

Taming the Tail

Spending less on logistics and more on military might:
The challenge for military aircraft MRO

Governments are grappling
with how to support 39,000
aging military aircraft

Military forces around the globe are in the midst of a quiet but profound revolution. New technologies, evolving missions, budget pressures – and the consequent focus on life-cycle economics – are forcing military planners to rethink how they develop, operate, and support military assets and weapons systems. Aircraft – one of the most expensive and critical weapons categories – are no exception.

While flashy new programs like the Joint Strike Fighter, NH90, and A400 grab headlines, governments and military forces are grappling with a less thrilling but still critical

challenge: How to support more than 39,000 aging military aircraft at the lowest possible cost while maintaining mission readiness. Far from an academic exercise, savings in the

\$50B+ spent annually on military aircraft maintenance will be required to fund new weapons systems.

Operations, maintenance, and personnel account for 71% of global defense spending

This imperative raises important questions for governments, original equipment manufacturers (OEMs), and maintenance, repair, and overhaul (MRO) suppliers alike: How much is spent on military aircraft MRO? How are MRO supply chains and procurement strategies changing? How much MRO activity is available to outside contractors? Is the military MRO market becoming more global? After recently completing a broad market assessment, AeroStrategy has answers to these important questions.



Wag the Dog

Military aircraft maintenance expenditures are ultimately derived from national defense budgets. An estimated \$1.1 trillion is spent annually on defense worldwide – approximately 3% of global GDP. This spending is strongly skewed to a small group of countries in North

America, Europe, and East Asia. The US alone accounted for more than 40% of global defense expenditure in 2004 – in excess of \$450B. The largest defense budgets after the US were China (\$110B), Russia (\$81B), Japan (\$44B), the United Kingdom (\$42B), France (\$38B), Germany (\$35B), Italy (\$24B) and Saudi Arabia (\$23B).

Defense spending can be placed in three broad categories (see Figure 1):

- Procurement of weapons systems
- Research, development, test, and evaluation (RDT&E) of weapons systems and defense technologies
- Operations, maintenance, and personnel expenses for defense forces

Procurement of weapons systems, including aircraft, accounts for 22% of global expenditures, while RDT&E drives 8%. At a massive \$772B, operations, maintenance, and personnel – the logistics “tail” – is by far the largest category, making up 70%.

So, development and procurement of new weapons – the “tooth” of defense – comes to less than 30% of costs while the tail consumes more than twice that. Clearly, the combination of an array of new technologies and weapons systems that promise to revolutionize warfare and the prospect

of fairly flat top line budgets means defense forces must improve their tooth-to-tail ratio. But how? By reducing operations and maintenance expenditures. Military aircraft are a central part of the problem – and the solution.

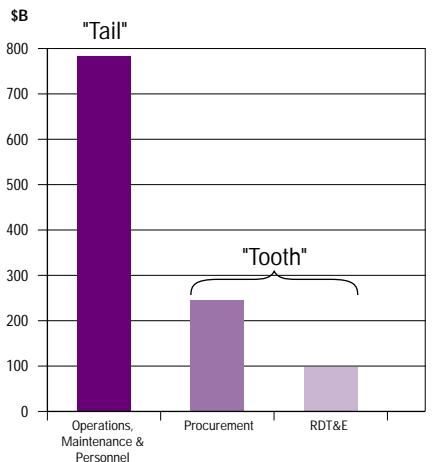
Shrinking With Age

AeroStrategy estimates that governments and military forces operate more than 39,000 Western-built aircraft. (Including non-Western aircraft, operated primarily in Russia, China, Ukraine, and India, would add many thousands to this total.) More than 40% of the fleet is rotary wing aircraft (see Figure 2). The most populous aircraft among the fixed wing fleet are fighter/attack aircraft (28%), followed by trainer/light attack (13%), transport (9%), general aviation/utility (4%), special mission (3%), and tanker (1%) aircraft. Nearly 40% of the Western-built fleet is based in North America (mostly US aircraft), while Europe (24%) and Asia-Pacific (18%) are the second and third largest regions. The military engine fleet numbers more than 70,000.

Although it is anticipated that over 8,000 new aircraft will be delivered in the next decade, the military fleet will likely shrink due to several factors:

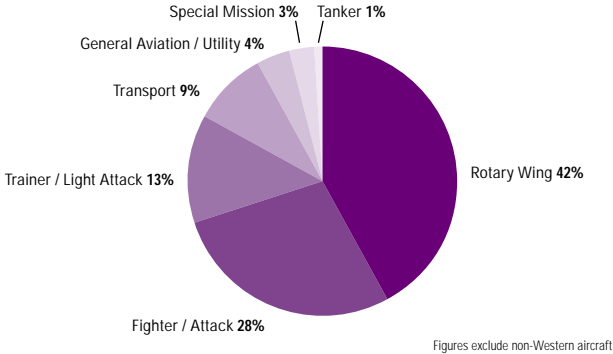
- Revised missions: As military forces adapt their fleets to new

Figure 1: 2004 Global Defense Spending. Total = \$1,109B



Source: Teal Group

Figure 2: 2004 Military Aircraft Fleet. Total = 39,000



threats in a post-Cold War world, they are finding that some aircraft, such as bombers or certain fighters, are no longer necessary

- **Network-centric warfare:** Information superiority and precision weapons make new-generation combat aircraft far more lethal and flexible, so fewer are needed
- **Budget constraints:** Most large military forces face low-growth or flat budgets, limiting their ability to recapitalize their fleets
- **Ageing fleet:** Large numbers of old aircraft are likely to be retired as the average age of the global military fleet (now 22 years) rises

AeroStrategy expects the fleet to contract to 38,000 aircraft over the next decade, an estimate that will likely prove conservative if key governments pursue aggressive fleet restructuring. Should this happen, the active fleet could be closer to 35,000 – or less – by 2014.

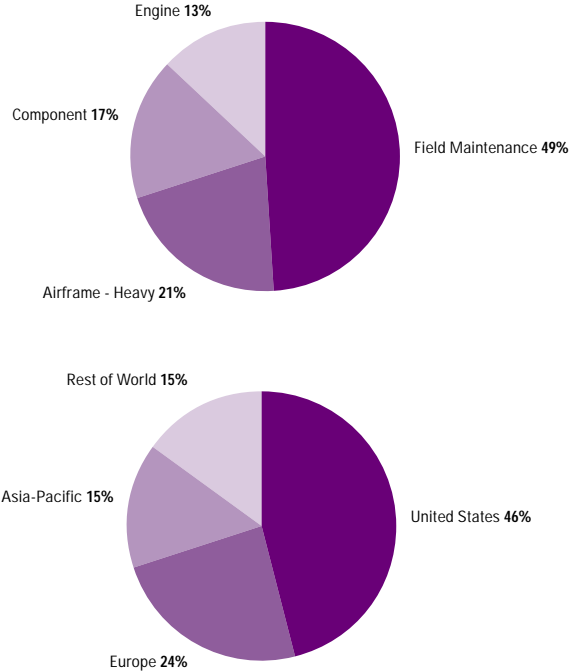
Where the Money Goes

AeroStrategy estimates that about \$52B was spent on maintenance for the military aircraft fleet in 2004 – about \$1.4M per aircraft. Astonishingly, this figure is nearly *twice* the value of global military aircraft production, which stood at about \$25B, according to the Teal Group. Thus, looking at military aircraft alone, the MRO “tail” is valued at twice the procurement “tooth.” What’s more, these figures exclude logistics, training, and major modification/aircraft rebuild programs.

The American defense fleet and budget dominate, accounting for 46% of global military MRO spend (see Figure 3). This is a product of the size of its fleet (more than 15,000 aircraft), technologically sophisticated arsenal, and relatively high operational tempo. Europe, led by the United Kingdom, Germany, and France, is the second largest market constituting about one-quarter of total spending.

The US accounts for more than 45% of military aircraft MRO spending

Figure 3: 2004 Military Aircraft MRO Spending. Total = \$52.7B





Fighter and attack aircraft drive half of military MRO spending

Next is Asia-Pacific (15%), where Japan, South Korea, and Taiwan are the biggest spenders. AeroStrategy has determined that the most significant driver of military MRO spend is field maintenance at \$25B or 49% of the total (see Figure 3), followed by airframe (21%), component (17%), and engine (13%) maintenance.

Field maintenance, which is analogous to line maintenance in commercial air transport terms, includes organizational and intermediate-level maintenance – non-depot maintenance required to achieve operational readiness. It is labor-intensive, requiring between 10 and 15 people to support each aircraft. According to the Logistics Management Institute, the US alone has more than 180,000 field maintenance personnel dedicated to

aircraft maintenance! Not surprisingly, the vast majority of this maintenance is performed by military personnel. Less than 10% is outsourced to outside contractors.

Airframe heavy maintenance (see Figure 4), the second largest spending category, is also labor-intensive. It includes scheduled airframe maintenance performed at offsite government and contractor depots but excludes aircraft remanufacturing programs. Although the high cost of heavy maintenance for 50-year old tankers and bombers gets most of the publicity, fighter and attack aircraft generate the majority of this spend. Maintaining modern fighters, which increasingly resemble flying computers, calls for high fixed cost, advanced technologies. Moreover, fighters generally demand a steady stream of structural modifications, capability enhancements, and software upgrades to be current and operationally ready. Rotary wing aircraft are the next largest consumer of heavy maintenance (13%), followed by special mission (12%), large transport (8%), and light-medium transport (7%).

The aircraft models with the largest airframe spending are the F-18 A/B/C/D, F-16 C/D, Tornado, F-15 C/D, and the venerable C-130 standard.

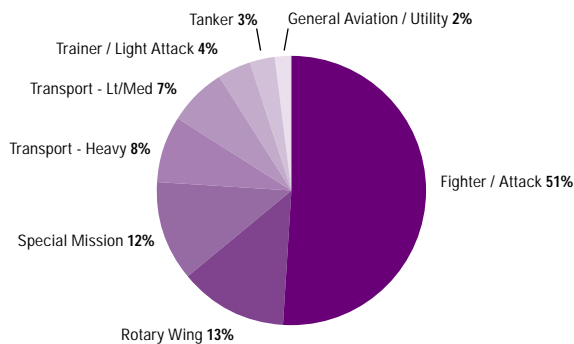
The supply side of the airframe maintenance market differs markedly

by aircraft mission and from country to country. Some governments (the US, United Kingdom, France, Taiwan, Korea) maintain significant organic capability, particularly for fighter and special mission aircraft. Other countries (Canada, Germany, Italy, Japan) are willing to rely on outside, generally domestic, contractors to perform this maintenance. In some cases, the contractors are former depots that have been spun out as separate businesses. Examples include Ruag (Switzerland), OGMA (Portugal), and ENAER (Chile). In all, government depots handle between 50% and 60% of airframe maintenance activity.

The third-largest MRO category, maintenance of aircraft components and systems, is worth \$9B annually. The single largest segment, avionics and defense electronics, accounts for about 33%. Other major categories are dynamic components, landing gear, and hydraulics and flight control systems.

Few governments maintain significant component maintenance infrastructure preferring to rely on outside contractors, including OEMs and independents. A major exception is the US, which employs thousands of maintenance technicians at major depots to support its massive fixed and rotary wing fleets.

Figure 4: 2004 Military Airframe MRO Spending. Total = \$11B



Finally, AeroStrategy estimates that \$6.9B is spent on off-wing engine overhaul (see Figure 5). Engines used on fighter and attack aircraft are by far the most expensive to maintain due to their complexity, demanding operational environment, and high number of cycles. At the extreme, engine costs on old generation fighter aircraft can reach \$2,000 per flight hour. New generation engines are less maintenance-intensive and have lower costs. The largest engine markets include the F414 (14%), F100-220 (9%), RB199 (7%), and T56 (6%).

As with airframe and component maintenance, government depots remain the largest supplier group for engines, with well over 40% of the market. However, there are significant regional variances. AeroStrategy believes that US government depots handle fully 75% of US engine maintenance activity. One depot, the Oklahoma City Air Logistics Center, may be the largest engine overhaul center – civil or military – in the world. Its engine directorate employs more than 1,800 people and manages and maintains more than 17,000 US military engines. In contrast, independent suppliers and OEMs handle the majority of engine maintenance activity in Europe, Asia, and elsewhere. In Germany, for example, MTU and Rolls-Royce Deutschland support the majority of

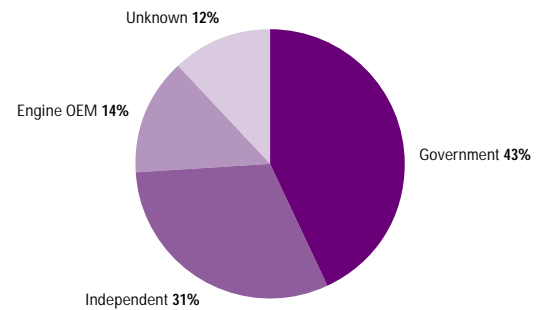
military engine maintenance, while Avio and ITP do the same for Italy and Spain, respectively.

What of future military MRO spending? Any firm calculation will have to account for political and economic factors that are notoriously difficult to predict. Simply using AeroStrategy's fleet forecast and maintenance assumptions – including the consideration that the effects of aircraft aging will more than offset a decline in the aircraft fleet – it is expected that MRO spending will grow at a modest 2% annually for the next five to ten years. At this rate, global military MRO spending will exceed \$60B in current dollars by 2014.

Market Trends

Several trends will shape the global military MRO market in the forecast period. One is the *aging military fleet* – a strong driver of increasing MRO activity. The global military fleet, already old, is getting older. The average military aircraft is 22 years old – about 10 years beyond the average air transport aircraft – placing a significant burden on governments and MRO organizations. Take just a few resulting issues. The US Dept. of Defense has established a corrosion directorate to deal with a problem that by one estimate exceeds \$20B in annual costs (all equipment types).

Figure 5: 2004 Military Engine MRO (\$6.9B) Supplier Market Share



Parts obsolescence also creates challenges and opportunities such that new suppliers are entering the military MRO market to provide out-of-production parts. Another by-product of the aging fleet is an increase in the proportion of spending on airframe maintenance, which consumes 21% of total military MRO spending compared to 14% in the air transport market.

A second key trend is a *greater emphasis on higher-level MRO contracts* that place greater outcome-oriented responsibility on MRO suppliers. Procurement contracts are evolving from huge numbers of discrete contracts (level one – see Figure 6) to programs that assign a contractor or consortia responsibility for an aircraft system – sometimes the life of the aircraft (levels two and three). The Canadian Department of National Defense, for example, is seeking to rationalize its MRO support

Government depots remain the largest engine MRO supplier group





The military MRO market is not likely to be as open and global as its commercial counterpart any time soon

through a small number of major long-term output-oriented contracts. The pinnacle of the MRO contract hierarchy is output-based solutions, where the contractor may even own the asset. Good examples exist in the UK Ministry of Defense, a pioneer of private finance initiatives (PFI), in which contractors are paid for service provision and often take responsibility for full life cycle support and asset ownership. UK capital investment in PFI programs is worth more than £4B, with £1.8B worth of new contracts signed in 2003–2004. Many more PFI initiatives are under consideration, including a massive A330 tanker support contract that could be worth as much as £13B over 27 years. Israel has also embraced PFI, awarding a 10-year, \$40M contract to Elbit Systems for operation and maintenance of Air Force Bell 206 and AH-1A helicopters. And Germany has just approved a PFI contract for NH90 training services. While PFI programs remain a niche and are unlikely to be

popular in the large fighter/attack MRO segment, they are gaining traction with training, transport, and utility aircraft in a growing roster of nations. In these instances, PFI suppliers will be calling the shots for MRO service provision.

A third trend is the *increasing convergence of the commercial and military MRO markets*. While some suppliers, including OEMs and independents like ST Aerospace, Standard Aero, and Pemco, have always served both markets, structural changes are facilitating greater commingling in the long run. One reason is a growing tendency to use commercial platforms and commercial off-the-shelf (COTS) technology wherever possible to reduce development and life cycle support costs. The US Navy, for example, will base its new maritime patrol aircraft on the B737 platform rather than developing a unique military design like the Lockheed P-3. The latest US transport aircraft, the C17, uses engines based on the commercial PW2000 design. And COTS is widely used on systems and components, such as avionics.

A second factor is the globalization of the commercial MRO market over the last decade, which created a new breed of MRO suppliers with deep capabilities and broad geographic

reach. As these firms look for growth opportunities, the magnitude of military MRO spending will be hard to ignore. AeroStrategy estimates that total spending on military aircraft MRO accounts for 54% of the total aircraft MRO market and 39% of the MRO activity that is available to outside suppliers (see Figure 7). While the military MRO market is not likely to be as open and global as its commercial counterpart any time soon, it will yield significant opportunities for savvy and proactive MRO suppliers.

With \$36B in military MRO activity performed organically by government depots and military personnel, the *politics of outsourcing* is another factor to watch. This issue is especially acute in the US, which maintains a significant maintenance depot infrastructure underpinning tens of thousands of jobs. Political support for these depots is understandably strong, and outsourcing cannot by law exceed 50%. One way the US addresses the need for efficiency while minimizing the effect on local employment is public-private partnerships (PPP), in which a contractor provides management expertise, logistics support, and technical services while the government maintains ownership and control of the depot. To date, public-private partnerships make up no more than 2% of maintenance

Figure 6: Aircraft MRO Contract Hierarchy

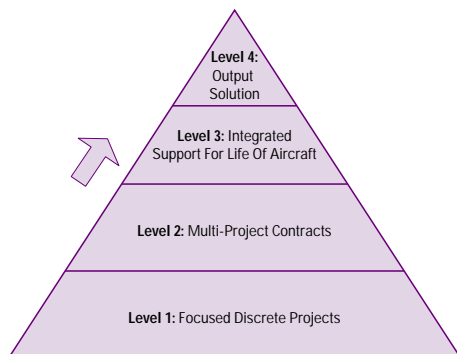


Figure 7: Global Aircraft MRO Markets: By The Numbers

Market Segment	Active Aircraft	Total Aircraft MRO Spending (\$B)	Outsourced Aircraft MRO Spending	% MRO Outsourced
Military	39,000	52	16	31%
Air Transport	16,500	36	18	50%
Business & General Aviation*	> 30,000	~ 8	> 7	> 90%
total	85,500	96	41	

*includes civil rotary wing aircraft.

spending. A base realignment commission is set to meet in early 2005 to recommend US base closures. If a major maintenance depot closes, the available MRO market could increase significantly. Outsourcing politics is not limited to the US – Taiwan recently unveiled a strategy of shifting MRO work from government depots to outside contractors.

A final trend to monitor is *MRO supplier consolidation and rationalization*. The global military MRO infrastructure is far too large – not surprising since it was designed to fight the Cold War without the benefit of the logistics revolution of the last decade. The case for consolidation is especially strong in Europe, where 25 EU members maintain independent MRO infrastructures despite a long-term trend towards closer military integration. If EU governments, many of which face severe budget pressures, can cooperate to develop sophisticated new weapons systems like the Eurofighter, NH90, and A400, military MRO cooperation may not be

far behind. An expanded role for OCCAR (Organisation Conjoint de Cooperation en matiere d'Armement) or NAMS (NATO Maintenance and Supply Agency), two organizations that procure arms and MRO services on a multi-nation basis, could facilitate closer MRO integration. The usual countervailing forces will be the politics of local employment and the desire for control. In the long run, however, the number of European MRO bases should shrink as the logic of the economies of scale prevails.

Conclusion

The imperative of converting the \$52B “tail” of military MRO expenditures into more “tooth” in the form of new aircraft and weapons systems – or, perhaps, into taxpayer savings – will create challenges and opportunities for military forces, OEMs, and MRO suppliers.

To reduce MRO expenditures, governments must balance domestic political realities with the potential payoff of reduced organic capability,

advanced supply chains, technology adoption, and procurement innovation – a difficult but inescapable balancing act made particularly critical by their fleets’ advancing age.

MRO suppliers must adapt their skill sets, value propositions, and investments to cope with emerging changes in military supply chains, particularly if they choose to pursue business outside their domestic markets. With the military fleet accounting for 54% of total aircraft MRO spending, it is a tempting target that will be difficult to ignore.

The case for MRO supplier consolidation is especially strong in Europe



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