White Paper

The Connected Fleet: Further Implications of Aircraft Health Monitoring for the Aviation Supply Chain

By Richard Brown, ICF

It is difficult to avoid a hot topic currently permeating the aviation supply chain. The issues surrounding big data and aircraft health monitoring (AHM), data ownership, access, and management are increasingly discussed in industry forums, publications, conferences, and boardrooms. Yet, the benefits and challenges for airlines, original equipment manufacturers (OEMs), maintenance, repair, and operations (MRO), and lessors continue to be debated, as does the role of each player in the AHM market.

The arrival of highly connected aircraft such as the 787, A350XWB, and CSeries now allow for the measurement, storage, and transmission of more data from aircraft engines, airframes, and systems than ever before. E-enablement presents numerous opportunities both in the short and the long term.

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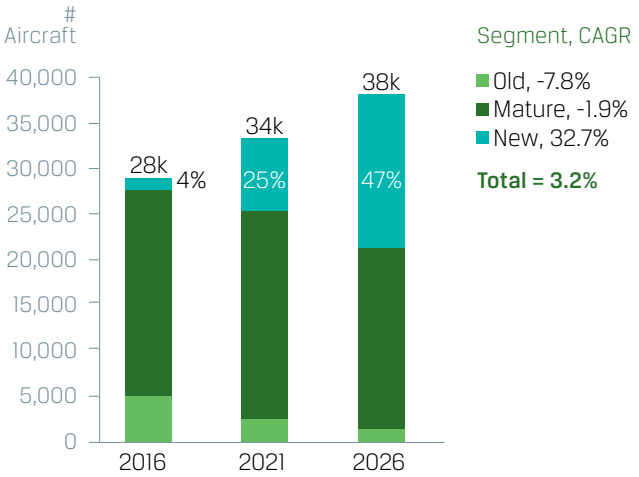
E-enabled aircraft are on approach

The arrival of e-enabled aircraft brought the promise of increased efficiency for airlines. OEMs discussed a new way of operating aircraft—a connected and integrated operation driving increased efficiency for airlines. The greater availability of maintenance and performance data encouraged a step-change toward health monitoring. Until recently, the adoption of AHM services has been slow. Though health monitoring has been available on aircraft engines since the 1990s, the benefits beyond the engine to the aircraft systems are only now gaining traction. The reason for monitoring engines is clear given the potential to maximize time-on-wing and avoid costly Aircraft on Ground (AOG). Yet e-enabled aircraft now provide the ability to monitor key aircraft systems such as avionics and electrical components.

Approximately 3% of the current fleet is e-enabled, and ICF forecasts that approximately 45% of the fleet (over 15,000 aircraft) will be e-enabled by 2025. As the connected fleet grows and service offerings mature to taking advantage of big data, ICF sees operator maintenance increasingly benefiting from advanced analytics. The heart of the debate centers on the form the analytics takes and who performs the analysis.

AIR TRANSPORT FLEET DEVELOPMENT BY THE TECHNOLOGY GROUPING



Old: first flight<1990s, e.g., A300/A310/ 747-1/2/3/ BAe146
Mature: first flight>1990s, e.g., 737CL/737NG/ A330/340/ 777/E-Jet
New: first flight>2005; e.g., 787/A350/A380/CSeries/E-Jet E2
Source: ICF

Enter the MROs

With an increasing amount of data, it is likely that only the very largest operators will develop internal analytical capability. Since the arrival of a new aircraft type provides operators with an opportunity to change their maintenance approach, many airlines that have traditionally performed MRO in-house have outsourced much of the MRO on new e-enabled aircraft. There is a variety of suppliers for operators to choose from ranging from the airframe OEMs to integrator MROs and independents willing to offer MRO services often under multi-component cost-per flying-hour contracts. The growing popularity of maintenance contracts covering a broad range of component types

provides an opportunity for the maintenance supplier to use data analytics to drive down cost, increase reliability, and ultimately improve the profitability of such service offerings. Given the relatively recent arrival of new e-enabled aircraft, the advantage in providing AHM systems has typically resided with the aircraft, engine, and system OEMs.

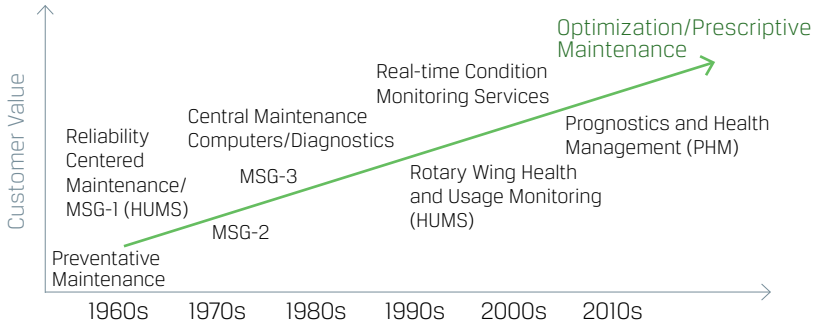
However, more recently, major integrator MROs have also been developing their own offerings. Airbus and Boeing launched their health monitoring service around 2012 and they continue to invest in data analytic capabilities. Rather than develop systems completely in-house, Boeing and Airbus signed agreements with Microsoft and IBM to provide IT infrastructure thereby speeding up the development of analytical capabilities. 2016 saw the large MRO integrators enter the data analytics market. Air France KLM E&M developed "Prognos" and Lufthansa Technik launched "Condition Analytics."

The approach taken appears to differ from the OEMs. The OEMs have taken the "Big Data" path by analyzing large sets of data to find nuggets of information. On the other hand, MROs appear to be leveraging their maintenance expertise by focusing on a smaller number of specific, known, and frequent reliability/cost issues caused by certain components. Lufthansa Technik offers analytical services to any airline and not just customers of their integrated support programmes.

Examining the benefits

The potential benefits offered by AHM are varied. ICF expects the majority of savings to come from improvements in dispatch reliability, reductions in inventory, and better line-maintenance troubleshooting. With improved reliability comes the potential for reduced provisioning spend—a key source of revenue for component OEMs. The potential is for $3B+ in industry-wide savings. In fact, the benefits are only just starting to be understood. To fully achieve the potential benefits that AHM offers, operators will need to go beyond just monitoring the aircraft to predicting when parts will fail. Maintenance will need to be further integrated into an airline's operation. If AHM can predict when a part will fail, the airline's scheduling department needs to be able to efficiently utilize this information to minimize disruption to the operation. Information from AHM systems should enable airlines to make better-informed decisions such as whether to cancel or delay a flight or substitute another aircraft instead and of course perform the proactive maintenance.

EVOLUTION OF AIRCRAFT MAINTENANCE APPROACHES



Source: KLM E&M, ICF

AHM also allows the airframe OEM to leverage their broad scope of services beyond maintenance thereby supporting their desire to grow revenue from services.

Health monitoring provides airlines with valuable time to make better decisions. Consequently, the industry is moving toward a prescriptive maintenance principle where data analytics work to prescribe maintenance activities based on the best outcome. For prescriptive maintenance to work optimally, OEMs and regulators need to continue to evolve current maintenance practices. Despite all the advances in maintenance computers, real-time condition monitoring, and prognostics, MSG-3 is still the underlying process for most maintenance programmes. For instance, even if a system monitors oil levels and pressures during every part of the flight, the maintenance manual may still require a mechanic to visually inspect the oil level. Should such activities be reduced through AHM, airlines can reap the benefit of quicker aircraft turnarounds and the reduction of some labor intensive activities.

Supplier considerations

E-enablement is arriving now. AHM capabilities are advancing and the benefits are being better understood. Suppliers are preparing for the implications that AHM will have on their business. Engine OEMs are well aware of the benefits of increased time-on-wing, which drive increased profits given that many of their engines are on $/hour maintenance programs. System OEMs offering their own maintenance solutions can also drive reliability improvements into their products by better understanding how rotables perform in flight. AHM offers the chance to reduce frustrating and unnecessary line removal of components.

A challenge for the smaller independent MROs is how to gain access to data given the increasing strength of the OEMs in the aftermarket. Furthermore, there is less opportunity for smaller MROs to justify investment in AHM offerings. Partnership with OEMs or larger integrator MROs may be the realistic approach should they wish to service the newest equipment.

Airframe and system OEMs—well placed to benefit from AHM—need to do a better job of demonstrating the real benefits that AHM heralds to operators. Some airlines see the benefits for MROs and OEMs but are less convinced about the tangible benefits AHM offers them directly. AHM is likely to assist the move to a more OEM-centric MRO market, and airlines are aware of this. Furthermore, airlines are keen to avoid AOGs. How can AHM analytics help reduce AOGs and the associated costs these entail?

AHM also allows the airframe OEM to leverage their broad scope of services beyond maintenance thereby supporting their desire to grow revenue from services. It provides OEMs with an opportunity to demonstrate value without turning wrenches.

For new technology aircraft MRO, there are three key battlegrounds:

1. Control of operational data
2. Control of the workscope
3. Control of the assets

The outcomes and winners in these battles will define the future "winning business models."

TO WIN IN THESE BATTLEGROUNDS, BIG DATA ANALYTICS IS A KEY ENABLER

The benefits and challenges posed by AHM therefore continue to evolve as more e-enabled aircraft enter service. AHM offerings from stakeholders continue to be developed and new partnerships are being established. The benefits of advanced AHM and the implications for the supply chain are still being quantified and understood. AHM adoption is moving fast and provides real opportunities to reduce maintenance cost and improve aircraft reliability. Yet more still needs to be done. For instance, antiquated airline IT systems need to be improved to take advantage of what is being offered and the benefits to the end-user more clearly communicated. It is necessary to further consider how AHM is likely to influence your business and the role you will play as the market evolves. The time to act is now.

About ICF

ICF (NASDAQ:ICFI) is a global consulting and technology services provider with more than 5,000 professionals focused on making big things possible for our clients. We are business analysts, policy specialists, technologists, researchers, digital strategists, social scientists, and creatives. Since 1969, government and commercial clients have worked with ICF to overcome their toughest challenges on issues that matter profoundly to their success. Come engage with us at **icf.com**.

About the Author

Richard Brown has over 17 years' experience in aerospace, including 12 years consulting. He leads the ICF Aerospace consulting practice. During this time he has managed strategy and market analysis projects with a broad global client base including airlines, manufacturers and training suppliers. Mr. Brown's areas of special interest include aircraft component manufacturing and support, big data analytics, aftermarket forecasting, surplus parts, the Middle East market, business aviation, and, pilot and mechanic training. Mr. Brown has extensive aerospace market forecasting experience and is a regular conference speaker. Prior to joining ICF International, Mr. Brown was part of the European practice at AeroStrategy. His career previous to AeroStrategy included various market analysis roles at TRW Lucas Aerospace and Goodrich Corporation.

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