AIRFINANCE GLOBAL

Analysis: New generation engines values and costs

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This year is set to see significant milestones for the new generation of engines powering narrowbody aircraft. CFM's Leap engine should start flighttesting during 2014 and Pratt & Whitney's (P&W) PW1000G geared turbofan is expected to enter into service.

Both engines will power multiple aircraft types, including the Bombardier CSeries (PW1500G), Airbus A320neos (Leap 1A and PW1100G-JM), Boeing 737 Maxs (Leap 1B), Mitsubishi Regional Jets (PW1200G), the Comac C919 (Leap 1C), Irkut's MS-21 (PW1400G) and Embraer's E2 Jet family (PW1700G and PW1900G).

The two original equipment manufacturers (OEMs) – CFM and Pratt & Whitney – claim that their new products will bring significant improvements compared with the current generation of engines. Those improvements are expected to reduce fuel burn, NOx emissions and noise levels. It is interesting to note that from a fuel burn and NOx emission point of view, both OEMs are claiming comparable improvements.

However, things look a little different from a maintenance cost perspective. According to the latest information available, the Leap engine should have maintenance costs comparable to today's industry-leading CFM56 engines

(ie, CFM56-5B and CFM56-7B), while the New generation engines values and costs PW1000G is targeting lower maintenance costs than the V2500-A5 (up to 20% reduction).

To assess the expected maintenance costs of the new engines it is helpful to compare them with the current generation of engines and to look at the major technical improvements these engines will bring.

The A320 current engine option (ceo) is powered by the CFM56-5B or the V2500-A5, while the 737 NG is exclusively powered by the CFM56-7B.

Starting with the fan

Both engines will have a lower number of fan blades (18) compared with current engine types. The PW1000G will feature bimetallic fan blades, while the Leap will introduce 3D woven carbon fibre composite blades. Thanks to the lighter fan blades on the Leap engine, CFM estimates a weight saving of 50% compared with the standard CFM56-7B parts. This also translates into additional weight savings on the fan disk and fan case (lighter containment structure). However, the manufacturing costs of such advanced fan blades are likely to be higher than traditional components, and the cost of ownership and the repairability needs to be evaluated. Both engines will feature a composite fan case.

The PW1000G uses a geared architecture allowing the fan to rotate at a lower speed than the low-pressure system while keeping the core rotating at high speed. By comparison the Leap engine uses a more conventional direct-drive configuration. The benefit of one configuration over the other is yet to be measured in real life operation.

The gearbox enables P&W to reduce the number of stages especially in the low-pressure turbine (LPT) section (three stages compared with seven for the Leap). According to P&W, the gearbox does not contain any life-limited parts and, providing the reliability achieves expected standards, there should not be significant maintenance costs relating to the gearbox.

Both engines will use a blisk (or integrally bladed rotor) configuration in the high-pressure compressor (HPC) – stages one to five for the Leap. Both engines have been designed to reduce debris ingestion into the core. The blisk architecture is a proven technology because it already features in the CF34, PW6000 and GEnx engines.

The combustion sections of both engines will utilize the latest technologies to minimize fuel burn and reduce emissions. Durability and repairability of these combustors is yet to be proven.

Two for one

Both engines have a two-stage high-pressure turbine (HPT), which use the latest coating and cooling technologies. The two-stage configuration represents a change for CFM as a single-stage HPT distinguished the CFM56 from the V2500. No doubt this will have a significant impact on the shop visit costs because two sets of HPT blades will always be more expensive to repair or replace than one set in a typical time and material (T&M) engine shop visit. The Leap will also introduce HPT stage one shrouds made of ceramic matrix composite to improve efficiency.

The main difference in the LPT section is the number of stages in each engine type (PW1000G has only three stages, while the Leap has seven).

Therefore, the number of airfoils will be significantly higher in the Leap. Based on the durability of the LPT section and the workscoping philosophy, this again could have a significant impact on the maintenance costs in a normal T&M shop visit.

This is a theoretical assessment and the commercial proposals offered to airlines will certainly ensure the operational costs and durability match those of the previous generation of engines. This is expected to be achieved through power-by-the-hour type proposals.

The exact number of life-limited parts (LLPs) and their respective limits are unknown because the engines are yet to be certified. However, it is expected that original equipment manufacturers (OEMs) will provide guarantees to at least match the limits, in terms of LLP profile, of the previous technology engines such as the CFM56-5B, CFM56-7B and V2500-A5.

More shops required

Aside from the specific maintenance costs linked to the architecture of each engine, the shop visit costs will depend on the willingness of the OEMs to authorize third-party maintenance, repair and overhauls (MROs) and vendors to maintain and repair their products. Since a lot of new technology and exotic materials will be introduced in these engines, they will require highly specialized repairs usually controlled or performed by the OEMs. A wider base of independent maintenance repair and overhaul facilities and vendors allows greater competition, and thus helps to drive the maintenance costs down.

Historically, CFM and P&W have not restricted the engine MRO market. There are many independent MROs, as well as independent piece parts repair vendors, capable of maintaining the CFM56 and P&W engines and components.

The size of the fleet can also play an important role in maintenance costs. It can be reasonably expected that the Leap and PW1000G fleets will eventually reach a similar size to the current CFM56-5B, CFM56-7B and V2500-A5 fleets. As a result, the OEM's shops, based on their current capacity, could not maintain such a high number of engines and the resultant shop visits (400-plus a year for the CFM56-5B and 700-plus for the CFM56-7B).

This is a business decision that needs to be made by the OEMs on whether the fleet of engines will be maintained in-house or through joint ventures or third-party (independent) MROs.

Contract choice

Since these engines have not entered service and there is no in-service experience on which to base decisions, airline customers are mainly choosing power-by-the hour-type maintenance contracts to alleviate any technical and financial risk. Once these products mature, then T&M contracts can become more cost effective, provided there is a competitive market for repairs. This, of course, depends on the ability of the customer to manage properly the engine shop visits and thus control the costs.

Another aspect impacting the maintenance costs of such engines will be their time on wing. If they perform as expected or better then the cost per flight hour can be significantly reduced. However, if they face entry-into-service issues this could have considerable impact on the operating costs.

Customers that choose competitive power-by-the hour contracts will be initially protected against such technical, operational and financial risk; however, those contracts are only valid for a limited period and for a specific operator and type of operation.

Transition to another operator or type of operation means operational assumptions will be different and commercial terms of power-by-the-hour contracts will be different too.

From a lessor's point of view, the details and restrictions on such contracts can have an impact on the transitioning between operators. Great consideration must be given to items such as engine condition at the end of the contract and the possibility to transfer the contract and its maintenance and LLP reserves funds to another operator, which might have different monthly utilization, flight hour/ cycle ratio, operating environment or thrust-rating requirements.

Another point to consider is the ability to supply used serviceable material into the engines once they have become mature products. Most of the revenue for the OEMs comes from the parts sold when engines undergo shop visits. By tying customers in with power-by-the-hour contracts and preventing independent MROs entering the market, the OEMs can maintain control of what material is fitted to the engines during shop visits and thus maintain a constant demand for new parts, which is a critical part of an engine OEM business model.

If independent MROs and piece-parts repair vendors have not been allowed to enter such a market, there will be no real open market for used serviceable material.

In turn this means there will be less trading activity because of a lack of confidence in the residual value of those engines. Only engines with enough green time (remaining life) will be valuable – for short-term lease, for example – and there will be little or no part-out trading activity. As a result, the residual value at the end of life of the engines will be greatly affected.

On the other hand, if independent MROs are allowed to maintain the engines, usually under T&M contracts, then the spare parts market will be much more active. Again, this will help drive shop visit costs down and will generate a more dynamic market for end-of-life assets.

At this stage it is still too early to forecast precisely the value trend for the new generation of engines or to forecast their maintenance costs in a traditional time and material approach. It is clear that the strategy chosen by the OEMs in terms of access to the shop visit market by independent MROs, and the ability to repair parts and supply used service material, at a later stage, will dictate the maintenance costs and value of the new generation of engines.

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