fair and best practices for aftermarket programs. **For example, by endorsing the same principles as those defined in the IATA-CFM Agreement** (*in which CFM recognizes the right for customers to choose using FAA/EASA approved non-OEM parts & repairs: PMAs & DER / Part 21*). In the IATA-CFM Agreement, it is also remarkable that third-party competing MROs are recognized by CFM as direct beneficiaries of those measures.

While these strategic levers may not address all existing bottlenecks, they can mitigate the disruptions and remain essential to managing shop-visit demand through the 2030s and 2040s.

Introduction

Among the many challenges tied to the aviation sector's rapid traffic expansion (*with a forecasted growth of +3.6% per year until 2044*), engine maintenance has emerged as a major bottleneck. Airlines are currently experiencing significant operational disruptions: the demand for shop visits is surging while supply-chain constraints are still tight².

The bottleneck is particularly acute for the latest engine models equipping the new generation of single aisle aircraft: A320neo (*powered by LEAP-1A or GTF engines*), 737 MAX (*powered by LEAP-1B*), and A220 (*powered by GTF engines*).

For example, a peak of aircraft groundings was recorded in March 2025, when 648 aircraft³ powered by GTF engines (A320neo, A220, E190/195-E2) were in extended storage (*representing 28% of the total GTF fleet*), waiting for engine spares during shop visits. As communicated by the OEM, this situation was mainly due to a production anomaly in the HPT and HPC disks of GTF engines (*a powdered-metal anomaly*). Most airlines were affected. Some of those that are particularly exposed to GTF engines had to take costly measures to adapt their operations. Examples from the public domain include:

- IndiGo (*one of the largest customers for the A320neo with around 330 aircraft, most of which are GTF-powered*) retained 14 older A320 in service and extended leases on 36 other aircraft. By delaying the transition from legacy to next-generation aircraft, they postponed expected fuel savings. In addition, they had to arrange leases for 11 aircraft⁴
- Wizz Air (*around 200 A320neo aircraft*) reported having reduced their capacity by at least 10% in 2023 due to those issues⁵

The LEAP engine has also faced premature issues, reflecting the early-service maturity phase, particularly on the high-pressure turbine (HPT) stage-1 blades in hot and dusty operating environments. This has led to increased borescope inspections, premature engine removals and occasional in-flight shutdowns for airlines operating in the Middle East and North Africa. Some airlines like IndiGo, Iberia and Cathay Pacific were especially affected. Ascend Airways (a wet lease company) also reported a challenge in handling a 30% shorter TOW in harsh environments.

The number of commercial aircraft in service (passenger and freighter) is forecasted to double between 2024 and 2044 (*from 24,730 aircraft in 2024 to a projected 49,210 in 2044*⁶). This will increase the aviation sector's exposure to this type of MRO-capacity bottleneck in the event of unexpected production or in-service issues.

2 This situation is also described in the global Industry White Paper co-issued between IATA and Oliver Wyman ("Reviving the Commercial Aircraft Supply Chain", and available on the IATA website: [reviving-the-commercial-aircraft-supply-chain.pdf](#))

3 Based on [Cirium](#) database

4 India's IndiGo to lease new aircraft to weather Pratt engine issues — [Reuters](#)

5 Wizz Air Expects To Reduce Capacity By 10% Over Pratt & Whitney Engine Issues — [Simple Flying](#)

6 Based on Airbus 2025 global market forecast. Figures reflect passenger aircraft with ≥ 100 seats and freighters with a payload above 10t

Acting now to improve the single aisle engine MRO sector’s resilience to unexpected peaks in demand is therefore essential.

This report explores the underlying demand-side factors for single aisle engine MRO services, the way the supply of MRO services has been driven by engine manufacturers and identifies levers to alleviate tensions in the MRO supply chain.

LEAP Family

GTF Family



Figure 1: Reminder on engines and aircraft models

Source : Boeing, Airbus, Comac, Embraer



SECTION I.

Rising engine MRO demand strains capacity and creates severe bottlenecks

Engine MRO is mainly performed through shop visits during which engines typically undergo performance restoration and/or replacement of Life-Limited Part (LLP) parts.

Global engine MRO⁷ was a market of about USD 50 Billion⁸ in 2024 and typically represents 40-50% of total aircraft MRO spending. It mostly consists of shop visits, often exceeding USD 3-4 million depending on the engine type, work scope, and parts needs.

Shop visits vary in their scope, their concerned engine modules, and can be triggered by multiple reasons including performance restoration, mandatory retrofit campaigns and LLP replacement requirements⁹. LLPs are parts with a cycle limit (e.g., disks, shafts) and require disassembly and replacement at fixed intervals, typically around 15,000 to 20,000 cycles for HP parts on mature engines. For a single aisle aircraft, this typically corresponds to 5-7 years of operation¹⁰.

The current demand for engine shop visits for single aisle aircraft is experiencing a severe surge, mainly due to four factors:

1. Transition from legacy to new-generation aircraft.
2. Unprecedented ramp-up of new 737 MAX and A320neo aircraft deliveries.

⁷ On-wing maintenance (line maintenance) is excluded from the MRO market. On-wing maintenance consists of borescope inspection, replacement of LRU (Line Replacement Unit) parts, troubleshooting, etc. These tasks are typically defined through the Aircraft Maintenance Manual (AMM) without removing the engine from the wing. It is usually performed by the airline or their Line Maintenance providers

⁸ Based on Global Fleet and MRO Market Forecast 2024-2034 from Oliver Wyman

⁹ These visits are the ones requiring a test cell. However, there are other light maintenance shop visits that require licenses, tools, expertise etc. that do not require a test cell (off wing) run at the end. They are also part of the bottleneck

¹⁰ LLP (Life Limited Part): One cycle corresponds to one flight. An aircraft used for short rotations (e.g., between New York and Washington DC) could perform around 3,000 cycles per year. It would induce a shop visit to replace first limiting LLP on HP module after around 5 years. Aircraft used on longer rotations would have their first LLP shop visit later (for example, after 7 years)

¹¹ Based on the number of aircraft delivered. This figure does not include spare engines and does not account for the lead time between engine delivery and aircraft delivery. Thus, the figures provided by engines OEM may differ

3. Early-life maturity issues, which are typical and expected during the first years after entry into service, leading to a temporary reduction in TOW.
4. Unexpected quality and performance issues further reducing TOW below initial expectations, even during the early in-service period.

1. Transition period

The single aisle aircraft market is in a transition phase between legacy aircraft (A320 powered by CFM56-5 or V2500 engines and 737 NGs powered by CFM56-7 engines) and new-generation aircraft (A320neo powered by LEAP-1A or GTF, 737 MAX powered by LEAP-1B and Comac C919 powered by LEAP-1C).

At the end of 2024 over 23,000 CFM56 and 5,000 V2500 were still in service, while around 7,000 LEAP¹¹ and 5,000 GTF engines had already been delivered by this date.

Thus, significantly larger MRO capacities must be developed to service both LEAP and GTF engines, while maintaining capacities for legacy models (CFM56 and V2500) which will continue to be operated by airlines. For example, the CFM56 series is currently experiencing its peak level of shop visits (around 2,000 shop visits estimated in 2025).

2. Unprecedented rapid ramp-up

Since entry into service, the ramp-up of LEAP and GTF engines has been unprecedented. This is directly driven by the ambitious aircraft production delivery rates set by Airbus and Boeing.

As illustrated in Figure 3, the LEAP fleet is growing twice as fast as the CFM56 fleet in its early days, driving a very fast ramp-up of MRO capacity needs.

The LEAP and GTF fleets are set to continue their rapid expansion, with yearly deliveries expected to be slightly below 2,500 LEAP engines and 1,200 GTF engines (Figure 2).

Overall, the in-service LEAP and GTF fleets are expected to multiply by 5 or 6 between 2024 and 2040. This is because previous aircraft models including A320ceo and 737NG will be progressively phased out and replaced by A320neo and 737 MAX.

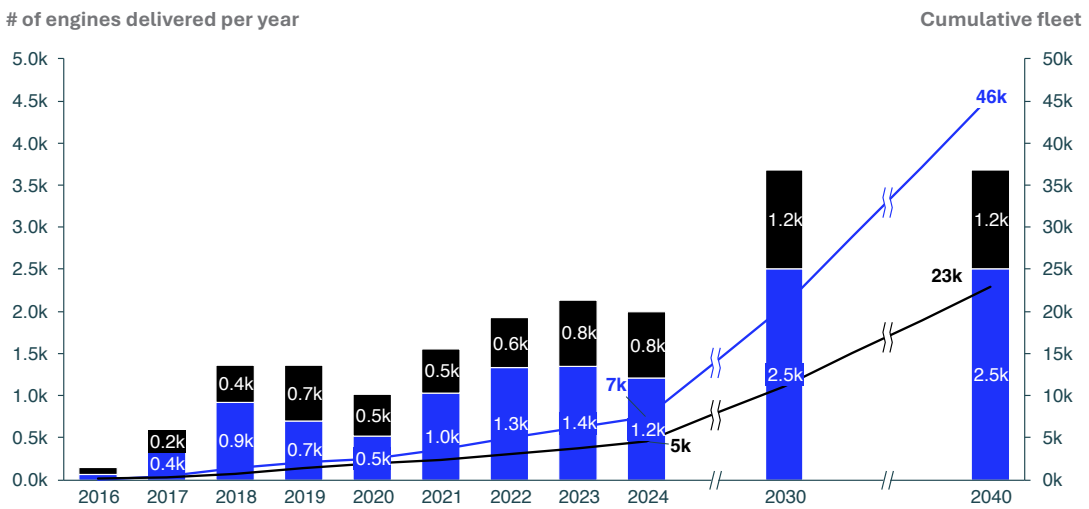
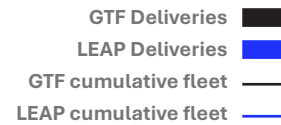


Figure 2: # of engines delivered and forecast – based on aircraft deliveries (excluding spare engines)
Note: Actual engine delivery differs from these figures because of 2 factors:
 i) lead time between engine delivery and aircraft delivery
 ii) spare engines (which are not included in this chart)
Source: Emerton estimate



LEAP & CFM56 cumulative engines fleet

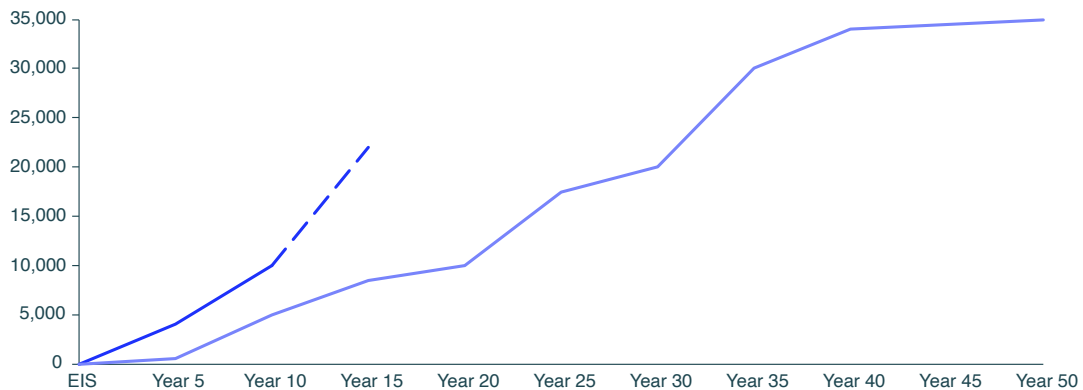


Figure 3: Comparison of CFM56 and LEAP ramp-up
Source: 2024 Safran integrated report



3. Typical early-life maturity issues, leading to a temporary reduction in TOW

Engines removal can be triggered by operational, technical, and administrative factors:

- Overhaul (major Engine Shop Visit – LLP replacement)
- Performance restoration including recovering EGT margin degradation, fuel efficiency, issues identified via ECM (Engine Condition Monitoring)
- Condition Monitoring and AMM (Aircraft Maintenance Manual) criteria: exceedances such as vibration limits, oil consumption, borescope findings, etc.
- Foreign Object Damage (FOD), bird strikes, or other unexpected events
- Gearbox and other mechanical failures
- Policy-related factors (lease return, convenience, staggering, spare rotation, etc.)

Shop visits can also be required when Airworthiness Authorities (e.g., EASA/FAA) release an AD (Airworthiness Directive) or when OEMs issue non-mandatory SB (Service Bulletin) for upgrades or inspections.

Neither LEAP nor GTF have reached their mature TOW levels yet. As a result, they currently require earlier and more frequent MRO shop visits.

LEAP engines have faced premature deterioration, reflecting the early in-service maturity phase. Examples include (but are not limited to):

- High-pressure turbine (HPT) stage-1 blades durability issues in “hot and harsh” operating environments

- Coating deterioration on CMC (Ceramic Matrix Composite) shroud surrounding the first stage of HPT
- Fuel nozzle coking, leading to potentially reduced fuel flow and subsequent loss of thrust

A sizeable portion of these modifications is expected to be completed across the LEAP fleet over the next 3-5 years (for example, the new HPT blade certified for the LEA-P1A in December 2024) aiming for engines to start achieving their full mature TOW, typically between 15,000 and 20,000 flight cycles for single aisle aircraft in normal environments.

The GTF fleet faces persistent technical difficulties, currently resulting in TOW of 5,000-6,000 flight cycles (without taking into account the inspections due to the powdered metal contamination). Since its entry into service in 2016, GTF engines have been affected by several maturity issues, which have required additional shop visit slots (heavy or light¹²) to implement the fixes (modifications) or perform additional inspections. Examples are:

- Corrosion of the HPC front hub
- Recurring oil leakage
- Excessive N2 (HP rotor) vibration
- Cracks in HPC rotor shaft (led to a redesign of the HPC front hub and HPC rotor shaft to increase durability and decrease vibration stress)
- Accelerated thermal degradation and wear of HPT blade
- Cracks in LPC stage 1 blades
- Premature deterioration of the combustor liner

¹² Due to shop slots constraints, MROs favor heavy visits that are linked to higher revenues rather than light visits that take slots away. This leads to unreasonable delays as engines must be shipped to other regions causing significant time delays and higher costs (as a result of the transportation)

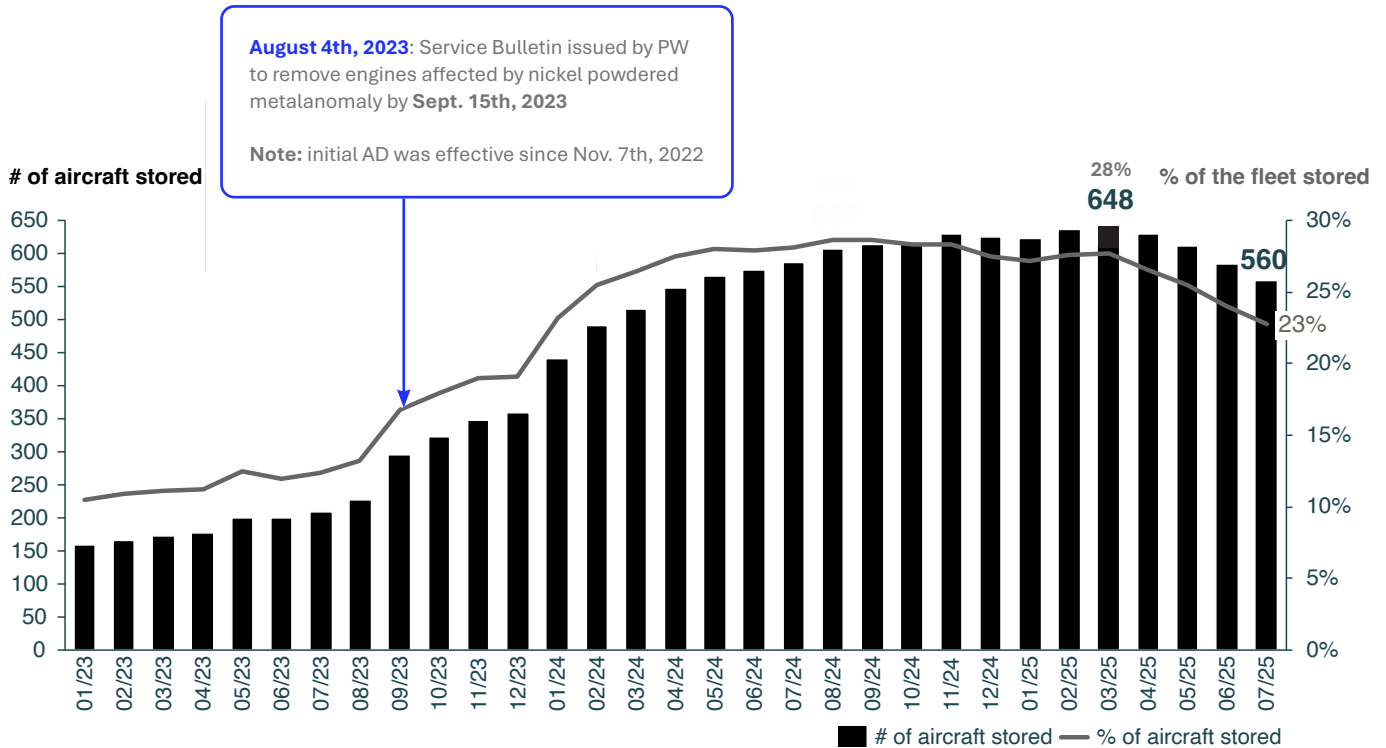


Figure 4 : Evolution of the number of aircraft powered by a GTF engine in long-term storage

Source : Cirium.

Note : Includes all GTF powered aircraft reported as stored (due to powdered metal inspection or any other technical reason)

4. Unexpected quality and performance issues further reducing TOW below initial expectations

In addition to these durability issues, the situation for the GTF has been significantly worsened by the powdered-metal anomaly affecting HPT and HPC disks.

This situation immediately increases the demand for GTF shop visits to perform inspections, resulting in long waiting times for airlines to secure a slot.

Under normal conditions, high-performing shops should be able to conduct this inspection (*including disassembly / reassembly*) in 120 days, but cases have been reported with a TAT (*Turnaround Time*) of up to 300 days.

Due to the lack of MRO capacity and material shortages, many aircraft are parked, waiting for spare engines during the time that their engine is in the shop. Figure 4 shows the evolution of the number of GTF-powered aircraft in long-term storage. It reached 648 aircraft (so 1,296 engines) in March 2025.

The total GTF fleet consisted of 2,344 aircraft, meaning 28% of the fleet was grounded due to the lack of MRO capacity (and a lack of available spares).

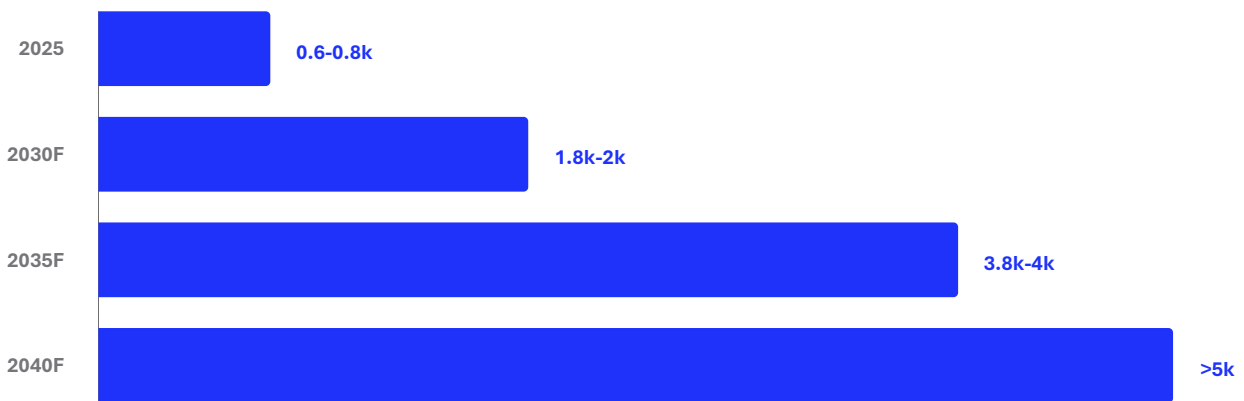
The LEAP and GTF ramp-ups will progressively increase the demand for shop visits, to reach a peak of over 5,000 visits for LEAP and 2,000 for GTF in 2040.

In 2025, the number of shop visits is estimated to be between 600 and 800 for LEAP and around 1,000 for GTF.

The current demand is impacted by the non-mature TOW, which creates a large backlog.

As illustrated in Figure 5, the number of shop visits is expected to increase significantly (and above the current peak), driven by fleet growth, to over 5,000 shop visits per year for the LEAP engines and over 2,000 for the GTF by 2040. Consequently, the industry must take measures to mitigate the risk of unexpected bottlenecks and enhance the resilience of the MRO sector.

LEAP shop visits forecast



GTF shop visits forecast

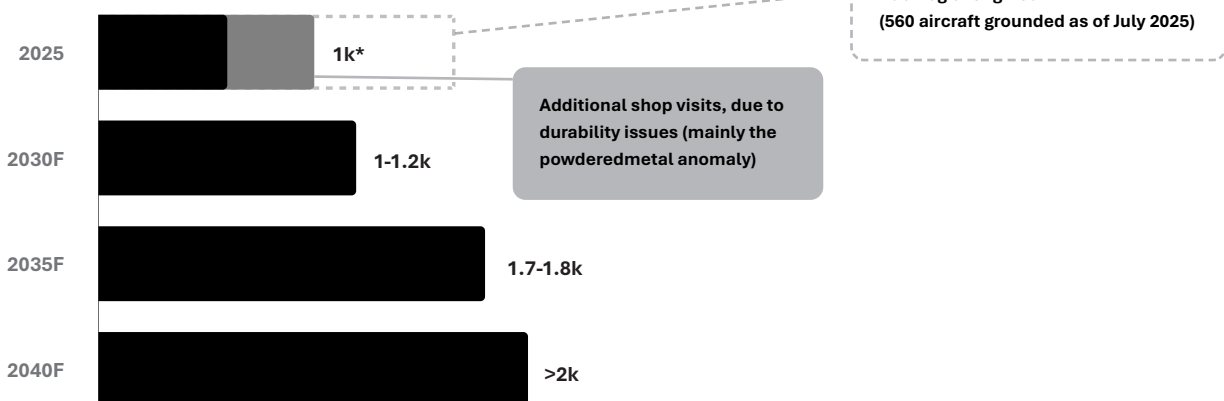


Figure 5 : Forecast for LEAP and GTF annual shop visits

Source : Emerton analysis based on CFM communications (Safran investor meetings 55th Paris Air Show–June 2025 and GE investor meetings 54th Paris Air Show–June 2023) and internal analysis

* Estimated capacity to date

SECTION II.

Single aisle engine OEMs are investing to expand both internal and external MRO capacities



OEMs control the largest share of the MRO market with their own shops. In addition, the global MRO capacity is complemented by external third-party shops. Many of them would typically have some form of commercial arrangement with the OEM, to access key enablers such as:

- The Engine Shop Manual (ESM) with the repair procedures
- Spare part sourcing at a competitive price and in a timely manner
- Quick support for technical queries

In this context there are different levels of MRO arrangements set by the OEMs :

MRO (affiliated) partners of the OEMs

They are part of their commercial MRO network and have access to the Engine Shop Manual (ESM), specific repair procedures and can purchase spare parts from the OEM at the most competitive price.

For CFM, an open MRO network has been set up (e.g., CFM Premier MRO previously known as CBSA – CFM Branded Service Agreement for LEAP engines) where each Premier MRO can compete against i) the other Premier MROs, ii) CFM, and iii) non-Premier MROs to offer their services to operators. In the case of both OEMs, their affiliated MROs typically benefit from the OEM's marketing and may perform offload shop visits for the OEMs.

Regarding Pratt & Whitney (PW), it is however understood that its' affiliated MRO partners cannot independently compete for shop visits, but rather only perform shop visits assigned by PW themselves (see Figure 7).

Semi-Independent MROs

These are MRO shops outside the commercial network of the OEMs, but who still sign some more limited commercial license agreements with the OEM to facilitate access to some of the above enablers (ESM, spare parts, etc.).

NOTE: in their response for the preparation of this white paper, CFM considers that although unaffiliated MROs outside of their "CFM Premier" network would still sign a different form of commercial license (called CFM General Support License Agreement "GSLA", or Purchase License Agreement "PLA"), those unaffiliated MROs are nevertheless considered as "independent" by CFM as such licensing would not prevent those MROs from using PMAs, regulatory approved non OEM repair instructions (EASA Part 21 / FAA DER), or third party Used Serviceable Material (USM) solutions, and compete with CFM for work.

Those elements also relate to the strategic merits of the IATA-CFM Agreement through which CFM not only affords for customers to choose to use PMAs, Part 21 and FAA DER repairs, but also provides free access to its engine shop manual to its MRO competitors. (More details are available on the IATA website: [cfm-conduct-policies-and-implementation-measures.pdf](https://www.iata.org/en/pressroom/2018/01/20180116-cfm-conduct-policies-and-implementation-measures.pdf)).

These dispositions do not, however, currently exist from Pratt & Whitney.

Fully independent MROs

(see Figure 6)

These are also regulatory fully approved Part 145 MROs, but those who choose not to enter in commercial licenses with the OEMs. The business model includes value creation through the development of approved repair instructions (both OEM repair instructions and regulatory approved non-OEM repair instructions such as through FAA DER or EASA Part 21) and the use of USM recovered from early engine teardowns. Until now, this category of MROs has focused on the market for mature and sunset engine programs. At the moment, none of this category has emerged yet to service the latest LEAP and GTF models.

Both CFM and PW have initiated investments to expand MRO capacity.

Figure 6 provides examples of LEAP and GTF MRO network expansion (internal and external).

Internal capacities

CFM has announced investments in internal MRO capacity. This includes new facilities in Brussels and Hyderabad (India), and expansions in Mexico and Morocco.

Pratt & Whitney is also heavily investing in its internal GTF MRO infrastructure. They have announced increased capacity of 40% at their West Palm Beach Engine Center in Jupiter by the end of 2025, and a 60% capacity expansion at the Eagle Services Asia facility in Singapore.

External capacities





(see Figure 8)

CFM has communicated on its network expansion, recently adding for example MTU Maintenance Dallas as a Premier MRO affiliated shop to support both LEAP-1A and LEAP-1B fleets (April 2025), and signing new licenses with non-affiliated MROs (e.g., IAI in July 2025).

PW has also announced capacity ramp up through its network of affiliated third-party MROs. New partners, such as Sanad and ITP Aero, have been integrated into the GTF MRO network. Existing partners are ramping up significantly; for instance, MTU Aero Engines aims at increasing its annual capacity to 600 shop visits across all GTF models. Delta TechOps is also planning a 30% capacity increase.

Figure 6: Recent developments in LEAP and GTF MRO networks

Source: Emerton

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|---|--|---|
| <p>Investments to increase internal MRO capacity</p> | <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>LEAP Family</p> <p>GE \$1 billion in its global MRO facilities across the Americas, Europe and Asia</p> <p>Safran €1 billion, to reach a capacity of 1,200 shop visits per year by 2028.</p> <p>Examples A new site in Brussels (2024) A new facility in Hyderabad, India (2025) A second MRO shop in Querétaro, Mexico (2026) A new facility in Casablanca, Morocco (2026) Expansion of Villaroche (2025) and Saint-Quentin-en-Yvelines (2026) facilities</p> | <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>GTF Family</p> <p>West Palm Beach (US) \$20m investment to increase MRO capacity by +40% by end of 2025</p> <p>Eagle Services Asia (Singapore) opening of a 48,000 ft² expansion which increases MRO capacity by +60%</p> <p>Christchurch Engine Center (New Zealand) \$150m investment announced in Nov. 2024 for a 14,000m² expansion to reach 140 shop visits per year by 2032</p> |
| <p>New external shops or expansions</p> | <p>CFM Premier Standard Aero: March 2023 ST Engineering: March 2023 MTU Maintenance Dallas: April 2025</p> <p>GSLA SR Technics: Sept. 2023 Sanad: Nov. 2023 IAI: July 2025</p> <p>CFM believes at least 50% of LEAP shop visits will be won by shops not controlled by CFM (i.e., Premier MRO shops and other independent MRO licensees)</p> | <p>Sanad enters GTF MRO network (February 2025)</p> <p>MTU to increase capacity to 600 shop visits per year (announcement in April 2025)</p> <p>Delta Ops to increase capacity to 450 (+30%) shop visits per year (announcement in April 2025)</p> <p>ITP Aero enters GTF MRO network (June 2025)</p> |



SECTION III.

PW and CFM have developed different MRO network models

Control over the aftermarket for new engine models has been a strategic objective sought by most OEMs. Over the years such practice has resulted in limited ability for fully independent MROs to compete.

PW and CFM follow different MRO strategies regarding GTF and LEAP engines. This results in varying perceptions of their resilience during the current MRO bottleneck and their ability to mitigate its impact.

Based on public domain information, PW appears to have adopted a tighter model for the GTF aftermarket, currently making it virtually inaccessible to third-party competitors (outside of the network of MROs controlled by PW):

- Nearly all new GTF engines are understood to have a maintenance contract directly with PW.
- Under this model, PW allocates shop visits exclusively across its 5 internal repair shops (*located in Midland, Jupiter and Dallas in the US, in Singapore, and Christchurch in New Zealand*) and a network of 20 selected MRO centers (which includes strategic partners like Lufthansa Technik, Delta TechOps, and MTU Aero Engines).
- This model also applies for airlines with in-house MRO capacities (e.g., Air France, Delta). Although such airlines may be a part of the PW MRO network for GTF, they may see their own engines being shipped to other third-party shops under such OEM network practices.

This model has at least two major consequences for airlines:

1. Independent MROs, which are not a part of the PW MRO network, cannot commercially access the GTF aftermarket (*not having access to*

the ESM or the capacity to purchase spare parts at a competitive price are secondary issues).

2. Even if there are several options to perform a GTF shop visit (*PW internal shops or from its network of 20 external licensed shops*), airlines are unable to put these shops in competition or decide on the scope of repairs to be managed during the shop visit.

CFM appears to have adopted a more open approach in which non-affiliated MROs may have easier access to compete in the LEAP aftermarket

(*see Figure 7*)

Through the co-existence of i) the CFM Premier affiliated MROs, and ii) the other non-affiliated licensees of CFM, airlines appear to have wider access and ability to choose between different competing shops. However, non-affiliated MROs mostly remain dependent anyway on CFM's parts and the pricing policies of CFM.

LEAP shop MRO activities

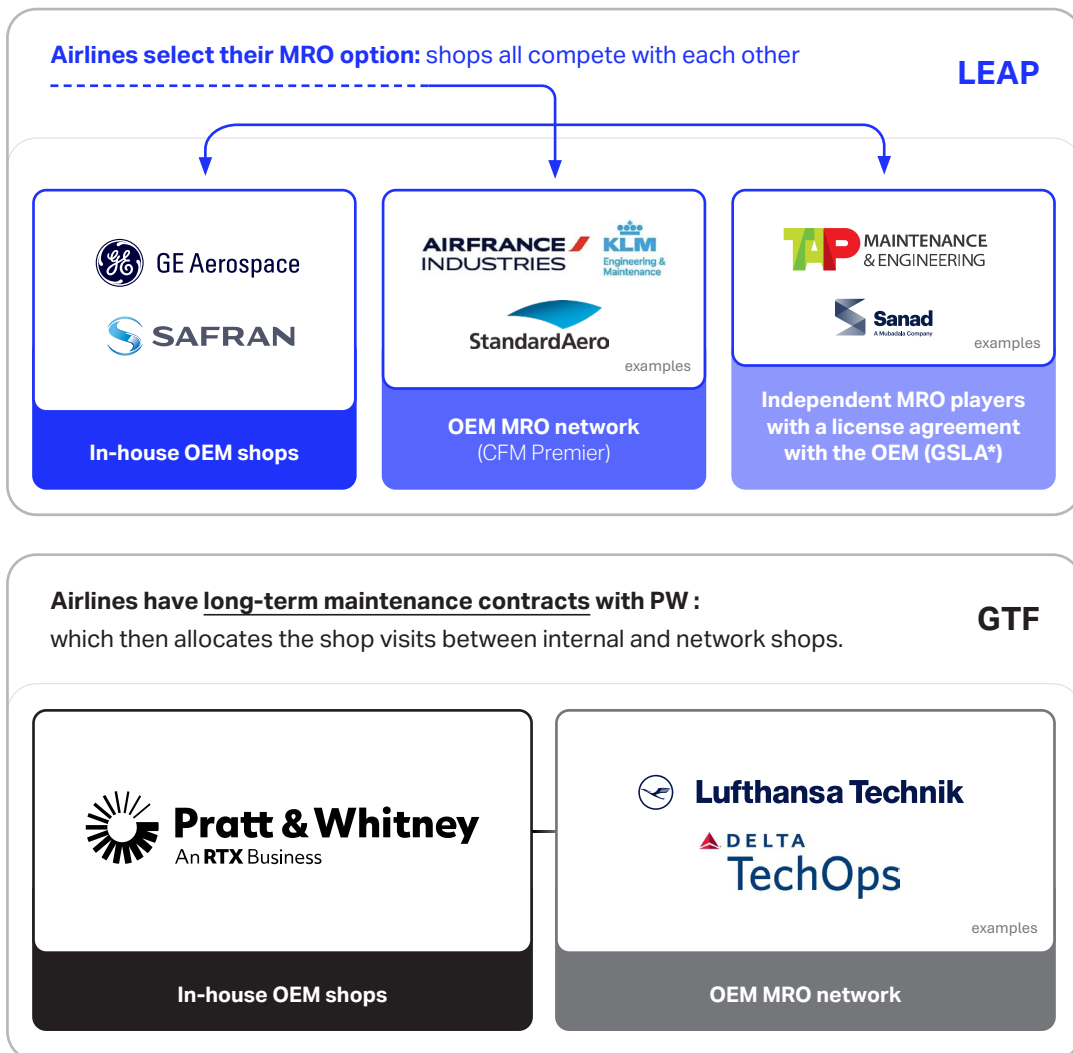
LEAP shop MRO activities can be conducted in several ways:

1. Like for GTF, in one of the **OEM shops** (CFM: Safran / GE)
2. In one of the **CFM Premier MRO** (previously known as CBSA: CFM-Branded Service Agreement – see list in Figure 8). It includes MROs like Air France Industries-KLM E&M or Standard Aero. Each of the Premier MROs competes with the other Premier MROs (and with CFM and non-Premier MROs, although through different access to spares parts pricing policies by CFM).
3. In a **non-affiliated MRO shop with whom CFM has signed some commercial licensing** (GSLA: General

Support License Agreement or PLA: Purchase License Agreement), e.g., Sanad, TAP Maintenance & Engineering. These shops can also, like the Premier MRO shops, contract directly with the airlines themselves. They mainly compete on work scope optimization, labor cost, test cell, transportation and spare engine support. In addition to bilateral arrangements between these shops and CFM, it is important to note that thanks to the IATA-CFM Agreement, these MROs have free access to the ESM, can source spare parts from CFM and/or from third part USM providers,

and use regulatory approved non-OEM repair instructions (e.g.: EASA Part 21 / FAA DER).

CFM accounts for 39 shops (full MRO capacity or maintenance centers) which can participate in the LEAP aftermarket (see Figure 8), of which 13 are non CFM Premier affiliated shops (GSLA/PLA), whereas **PW currently accounts for 25 shops**, but all of them are understood to be **only commercially accessible for airlines through PW themselves.**



* General Support License Agreement

Figure 7 : Management of the aftermarket for LEAP and GTF engines

Source : Emerton analysis

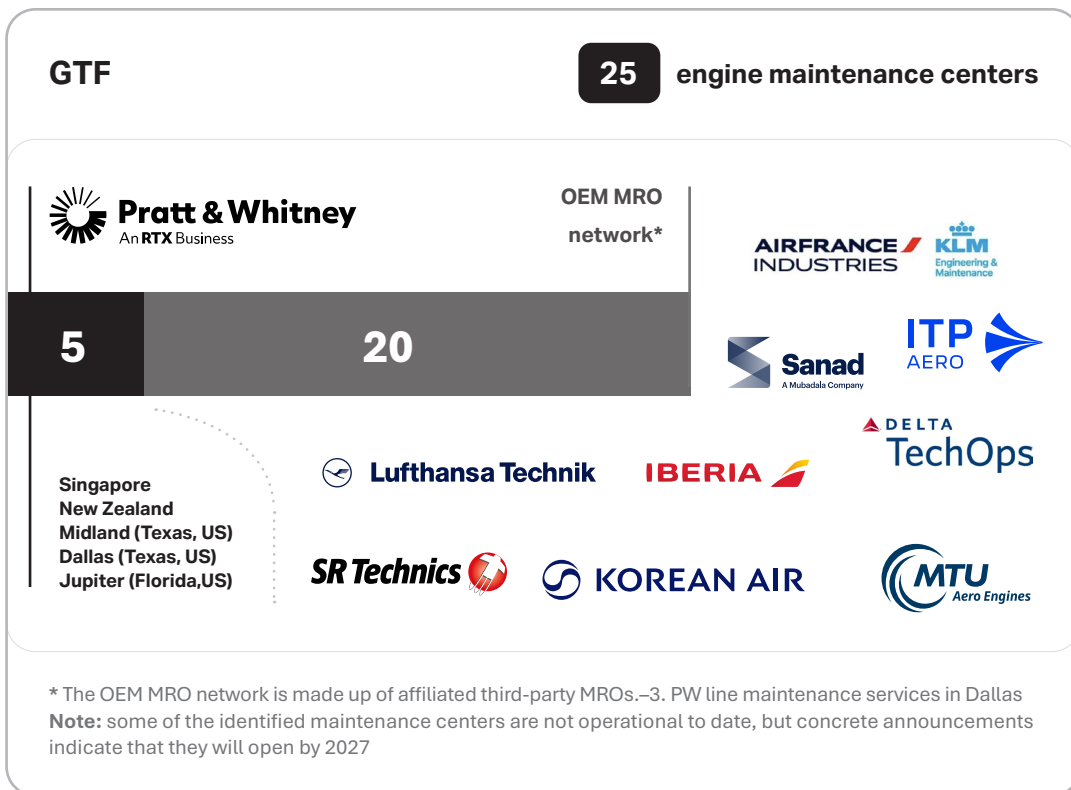
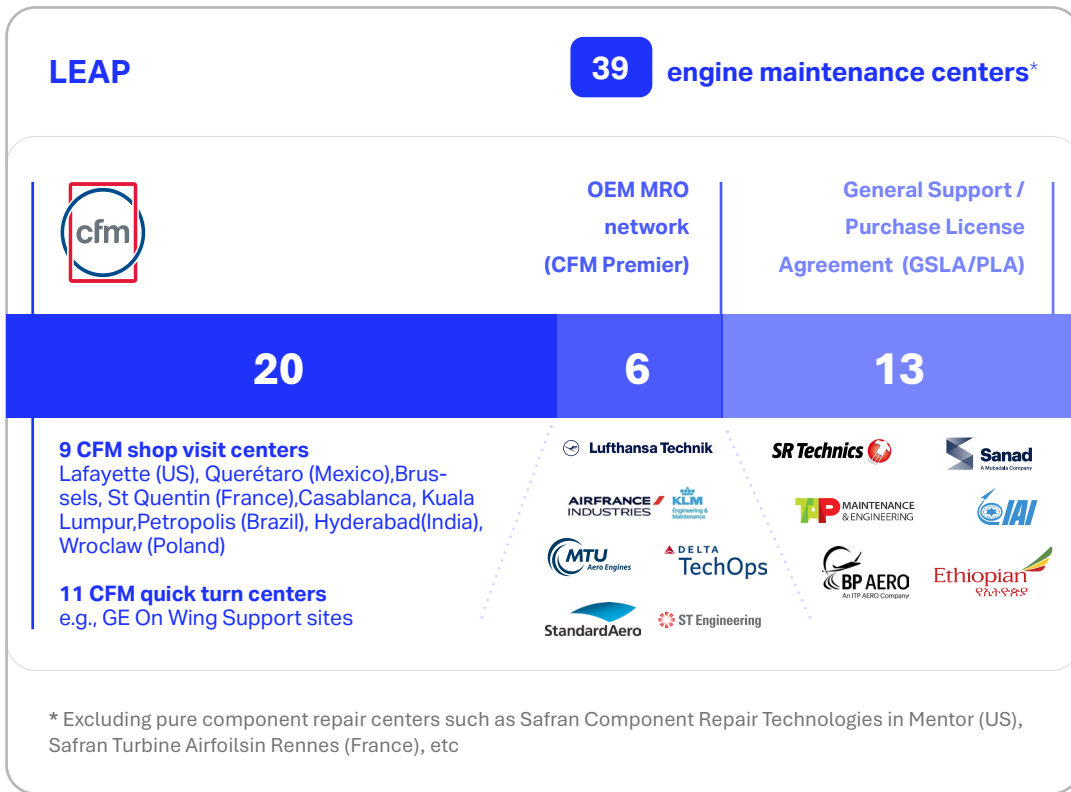


Figure 8 : Number of LEAP and GTF maintenance centers
 Source : Emerton analysis

In this context, the CFM/IATA agreement (which was recently renewed in January 2026) is considered as a significant and unprecedented industry breakthrough, creating more open and fair access to aftermarket competition.

In particular, this open advocacy agreement includes the following key enablers for airlines and MROs outside of the OEM's licensed network:

- No royalties or fees from CFM to overhaul shops for using the ESM, and CFM not seeking any other forms of financial compensation for such use by shops overhauling CFM engines
- Full recognition by CFM (including a no-waiver on warranties) of the right which customers have to use PMAs and regulatory approved non-OEM repair instructions (e.g.: EASA Part 21 / FAA DER) at the discretion by the engine owners and/or operators (airlines and lessors).
- PMAs found installed during the shop visits at CFM shops or its Premier network affiliates can be kept / re-installed on the engines before conclusion of the shop visit if they are serviceable.
- Preservation of repair instructions in the ESM, with continuous updates
- Direct access to CFM spare parts
- Direct access to CFM OEM technical support

- MRO competitors of CFM are recognized as “direct beneficiaries” of those provisions, along with the operators and owners of the engines (airlines and lessors).

More details of those “conduct policies” can be found on the IATA website: [cfm-conduct-policies-and-implementation-measures.pdf](#)

Additionally, CFM has undertaken another positive step with regards to the third-party vendor parts mounted on the LEAP engines (mainly QEC parts) through the deployment of the Controls and Accessories Suppliers Support Summary (CAS PSS).

This product support framework applicable to its vendor parts may be described as a mini Airbus SSC or Boeing PSAA platform to provide LEAP's operators with easier product support on the vendor Line Replaceable Units (LRUs).

Despite these developments, market entry at this stage may remain challenging for independent MROs, primarily due to the still limited volume of alternative repair instructions (through EASA Part 21 or FAA DER) and of alternative parts (FAA PMAs) for the most recent engine platforms:

- Independent MROs and PMA manufacturers are often reluctant to invest in developing such regulatory approved parts or repairs, because the fleet is still sub-mature with frequent design changes yet to be implemented.
- There is also little commercial incentive for independents to invest in the above whilst most of the fleet is still under its product warranty period.

- Additionally, some leasing companies still commercially resist the possibility for lessees to maintain installation of approved alternate parts (typically FAA PMAs) upon the end of the engine leases.

NOTE: notwithstanding the above, it is however understood that an increasing number of leasing companies now commercially recognize the ability for lessees to retain PMAs and the use of such approved alternate repair solutions (e.g., EASA Part 21) on other non-engine applications (in particular, consumables, cabin items, airframe sub-components and also in cases of part shortages). It is therefore anticipated that such positive industry trend will continue and expand for the benefit of engine lease transitions as well.

For example, the above is reflected in the recent IATA Guidance Letter encouraging active use of PMAs in leasing activities:

(This Guidance Letter is available on the IATA website: [IATA - Aviation Supply Chain](#)).

Regarding CFM engines, it is believed that some lessors may not yet be fully aware about the provisions of the IATA-CFM agreement – also available on the IATA website: [cfm-conduct-policies-and-implementation-measures.pdf](#)

Challenges during the first years of any new engine programs are not uncommon in the industry. However, more independent MROs may consider exercising the enablers from the IATA-CFM agreement to feed the LEAP aftermarket with additional MRO options once the program matures further.

Such possibility, however, does not currently exist with PW who have not yet endorsed any similar framework.

The new normal, due to unprecedented production rates, worsened by severe supply chain shortages, requires making the engine MRO supply chain much more resilient. It also requires all OEMs to change former practices, and to open their aftermarket.

As seen above, both the LEAP (CFM) and GTF (PW) MRO programs are experiencing significant challenges in shop visits, due to:

- A very fast ramp-up of the aircraft deliveries (A320neo and 737 MAX)
- The concomitant necessity to rapidly address all the sub-maturity technical issues affecting the TOW of those new engine models

Although CFM and PW have been significantly investing in their respective MRO capacity, this has not been enough to fulfill all the demand resulting from the teething issues of multiple products.

In addition, both the LEAP and GTF engine fleets will continue to grow rapidly, which will further stress the demand for shop visits even beyond the current situation.

- The current demand for LEAP and GTF shop visits due to non-mature TOW will be overtaken by the demand induced by the growth of the fleet (see Figure 5).

- Figure 9 illustrates how CFM forecasts the evolution of the aftermarket between CFM56 and LEAP engines. For the CFM56 fleet, the peak of shop visit demand is occurring now. On the other hand, LEAP shop visit ramp-up is only starting and is forecasted to reach a peak in 2040. Overall, the number of annual shop visits on CFM56 and LEAP combined will more than double between 2024 and 2040. A similar transition is being experienced between V2500 to GTF (PW1100G).

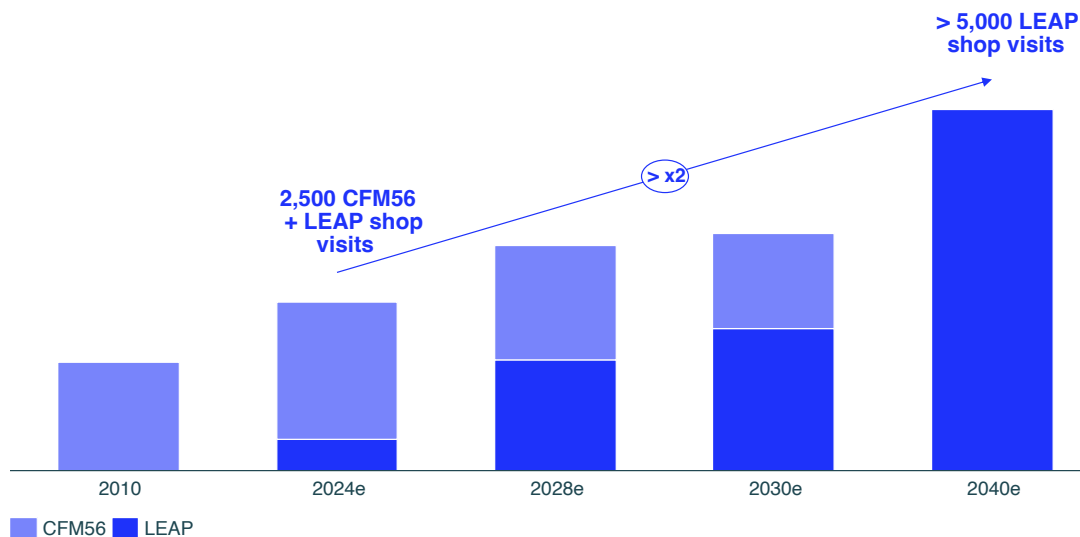
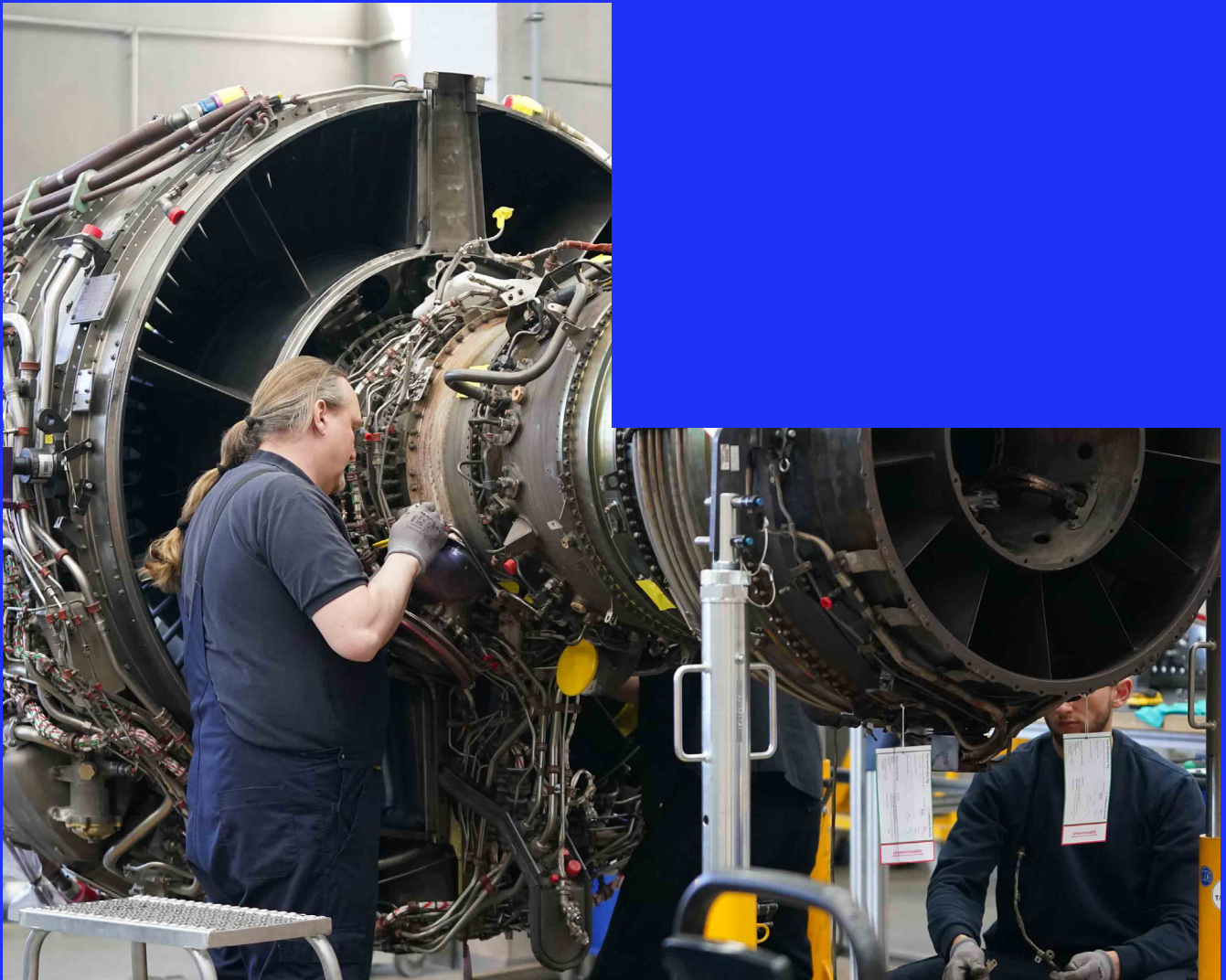


Figure 9 : Evolution of Safran revenue from the CFM and LEAP aftermarkets
Source : Safran Investor meetings 55thParis Air Show-June 2025



SECTION IV.

Best practices to alleviate engine MRO and supply chain shortages

Further increase in shop-visit capacity will ease the recent tensions on engine MRO, but other levers can also improve resilience from unexpected peaks:

1. Afford more flexibility to airlines in their MRO strategy

Airlines need to be able to choose freely between MROs who may be affiliated with the OEM networks, and other independent (or semi-independent) MROs. As further described under the next section 2, this implies that OEMs adopt best practices and conduct policies to maintain level playing field for fair competition.

Airlines also need to retain freedom to choose their MRO shop (OEM or independent) and have more flexibility to optimize the work scope of each shop visit.

2. Ease the conditions for fair market access for independent MROs to accelerate new capacity development

The agreement between CFM and IATA is perceived as a key enabler and should pave the way for all other OEMs (engine and airframe) to follow the adoption of similar open practices, for all MRO programs, including the airframe.

Independent MROs facilitate capacity growth by enabling the pooling of investments in additional shop visit capacity, which is key in the context of a fast ramp-up.

Independent MROs also bring valuable industry experience to develop additional regulatory approved specialized repair instructions (through EASA Part 21 and/or FAA DER), which are even more essential in the context of supply chain shortages.

Resolving the immediate grounding crisis is the priority. Long-term industry resilience depends on transitioning toward a more transparent and competitive aftermarket.

Furthermore, securing a diversified supply of components (new spares, USM, repairs) is a necessity to ensure the viability of the global single aisle fleet.

3. Beyond shop visit capacity, secure availability of parts by combining all available levers on spares and repairs

Open collaboration between OEMs and MROs to accelerate the development and certification of new repair instructions. The advent of such new repair instruction would provide relief to the entire industry, including the OEMs themselves.

Increase the repair capabilities of existing MROs and expand the pool of MROs to support additional repair capacity.

Encourage OEMs to qualify at least one back up supplier (specialized piece part manufacturer) third party to produce the same part numbers of critical piece parts through production licensing, which remains under OEM control to mitigate the risk of shortages.

Source parts from engine teardowns to increase the use of USM. This is very powerful in the context of extended lead times by OEMs to produce new parts. This will develop as the fleet grows and the engine reaches a mature configuration.

Spare engines management by airlines: optimizing the allocation, rotation, and short-term leasing of spare engines can significantly reduce aircraft downtime and absorb unexpected shop visits during periods of supply-chain stress.

Develop collaborative platforms where the information of available engines on lease could be centralized. Note: this is one objective pursued by IATA through the advocacy use of its IATA MRO SmartHub platform, of which the core features are being made free to access for the airlines.

4. Encourage airlines and lessors, prior to aircraft or engine acquisition, to secure extended lifelong term access to pre-negotiated spare parts price catalogues (e.g., LLPs, HPT, fan blades, etc.)

Such arrangements could include provisions covering future part-numbers evolutions, and incorporate capped annual price escalation, similar to the mechanisms available to airlines under Boeing's PSAA and Airbus's SSC for airframe SFE components. These terms could be assignable to the MRO of choice, including independent MROs, allowing lessors to extend the benefits of these protections to their lessees and independent service providers.

5. Encourage all OEMs, including manufacturers of widebody engines and airframe equipment, to adopt fair and best practices for aftermarket programs

For instance, by endorsing the same principles as those included in the IATA-CFM Agreement (*in which CFM recognizes the right for customers to choose using FAA/EASA approved non-OEM parts and repairs: PMAs, DER / Part 21*). In the IATA-CFM Agreement, it is also remarkable that third-party competing MROs are recognized by CFM as direct beneficiaries of those measures.

Resolving the immediate grounding crisis is the priority. Long-term industry resilience depends on transitioning toward a more transparent and competitive aftermarket. Furthermore, securing a diversified supply of components (new spares, USM, repairs) is a necessity to ensure the viability of the global single aisle fleet.

Glossary

APPENDIX A

| | |
|-----------------------|---|
| AD | Airworthiness Directive |
| AMM | Aircraft Maintenance Manual |
| AOG | Aircraft on Ground |
| CASPSS | Controls and Accessories Suppliers Product Support Summary (LEAP Product Support Agreement) |
| CBSA | CFM Branded Service Agreement, also named CFM Premier: Commercial MRO network for LEAP engines |
| CFM | Joint Venture between SAFRAN and GE Aviation (GE), OEM of the LEAP engines family |
| DER | Designated Engineering Representative |
| DOA | Design Organization Approval |
| EASA | European Aviation Safety Agency |
| EIS | Entry Into Service |
| ESM | Engine Shop Manual |
| FAA | US Federal Aviation Administration |
| GSLA | General Support License Agreement (basic licensing by CFM for third party MROs which are not affiliated to its CFM Premier network) |
| GTF | Geared Turbofan: refers to PW1100G, PW1500G and PW1900G engines |
| HP / LP module | High Pressure module / Low Pressure module |
| HPT / HPC | High Pressure Turbine / High Pressure Compressor |
| LLP | Life-Limited Part |
| LRU | Line Replaceable Unit |

| | |
|----------------|---|
| MRO | Maintenance, Repair, and Overhaul |
| OEM | Original Equipment Manufacturer |
| PBH | Power by the Hour |
| PLA | Purchase License Agreement (licensing model for CFM) |
| PMA | Parts Manufacturer Approval |
| PSAA | (Boeing) Product Support Assurance Agreement |
| PW | Pratt & Whitney (an RTX company, OEM of GTF engines family) |
| QEC | Quick Engine Change |
| RPFH | Rate Per Flight Hour (another name for PBH) |
| RPK | Revenue Passenger Kilometers |
| SB | Service Bulletin |
| SFE | Seller Furnished Equipment |
| SSC | (Airbus) Supplier Support Agreement |
| T&M | Time and Materials |
| TAT | Turnaround Time |
| USM | Used Serviceable Material |

References

APPENDIX B

IATA-CFM Agreement - information available on the IATA website: [cfm-conduct-policies-and-implementation-measures.pdf](#)

IATA Guidance Letter encouraging the use of PMAs in the context of leasing – available on the IATA website: [IATA - Aviation Supply Chain](#)

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This document includes independent research and analyses conducted by Emerton.

The analyses rely on a triangulation of different data sources, including official disclosures from OEM public communications (Safran, GE, CFM, Pratt & Whitney), third-party databases such as Cirium, public market reports, news, and interviews with industry stakeholders. Pratt & Whitney was approached by Emerton but declined to comment.

Press releases

Aviation International

CFM Fixes Leap Turbine Shroud Coatings

July 17, 2018

[Visit →](#)

Aviation Week

EASA And FAA Call for Leap 1A Inspections in Certain Regions

April 7, 2022

[Visit →](#)

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CFM Aims to Reach 20 Shops Offering Leap MRO Support

June 19, 2023

[Visit →](#)

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Wizz Air forced to reduce capacity by 10% following problems with Pratt & Whitney GTF engines

September 12, 2023

[Visit →](#)

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India's IndiGo to lease new aircraft to weather Pratt engine issues

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November 17, 2025

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December 11, 2025

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Contributors

Emerton

Sebastien Plessis

Managing Partner

Pascal Simon

Managing Partner

Götz Giering

Case Team Leader

International Air Transport Association

Alex Lan

Head Aviation Supply Chain

Chris Markou

Head Technical Operations

Stuart Fox

Director Flight and Technical Operations

Miriam Geiss

Senior Specialist Counsel Antitrust

Katherine Kaczynska

Assistant Director Corporate Communications

About



Emerton is a global strategy consulting firm with offices in New York, Montreal, Paris, London, Munich, Hong Kong and Tokyo. Emerton has dedicated expertise in aerospace & defense and transportation & mobility, supporting OEMs, MRO players, and industry stakeholders on high-stakes strategic, operational, and transformation topics.

Its work in aviation spans areas such as maintenance strategy, industrial footprint optimization, AI transformation and innovation roadmaps, alongside increasing focus on decarbonization levers including sustainable aviation fuels and next-generation technologies. With a global footprint and deep industrial sector specialization, Emerton partners with industry leaders to address structural challenges and long-term growth in the aviation ecosystem.



The International Air Transport Association (IATA) is the trade association for the world's airlines, representing some 375 carriers and more than 80% of global air traffic. IATA represents airlines worldwide by engaging with governments and regulators to shape policies that support aviation's role in connecting people, goods, and economies.

It leads the industry through global standards that make flying safe, secure, and efficient, while improving the passenger experience and reducing costs. It also serves the industry with products, services, and expertise that help airlines operate effectively and sustainably. For more information, visit iata.org or follow on LinkedIn and X.



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