



April 2004 | AN AVIATION INDUSTRY COMMENTARY

A new dawn?

The outlook for Commercial MRO through 2013

Aviation is facing significant uncertainty with fundamental challenges to profitability, yields and the traditional business models. The resulting outlook for the aftermarket is cloudy indeed.

AeroStrategy has developed a new commercial Maintenance, Repair and Overhaul (MRO) market forecast – with the assistance of more than 20 airlines and global MRO suppliers – to dispel some of the murk and address unresolved MRO concerns,

such as: When will demand spring back? How many aircraft will be permanently retired, how many “unparked”? How will increasing engine size and reliability influence demand? How rapidly will the market grow? Which aircraft types, engine

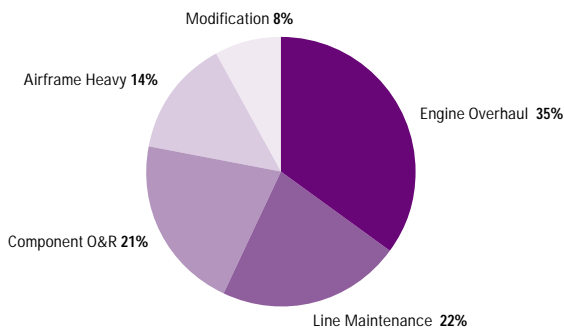
models and regions will lead the way? Beyond facts and figures, AeroStrategy also provides in this commentary its perspective on evolving customer needs and critical supply-side trends that will shape MRO markets for years to come.

MRO demand will reach \$60 billion in 2013, an annual growth rate of 5.3%

The View From 35,000 Feet

AeroStrategy estimates that commercial jet aircraft (with more than 35 seats) generated MRO demand worth \$35.8 billion in 2003. This includes five primary market segments: off-wing engine overhaul, airframe heavy checks (C and D checks), component overhaul and repair, line maintenance (including A, B and overnight checks) and major airframe modifications (including cargo conversions, avionic upgrades and IFE modifications).

2003 Commercial MRO Market \$35.8bn



We estimate that MRO demand will reach \$60 billion in 2013, an annual growth rate of 5.3%. (Forecasts are in constant 2003 dollars and do not account for future price changes in labor rates or spare parts.) Underlying this result are four key trends:

Fast Fleet. Air travel growth will average 4.7% over the next decade, fueling an expansion in the active air transport fleet from 16,000 in 2003 to 23,360 in 2013.

Boomer Generation. The airline industry imperative to contain MRO expenditures will be challenged by the MRO requirements generated by the unprecedented number of aircraft – in excess of 5,000 – delivered between 1998 and 2002, that are only now generating their first heavy maintenance events.

Space Available. Over 600 of the 2,000-plus inactive aircraft fleet will return to service in the next four to five years, with many young aircraft parked during the 2001-2002 industry crisis likely to return to passenger service and more than 200 parked aircraft converted to freighters.

Just Use It. Daily aircraft utilization will be nearly 10% higher in ten years for three reasons: the expansion of high-utilization low-fare carriers, the pressure they place on traditional

airlines to increase the economic productivity of their major assets and the fact that many operators are now at relatively depressed levels of utilization.

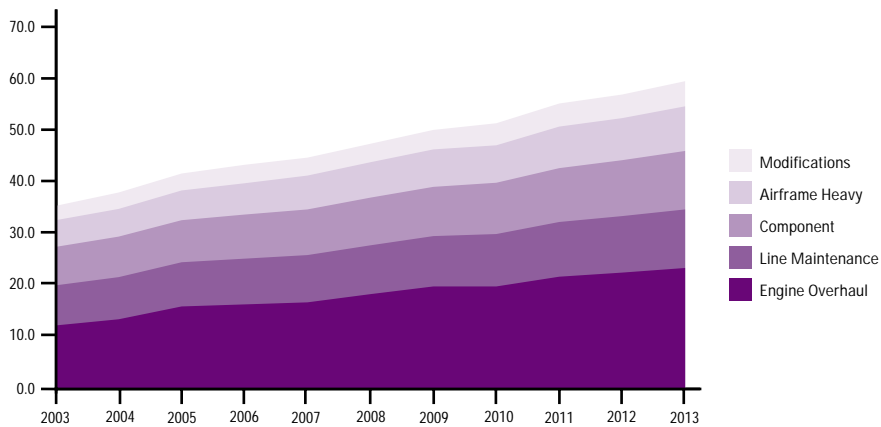
Engine Overhaul

Engine overhaul is the largest segment of the commercial MRO market, currently valued at \$12.4 billion. The largest engine submarkets are the CF6-80C2, CFM56-3 and PW4000-94, the only ones with activity exceeding \$1 billion each. Pratt & Whitney engines, despite the rapid reduction in the venerable JT8D fleet, generate 29% of total overhaul demand due to their still sizable installed base.

The fastest growing engine models include the CF34-3B, CFM56-5B, CFM56-7 and V2500 – no surprise, given the growth of regional airlines and the robust outlook for the preferred aircraft of the low-fare carriers, the A320 family and the 737NG.

A few larger engines – the CF6-80E, GE90 and Trent 700/800 – will see significant growth as well. Overhaul spending on these extremely reliable and relatively young engines will rise more than 15% per annum, as their initial shop visits for major life limited components (LLP) begin to occur later in the forecast period.

2003-2013 MRO Market Forecast (\$bn)



By 2013, six engines will each generate more than \$1 billion per year in MRO demand, with the CF6-80C2 leading the way, followed by the CFM56-3, CFM56-5B, CFM56-7, PW4000-94, and V2500-A5/D5. Partially offsetting this growth is the inevitable decline in some currently significant engine markets. The JT8D, JT9D, CF6-50 and RB211-524 will get hit with a double whammy – not only will the associated aircraft rapidly retire, this will also create a supply of cheap surplus engines that will in some instances make them cheaper to replace than overhaul.

On the supply side, OEMs will maintain their strong aftermarket presence, albeit with varying strategies. Led by GE, they will garner 43% of the market. Rolls-Royce and Pratt & Whitney will improve their shares of market too. Airlines and airline-affiliated suppliers have a slightly higher 44% share (30% for internal customers and 14%

for third parties), while independents, led by MTU and IHI, have 13%.

Several developments are reshaping the engine overhaul market:

- The spate of aircraft deliveries in the late 1990s will provide the impetus for a jump of over 20% in shop visits, from about 8,400 in 2003 to almost 10,300 in 2005.
- OEMs are continuing to use licensed service center networks and joint ventures to enhance their position in the aftermarket rather than invest in their own facilities. Consider two recent examples: the establishment of N3, a joint venture between Rolls-Royce and Lufthansa Technik, and GE's licensing of several well-known suppliers to service the CF34 in competition with its own maintenance centers. These moves occurred while OEMs were closing engine overhaul facilities, suggesting they are emphasizing return on assets over revenue growth.

- Mergers and acquisitions among independent suppliers will continue apace. Witness the Carlyle Group investing in Avio, KKR purchasing MTU and 3i buying SR Technics. Some consolidation will likely occur at the "second-tier" of the engine sector, possibly creating new, independent entities that can more effectively compete with the OEMs.
- With airlines pressuring OEMs to keep spare part prices down and service levels up, the penetration of PMA parts will persist. Engine PMA

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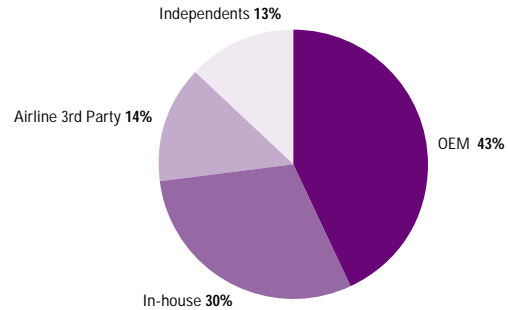
parts once consigned to burner cans, accessories, and low value-added parts have entered the gas path where many high value parts are found. The PMA phenomenon, combined with rising usage of DER repairs, will challenge OEMs to rethink the “razor-razor blade” paradigm – where spare parts profits subsidize engine development – that has long underpinned the aero-engine business.

Airframe Heavy Maintenance

Airframe heavy maintenance is a \$5.2 billion market, with about three-quarters derived from labor – nearly 70 million hours worldwide. Six airframe models account for more than 55% of the market; in order of decreasing size: 747-400, 767, A320 family, 757, 737 classic and the MD80.

Despite Airbus’ recent sales success, a large proportion of the active fleet today remains Boeing, which currently generate about 75% of airframe heavy

2003 Engine Overhaul Supply Share (\$12.4bn)



maintenance expenditures. Airbus aircraft make up most of the remainder, about 20%.

Over 60% of airframe heavy maintenance is performed by airlines in-house due to two factors. First, the size of the major US fleets has itself historically justified in-house capability. This in turn has given labor unions strong influence over, and some protection against, the amount of maintenance work US majors can outsource (witness the current battle at US Airways). Second, Asia-Pacific and Latin American carriers are influenced by low labor costs and attracted by the technological and employment benefits associated with building in-house capability.

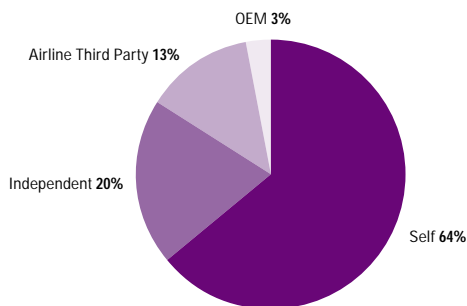
AeroStrategy foresees the airframe heavy maintenance market growing at a rate of 5.5% annually, reaching \$8.9 billion by 2013. Four aircraft families will comprise over 45% of the market by 2013: A320 (19%),

B747-400 (10%), B737 NG (9%), and the B767 (9%). Since regional jets are not maintenance-intensive, they are expected to account for little more than 3.5% of the market in 2013.

Four key trends stand out in airframe heavy maintenance:

- As with engine overhaul, the delivery profile of the late 1990s will produce a spurt in heavy maintenance events, from 9,800 in 2003 to about 11,400 in 2005 (a 16% gain).
- Phase checks are becoming more common as airlines, particularly high-utilization low-fare carriers strive to increase aircraft productivity and availability. More work will be conducted on line or light checks, so that some airline maintenance programs may not include a C check within the first five years of operation.
- The supplier base, traditionally regional or local, will experience fundamental change. The market will likely see the emergence of 3-5 global brands making use of scale and scope

2003 Airframe Heavy Maintenance Supply Share (\$5.2bn)



to win significant outsourcing contracts and grow share. ST Aerospace is already positioned in Asia-Pacific, Europe and North America. Lufthansa Technik has a solid presence in Asia-Pacific by virtue of the opening of Lufthansa Technik Philippines and its AMECO joint venture in Beijing.

And the recent merger of SR Technics and FLS Aerospace creates another independent supplier potentially poised for global expansion. One of the factors that will drive airframe supplier globalization is the need to leverage regions with low labor costs while maintaining brand, quality and simplified distribution channels.

- Outsourcing will spread. Given current concerns about costs, it is staggering to contemplate that airlines continue to insource 64% of heavy maintenance despite the potential for savings of 50% or more by outsourcing. Three elements should facilitate greater

outsourcing: continued cost pressure, revised labor agreements and a high-quality global supplier base. United Airlines' recent decision to close several maintenance bases and outsource most heavy maintenance may herald a broader restructuring.

Component Maintenance

The \$7.5 billion component maintenance market remains fragmented and fast-changing. The largest product segments include wheels & brakes (17%), auxiliary power units (14%), avionics (14%) and engine exhaust/thrust reversers (8%). Combined, these four categories make up just over half of component MRO spending. The remaining half is composed of numerous system categories, including engine fuel & control, flight control, landing gear, environmental control systems and hydraulic power.

The rapidly growing A320 fleet generates more component MRO demand than any other aircraft family (12%), followed by the 747-400 (9%), B737-3/4/500 (9%), B767 (8%) and B737-NG (7%).

AeroStrategy expects component MRO spending to grow at a 4.2% annual rate to reach \$11.3 billion by 2013. Two aircraft families favored by low-fare carriers, the B737-NG and A320, will drive more than half of this growth. Asia-Pacific (5.0%) will grow fastest, followed by Europe (4.1%) and North America (3.1%). Several trends will have a profound and lasting impact on component maintenance.

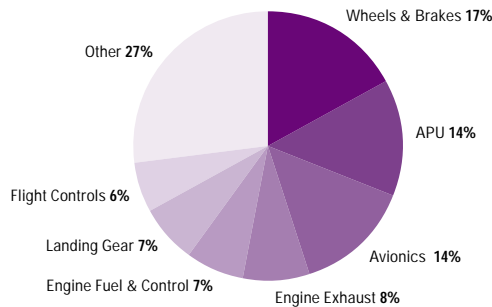
- Most significant is the emergence of broad component support (BCS) services that bundle component maintenance with asset management and sometimes airframe or engine maintenance for an entire aircraft, a trend we highlighted in our 2002 Commentary. Their popularity appears to be gathering momentum now as airlines seek to reduce assets and lower their repair management burden. We estimate that more than half of the European fleet is managed via some form of BCS contract. Curiously, North American operators have been slow to embrace the concept. This may be due to larger fleets, significant in-house capability, culture and limited supplier choice. Greater BCS

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The rapidly growing A320 fleet generates more component MRO demand than any other aircraft family



2003 Component MRO Market (\$7.5bn)



penetration should be expected in the next five-ten years as airlines focus on the transportation aspect of their business and as major suppliers make the necessary investments for total support provision. The trend in North America is likely to be led by regional airlines or start-ups rather than traditional carriers.

- PMA suppliers and operators, once largely focused on engine parts, are now shifting attention to large component segments such as APUs, fuel systems, hydraulics and pneumatics. Several major airlines and MRO providers, frustrated by what they believe is unreasonable OEM spare parts pricing, are working closely with PMA suppliers to identify and develop spare part alternatives. HEICO and Wencor West appear to be the two largest component PMA suppliers. While overall PMA penetration is less than 5% of component parts spending, it is challenging OEMs to revise spare parts pricing policies, expand their

share of the component overhaul market and develop new aftermarket value propositions such as material cost per hour programs.

- Component MRO spending is expected to grow commensurate with the transition of the more than 5,000 aircraft under five-years old from warranty to maturity, their maintenance-generating years. As a result, many OEMs' "non-warranty" fleet – particularly those with positions on Airbus and regional jet platforms – will grow faster than the overall fleet. Operators will face crucial choices about how to manage component maintenance – bundle requirements and work with a single total support component integrator or contract with a range of maintenance suppliers? Major airlines with in-house capacity have their own delicate decisions: how to lower unit costs while maintaining labor harmony.

Line Maintenance

Now valued at \$7.8 billion, line maintenance is forecast to grow at a rate of 3.9% annually to \$11.4 billion in 2013. The large narrow body fleets (737 Classic, 737 NG, A320 family and DC9/MD80) are responsible for 43% of this market.

Again, fundamental factors underly the outlook in this segment:

- The scope of line maintenance continues to evolve as some airlines adopt maintenance programs with more phased checks.
- Line maintenance is outsourced less than any other MRO activity because most airlines consider it a core element of operations – particularly at hubs and major bases – vital to the integrity of their daily schedule and dispatch reliability. This is especially true for low fare carriers striving for short turnaround times. When line

Operators will face crucial choices about how to manage component maintenance



maintenance is outsourced, it is typically contracted to other airlines since they have the necessary infrastructure: a network, airport presence and spares support. Consequently, independent, non-airline providers have limited market penetration in this segment.

Aircraft Modifications

The aircraft modifications segment is currently worth \$2.8 billion. Included are passenger-to-freighter conversions, in-flight entertainment (IFE) modifications, interior refurbishments, avionics upgrades and major structural modification programs. We expect this market to grow at 5.5% per annum to \$4.8 billion in 2013.

Of all MRO segments, aircraft modifications is the most volatile and difficult to forecast. Airlines have slashed discretionary disbursements to conserve cash, with spending on modifications declining accordingly. Investments today are focused on programs with compelling commercial advantage or those required by regulation. Future growth depends on a period of sustained airline profitability. Several trends shape the aircraft modifications segment:

- The cargo recession that began in late 2000 continues to curb demand for freighter conversions. Before the downturn, annual conversions typically reached 100. But 2003 saw

approximately half that. Activity should pick up with total demand for the next ten years expected to exceed 750 conversions. Popular models will be the 747, 767, 757, 737 and MD11. One factor limiting freighter modification demand, though, is the growing popularity of "air trucking," where operators substitute air cargo with a time-definite ground transportation network.

- Although IFE expenditures fell from a high of \$2.1 billion in 2000 to an estimated \$1.4 billion in 2002, a drop of over 30%, spending will increase as airline profitability recovers over the next few years. IFE has become an increasingly important differentiating factor among airlines, especially in Asia-Pacific.
- Highly discretionary spending for interior refurbishment will likely remain flat until airline confidence returns.
- There are several other potential programs that could increase modification activity in the medium-term including fuel inerting systems and manportable weapons defense systems. These are not factored into this current forecast.
- Finally, we should see more modification joint ventures that leverage low labor cost partners. Recently announced joint ventures include Boeing and Taeco (MD80/90 cargo conversions) and Pemco and Malaysian Airlines (B737-300 cargo conversions).

Conclusions

The outlook for the commercial MRO market over the next 10 years is a story with two strong themes: demand growth driven by fleet demographics and significant structural changes in supply.

Airlines have become significantly more focused on costs and value. What they require from suppliers is still evolving. What is certain is that they will seek to reduce the projected 5.3% annual growth in MRO expenditures through greater outsourcing, innovative commercial agreements and greater use of alternative parts and repair sources. In addition, airline alliances such as SkyTeam and Star will increasingly use joint purchasing and work sharing to realize cost synergies. As a result, demand is likely to consolidate.

MRO providers must adapt to succeed. As airlines increasingly focus on the transportation aspect of their business, MRO providers can count on heightened demand for broad aircraft support capability, enhanced asset management skills and improved productivity.

In the final analysis, the new value propositions yet to be developed by an increasingly global supplier base will make the biggest impact on the future size and shape of MRO.

What is certain is that airlines will seek to reduce the projected 5.3% annual growth in MRO expenditures

AeroStrategy has available for sale detailed forecasts for the engine, airframe heavy maintenance and component MRO markets.

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Printed April 2004