THE MILITARY'S MOUNTING COST FOR CUTTING-EDGE TECHNOLOGY

Why global air forces will spend more on their fleet MRO

Doug Berenson, Livia Hayes, Ian Ferguson

OliverWyman

Spending on global military aircraft maintenance, repair, and overhaul (MRO) is poised for a significant upturn, driven by a mix of evolving geopolitical dynamics and the continued demand for cutting-edge technology by air forces worldwide. Demand for military MRO is expected to grow at a compound annual rate 14 times faster than what the sector experienced from 2019 through 2024, with the compound annual growth rate (CAGR) in constant dollars at 1.4% over the next decade versus 0.1% over the previous five years.

One of the biggest drivers of this growth is the expanding fleet of advanced aircraft, such as the F-35, which requires greater maintenance inputs to be operationally effective. While the new aircraft's sophistication expands platform capability, it comes with significantly higher operating costs. These are related to the larger role of complex software, exotic materials, novel propulsion systems, and other innovative technologies, which are expensive and require additional hours of service.

The number of complex aircraft is growing, with the addition of platforms like the A400M and NH90 By 2035, they will make up 8% of the global fleet and 14% of the United States fleet. Meanwhile, global MRO costs are projected to rise 15% over that decade, as complex aircraft increase from an 11% share of fleet today to 17% 10 years from now.

UNMANNED AIRCRAFT AND THE UKRAINE CONFLICT

This premium for sophistication is not only the case with crewed aircraft. An increase in the number of unmanned aerial vehicles (UAVs), or drones, in the inventories of air forces around the world is also pushing up MRO spending.[1] Globally, Group 4 and 5 drones, which weigh 1,320 pounds or more, and are comparable in size to some crewed aircraft and rely on traditional aerospace practices and supply chains, will represent 15% of flying hours by 2035, up from 9% today.

The number of drones owned by major air forces surpassed 1,400 by the end of 2024, with 350 added over the last five years alone — a 30% increase over the total in 2020. We expect a compound annual growth rate (CAGR) of the global fleet of UAVs of almost 9% through 2035, after maintaining a CAGR of just over 5% between 2020 and 2024. By 2035, the number of UAVs will reach 3,460.

Some year-over-year growth is normal, given the increasing size, complexity, and age of the fleet. But MRO spending has started to grow faster than the global fleet. Besides the increased sophistication of newer platforms, the supercharged demand has been driven by aircraft needs related to the three-year-old conflict in Ukraine.

For governments operating these aircraft, the coming period of higher growth will bring significant challenges and questions about how ready is ready enough. It will require governments to strike a balance between a variety of competing measures of value — not the least of which will be the value of high aircraft readiness versus the rising cost to maintain it.

As buyers of aircraft MRO services, they will also need to expand the array of qualified suppliers of spare parts to avoid reliance on diminishing sources. They may need to determine whether to base aircraft MRO work with the original equipment manufacturer (OEM), which may bring contracting simplicity, but perhaps at a higher cost.

1 Our analysis considers Group 4 and 5 UAVs, which are comparable in size to some crewed aircraft and rely on traditional aerospace practices and supply chains, rather than smaller, lower-capability drones from outside that ecosystem.

IMPLICATIONS OF THE MRO GROWTH SPURT

For companies competing in the military MRO market, the rising demand signals an opportunity for growth. But to fully capitalize on the potential, it will be essential for MRO providers to work with their supply chains to reduce the delays and shortages that many are already encountering to keep up with the rising demand.

Because of ongoing supply chain tightness that started with the COVID-19 pandemic and the changing composition of global military aircraft fleets, the balance between original equipment manufacturers (OEMs) and independent MRO providers is also expected to be further altered. The shift is most likely to favor OEMs, because of their leverage over suppliers and control of intellectual property on the advanced technologies.

In addition, rising complexity in military aircraft is likely to reshape the technical and training requirements that aircraft MRO providers face, increasing the criticality of software and other engineering skills in MRO work. This trend may also advantage OEM-controlled MRO providers.

THE EXQUISITE CAPABILITY OF THE F-35

No complex aircraft has had more widespread adoption than the F-35. Of the 310 or so fighter jets bought each year by air forces worldwide, roughly 50% are F-35s. Over the next decade, their numbers will expand to 4.7% of the global fleet, up from 2.2% today, and by virtue of their ubiquity and technology, the aircraft will contribute to higher MRO spending moving forward. By 2035, the F-35 alone will account for 9.5% of the global total MRO spending — more than twice the aircraft's share today.

The US Government Accountability Office (GAO) reports that life-cycle sustainment costs for F-35 rose 44% between 2018 and 2023, while flight hours fell by 21%,[2] according to GAO's April 2024 report.[3] The higher costs associated with the F-35 program are not news to the defense aerospace community, and the F-35 Joint Program Office and the contractor team have been pushing hard to improve performance.[4]

2 Sustainment includes services beyond those of MRO (which is what this report discusses); such services can include (but are not limited to inventory support, training, mission planning, fleet management and many other activities)

3 Government Accountability Office report of April 2024 entitled "GAO-24-106703 F-35 Sustainment: Costs Continue to Rise While Planned Use and Availability Have Decreased"

4 Joint Program Office response reported at www.airandspaceforces.com/f-35-program-office-sustainment-costs-report/

The F-35 has become perhaps the most well-documented example of a complex aircraft, thanks to the abundance of public data available. But the F-35 are not the only exquisite capability aircraft contributing to the MRO cost spiral. There are other complex aircraft, such as the NH90 helicopter, A400M transport aircraft, and V-22 tiltrotor aircraft flying today and next-generation aircraft still in development that may contribute to a further bump in rising MRO needs over the next decade.

For instance, the drive to develop rotorcraft capable of reaching much higher speeds — in the range of 250 knots — began with the US Marine Corps' V-22 program in the 1980s. But the US Army has taken up the banner of high-speed rotorcraft with its future long range assault aircraft (FLRAA) platform, which will be developed by Textron using its V-280 Valor design. The European next-generation rotorcraft capability is less mature but will become a key area of focus for several NATO members.

COMPLEXITY'S IMPACT ON COST

What an analysis of MRO costs reveals is complexity's significant effect on budgets. As governments in the US, Europe, and Asia explore concepts for sixth-generation fighter aircraft — all of which would not enter service until years after this forecast — this should be a vital design consideration.

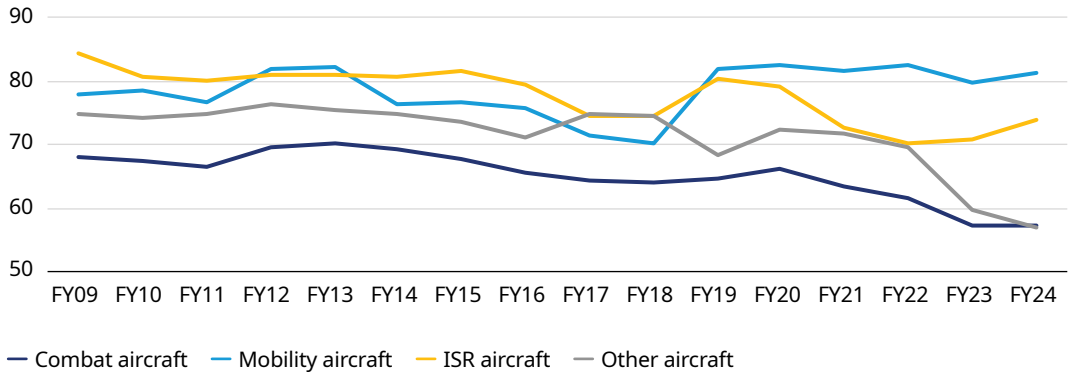
For NATO, complex aircraft will account for 26% of total aircraft MRO spending by 2035, up from 16% today. For NATO fleets other than the US, the F-35 MRO spend amounts to one out of every nine dollars.

Given that the demand for ever-more sophisticated technology shows no sign of abating, governments will see rising MRO costs exerting more budget pressure, making it harder to balance competing demands in defense spending. Increasingly, defense departments will need to make hard choices between sustaining levels of operation needed to train pilots and deter adversaries and containing operating costs to avoid spending cuts elsewhere.

The world's most advanced military operator, the US Air Force, is already demonstrating one approach to this quandary: It has steadily reduced the number of flying hours budgeted per aircraft over the past decade and has accepted declining mission capable rates for much of its fleet, particularly combat aircraft. As it prioritizes modernization, the Air Force is betting that it can manage these readiness risks.

Exhibit 1: Annual US Air Force mission capable rates, FY2009-FY2024

In percent



Notes: FY stands for fiscal year, and in the case of the federal government, it runs from October 1 through September 30.

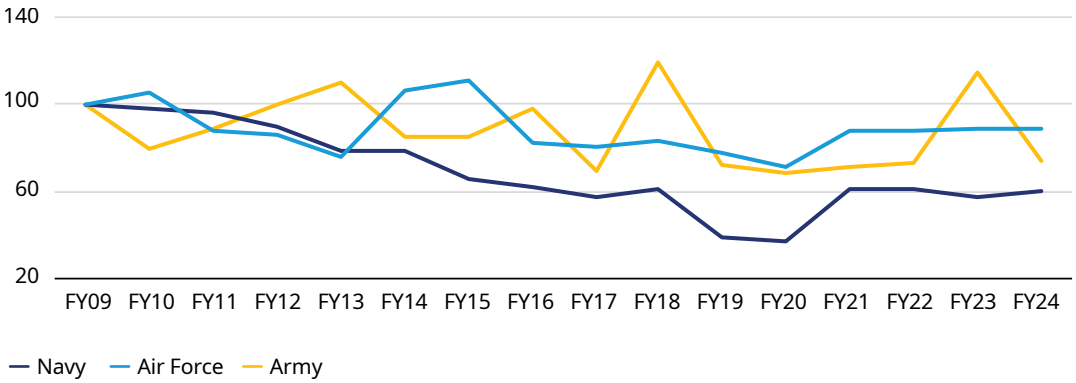
Source: Oliver Wyman compilation of US Air Force published data from Air Force Times, Military Times, Air & Space Force Magazine

For nearly a decade, US Department of Defense (DoD) officials have worried about persistently low mission capable rates, particularly among combat aircraft. (In the US, "mission capable rate" refers to the portion of time that a military aircraft is deemed able to fulfill its core mission.) Both the DoD and GAO have identified multiple factors for this structural decline in aircraft readiness. These include mundane issues like shortage of skilled maintenance personnel and supply chain bottlenecks for spare parts and key supplies.

This is not the case for every new aircraft program. Our analysis reveals good news in areas of training and transport aircraft, where there are numerous examples of cost-effective platforms, such as the Airbus C-295, Embraer C-390, and Pilatus PC-21, which deliver MRO cost savings without compromising mission readiness. But overall, efficiencies with a limited number of aircraft are not sufficient to offset the increases elsewhere.

Exhibit 2: Annual US Military Flight Hours, FY2009-FY2024

In percent



Notes: Flight Hours per aircraft relative to FY2009, FY is United States Fiscal Year.

Source: Oliver Wyman compilation of US Air Force published data from Air Force Times, Military Times, Air & Space Force Magazine

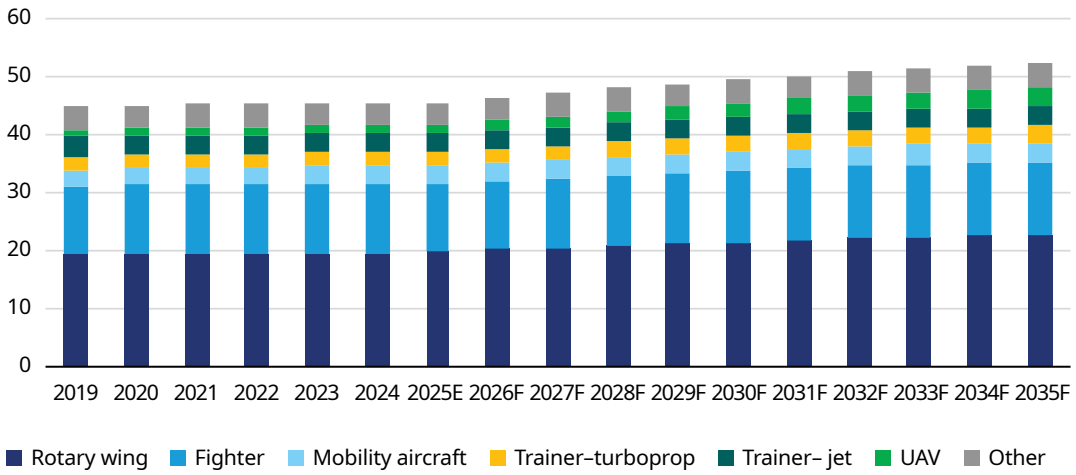
TRENDS IN MILITARY AIRCRAFT FLEETS

Of course, another factor that pushes up MRO costs is fleet size. The global active military fleet numbered more than 45,400 with a projected CAGR of 1.4% over the next decade. By 2035, the fleet is expected to grow to over 52,200. That growth represents a significant increase over the five-year period between Jan 1, 2020 and Jan 1, 2025, when the CAGR for military fleets worldwide was just 0.2%.

All categories of aircraft will see much faster growth over the next decade than they did between 2020 and 2025, with CAGRs for some two, three and four times greater. The strongest fleet growth — at more than an 8% CAGR through 2035 — is in UAVs. That is substantially higher than the 5% CAGR of the past five years for that category.

Increasingly, Group 4 and 5 UAVs are being armed with weapons payloads and fire control systems for ground attack. Systems like General Atomics' MQ-9 Reaper and Baykar's Bayraktar TB2 have demonstrated very high utility in these armed strike roles but are often too vulnerable for use against adversaries equipped with significant air defense systems. Oliver Wyman's forecast of military aircraft MRO does not track spending on small UAVs, like loitering munitions or first-person view drones that have proliferated on the battlefields of Ukraine. In Oliver Wyman's forecast, drones of all types above 600 kilograms in mass will expand to a global fleet size exceeding 3,000 by 2035.

Exhibit 3: Global military aircraft in service fleet, 2019-2035F
Number of aircraft (in thousands)



Note: In service is defined as active aircraft and does not include aircraft that are stored or parked
Source: Oliver Wyman analysis

THE RISE OF COMBAT DRONES

Partly for this reason, our forecast projects that deliveries of high-altitude, long-endurance (HALE) and medium-altitude, long-endurance (MALE) drones will begin to fall in the later years of the forecast period following years of strong growth, and unmanned combat air vehicles (UCAVs), a relatively newer category of UAV, will see increasing numbers in the US and around the world. UCAVs can be defined as UAVs that are designed specifically for combat roles, particularly in highly defended airspace. Thus, they include stealth features, like internal weapons carriage, low radar cross-section airframes, radar-reflective materials, and others. Importantly, they will draw on highly sophisticated software for autonomous operation.

The US Air Force's Collaborative Combat Aircraft (CCA) program is perhaps the most well-known example of this UCAV technology. But governments and companies in South Korea, Turkey, Europe, Russia, and China are also developing similar UCAV designs that are likely to enter service in significant numbers over the coming decade.

The UCAV designs — the aircraft that will generate the most growth in the fleet and MRO spending during the forecast decade — will have a traditional depot-level maintenance dynamic. Boeing's MQ-25 is a good example of this, with first delivery in 2024 and initial operational capability in 2026. It will begin by delivering fuel for US Navy tactical fighters but will move up into more advanced combat roles later. Long-term UCAV MRO requirements are unclear. Some of these are considered "attritable" systems — cheap enough to risk losing in combat operations at a much higher rate than piloted aircraft.

FIGHTER JET DEMAND

Meanwhile, fighter jet deliveries through 2035 are expected to remain steady at around 310 per year, similar to the previous decade. Globally, F-35s will remain the aircraft choice of many militaries, comprising about 50% of the total number of deliveries. The remaining 50% of fighter deliveries will be a combination of F-16s, a handful of F-15s, and some made in Europe and the rest of the world.

Two of Europe's fighter jets — the Dassault Rafale and Saab Gripen NG — are expected to maintain current production levels through export orders across the decade of the forecast. Eurofighter's Typhoon will continue to be built as production partners have orders to fulfill, but we think its cost/capability combination will prove less competitive on the export market than Rafale and Gripen NG. In total, we expect about 330 Rafale, 200 Typhoon, and 100 Gripen to enter the fleet over the next 10 years.

The next decade will see the appearance on the market of next-generation designs from non-US countries. Russia, China, Turkey, India, South Korea, and two separate European consortia are all developing fighter aircraft with features that collectively define the next-generation platform: various levels of stealth design, multi-sensor fusion for fire control and intelligence gathering, advanced propulsion, manned/unmanned teaming, and others. The Chinese J-20, Turkish TF-X Kaan and South Korean KF-21 Boramae are considered leaders among this emerging tier of producers.

While these models may lack some of the sophistication and capability of the F-35, they are likely to offer strong alternatives at lower prices. This may enable them to displace aging Russian designs and compete with less capable models.

OTHER AIRCRAFT TYPES

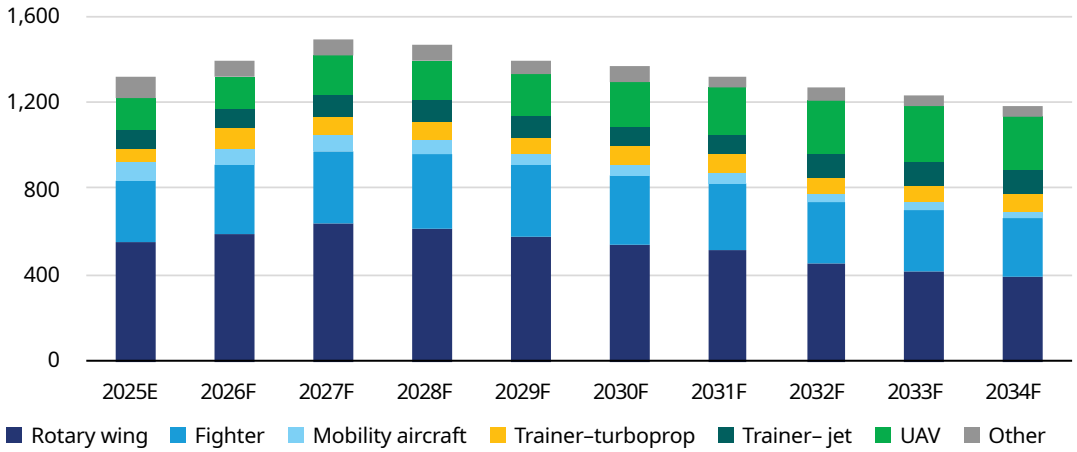
While recent conflicts drove a need for turboprop-powered tactical transports to move people and equipment, the force posture for the next decade emphasizes tanker aircraft able to support military aircraft over vast distances and over water. Thus, in addition to ongoing sales and operation of Lockheed Martin C-130J, Airbus C-295, and Embraer C-390 transports, the Airbus A330 MRTT and Boeing KC-46A are expected to remain in production through 2034. We expect deliveries of commercial derivative transports to remain at around 60 per year, with tankers forming about 25% of total deliveries.

Rotorcraft can expect to continue to see strong demand through the decade, despite the end of the Iraq and Afghanistan conflicts. After growing at a CAGR of 0.4% between 2020 and 2025, rotorcraft inventories will grow at a rate of 1.4% CAGR through 2035.

While there are a number of fleet replacement programs among smaller and lower-end utility/scout/training helicopters that will finish in the near future, such as Leonardo's TH-73 for the US Navy, we project growth especially among medium-to-large military rotorcraft of 1.8% CAGR from 2025 to 2035. Demand for attack helicopters is also expected to thrive, with a 2.9% CAGR over the decade, based on current orders from Central Europe and Asia as well as the US.

Among fixed-wing special mission aircraft, we project steady growth (1.5% CAGR 2025-35) in fleets of airborne early warning, maritime patrol aircraft, and other intelligence surveillance reconnaissance (ISR) platforms.

Exhibit 4: Anticipated deliveries, 2025E-2034F
Number of aircraft



Note: Based on projections for deliveries over the forecast; E stands for estimate and F stands for forecast
Source: Oliver Wyman analysis

THE 10-YEAR OUTLOOK FOR MRO

The global military aircraft MRO market in 2025 totaled about $97 billion. After remaining almost flat since 2019, MRO demand is forecast to grow at a 1.4% CAGR in real terms over the next decade, driven primarily by growth of the global fleet and complex aircraft within it.

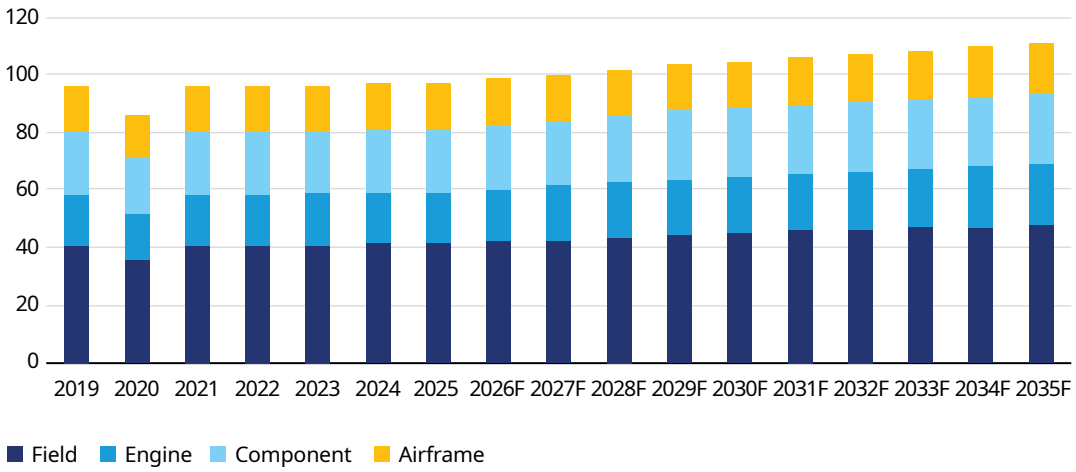
We're analyzing growth in real terms because looking at it in nominal terms may not necessarily show this CAGR explosion because of the inflationary spike experienced after the COVID-19 pandemic and the stable inflation trajectory expected moving forward. Nonetheless, the bottom lines of governments and companies will be hit by this surge in real growth happening through 2035.

As shown below, various MRO activities have different growth dynamics. For instance, engine maintenance is expected to grow at 1.6% CAGR between 2025 and 2035 (up from 0.4% in the prior 5-year period) and component MRO is slated to grow at 1.3% (up from flat), while airframe depot maintenance comes in lower at 0.9%. (These CAGRs are expressed in real terms, adjusted for inflation, with nominal growth rates considerably higher.) This reflects the shifting mix of aircraft types and generations. For example, helicopter rotor blades and dynamic components will demonstrate relatively higher growth at 1.8% while undercarriages, wheels, and brakes will grow more slowly at 0.9%.

When considered by aircraft class, the lowest MRO spend growth is among fighters and mobility aircraft (0.8% CAGR 2025-35.) Highest growth is among UAVs (more than 8% CAGR) and turboprop trainers (2.9%) with other categories nearer the mean growth rate of 1.4%. Underlying region-by-region changes are explored below in greater detail. (Again, these growth rates are shown in real terms.)

Exhibit 5: Global Military MRO demand by segment, 2019-2035F

$US billions

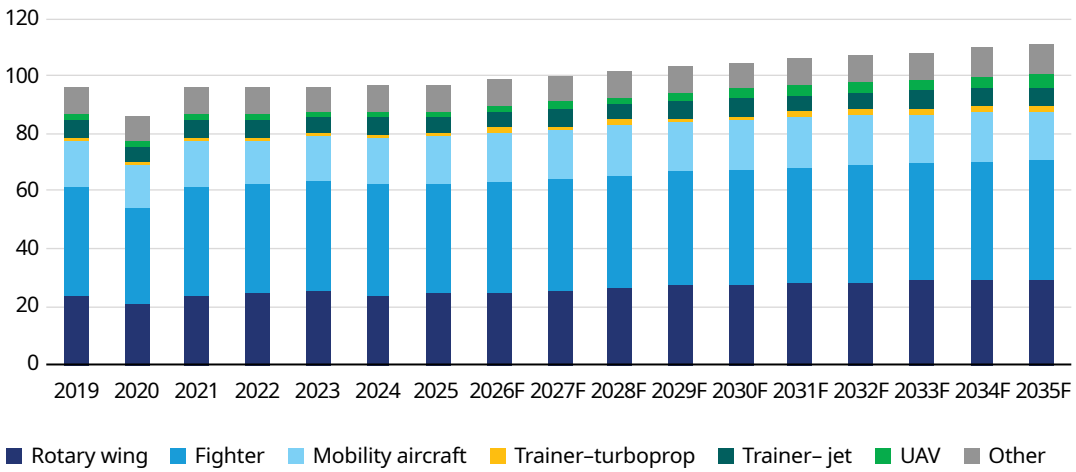


Note: Active aircraft, does not include stored/parked

Source: Oliver Wyman analysis

Exhibit 6: Global military MRO demand by aircraft type, 2019-2035F

$US billions



Note: Active aircraft, does not include stored/parked

Source: Oliver Wyman analysis

Exhibit 7: Global Military MRO demand by region, 2019-2035F

Region	Fleet growth 2019-2025	Fleet growth 2025-2035	MRO spend 2019-2025	MRO spend 2025-2035
North America	0.1%	0.4%	-0.1%	1.1%
Asia Pacific	-0.3%	2.4%	0.3%	2.3%
Europe	-0.5%	2.1%	0.2%	1.8%
Middle East	1.7%	2.8%	1.5%	2.5%
Global South	0.5%	0.7%	-0.2%	0.2%
Global	0.3%	1.4%	0.1%	1.4%

Source: Oliver Wyman analysis

The **Asia Pacific** region represents 12.5% of global military aircraft MRO spending with a growth of 2.3% CAGR through 2035. Fleet growth is similar at 2.4% with a lot of helicopters, MALE UAVs, and some fighters on order. Asia Pacific represents 12% of the global fleet. Over the next 10 years, the APAC fleet will grow from 6,200 to 7,740 aircraft. Looking forward, there is a theme of growing reliance on regionally manufactured aircraft.

In terms of MRO spending, the F-35 is important, with a share of just under 5% in 2024 growing to almost 9% in 2035. There is also potential for that to go even higher if the F-35 is selected to replace fighter fleets in the region that are aging. But in general, there is lower dependence across the Asia Pacific region on the F-35 than in NATO states. We expect that European-supplied aircraft, such as Airbus transports and helicopters and Leonardo helicopters will retain a 12% share, while those manufactured in the region grow slightly from just over 30% over the forecast decade.

In Japan, the major MRO costs for local aircraft are both from Kawasaki Heavy Industries programs, with transition from C-1 to C-2 transports and the growth in P-1 maritime patrol aircraft. The trend to maintain local capability will be reinforced by Japan's partnership in the Global Combat Aircraft Programme, which is a British, Italian, and Japanese government partnership.

South Korea's robust defense industry supports strong aerospace aspirations, with the KF-21 Boramae fighter and a Korean-made light armed helicopter (a local derivative of Airbus Helicopters H155) generating significant maintenance demand by the end of the decade. Meanwhile, Australian MRO spending is expected to grow more quickly than the region at 2.5%, driven primarily by the expanding F-35 fleet but with contributions from tanker, ISR and helicopter growth as defense spending moves up the political agenda.

The **Middle East** represents 12% of the global fleet and 10% of global military aircraft MRO spending. Growth has been at 1.5% CAGR (fleet) and 1.7% (MRO spending in real terms) over the last five years and remains high for the decade ahead, with the fleet growing at a 2.6% CAGR and MRO at 2.5% (in real terms).

Over the coming decade, aircraft supplied by US contractors will generate over 50% of the MRO demand in the Middle East, with European suppliers also holding steady at around 30%. For the remainder, there are noteworthy shifts. Despite the recent and visible Russian supplier marketing efforts in the region, their overall MRO value share is likely to remain steady at under 5%. Platforms manufactured in the region generate a few percentage points of MRO value, with noteworthy growth from Turkish drones (rising from under 1% to almost 7% by the end of the decade.) The balance of MRO spending consists of platforms from other regions, including as-yet small fleets of Chinese-manufactured drones.

Oliver Wyman estimates MRO spending in the Global South at 16% of the total worldwide, on around 25% of the global fleet (12,500 active aircraft.) Overall growth is modest with fleet growth of 0.7% CAGR but MRO growth rates well below that (0.2% in real terms.) Rapid risers include Malaysia and Nigeria. India's fleet grows, driven by a lot of Indian-manufactured helicopters, while Pakistan is expected to receive more Chinese fighters.

Across the range of countries grouped here, the role of various global suppliers will shift. The forecast is for Europe to remain steady, with aircraft programs generating 25% of MRO spending while the US has under 15%. Russia's share is projected to hold steady at around 35%, while Chinese share — based primarily on fighters and drones — is expected to remain at around 10%. India's share is currently modest at around 5% of total, but growth is over 3% with some potential for export beyond the modest success to date. Turkish drones appear to have made a successful debut and have high potential.

CONCLUSION

Our analysis reveals changing patterns of military MRO demand and a return to growth over the next decade after last decade's declines in flight hours and MRO spending associated with the wind-down of earlier conflicts. The composition of MRO spending moving forward is also changing.

UAVs have matured as a central element of global airpower. Fleets of Group 4 and 5 drones examined here will remain stable in the US, but they are proliferating across the world. The rise of UCAV technology in various forms will add a new wrinkle to military MRO spending, as operators figure out which aircraft to treat like "normal" piloted systems and which to use as short-lived or disposable items, with lower MRO costs.

The geographical pattern of military MRO spending is changing, too. Spending in Asia Pacific should outpace growth elsewhere, as the region not only modernizes but also expands its fleets. The region is distinctive in maintaining a base of strong regional manufacturers, with the effect of limiting reliance on any single platform, supplier, or nation for support. In the Middle East, we see demand for MRO across a varied fleet of US, European, Russian, and Chinese aircraft. Our analysis points out the possibility that new fighters from Turkey and Korea may start to take market share if their balance of capability, maintainability, and cost proves attractive.

Operators around the world will grapple with issues associated with exquisite technology in highly complex aircraft. This may drive demand for contract MRO services and other forms of sustainment. But these fleets may challenge military forces to preserve operational readiness — equipment availability, spare parts supplies, and qualified pilots — in the same way they have for decades.

Oliver Wyman, a business of Marsh McLennan (NYSE: MMC), is a management consulting firm combining deep industry knowledge with specialized expertise to help clients optimize their business, improve operations and accelerate performance. Marsh McLennan is a global leader in risk, strategy and people, advising clients in 130 countries across four businesses: Marsh, Guy Carpenter, Mercer and Oliver Wyman. With annual revenue of $23 billion and more than 85,000 colleagues, Marsh McLennan helps build the confidence to thrive through the power of perspective.

For more information, visit oliverwyman.com, or follow on LinkedIn and X.

Americas	Europe	Asia Pacific	India, Middle East & Africa
+1 212 541 8100	+44 20 7333 8333	+65 6510 9700	+971 (0) 4 425 7000

AUTHORS

Doug Berenson
Partner
doug.berenson@oliverwyman.com

Livia Hayes
Director
livia.hayes@oliverwyman.com

Ian Ferguson
Lead Business Specialist
ian.ferguson@oliverwyman.com