

GLOBAL FLEET & MRO MARKET FORECAST SUMMARY

2017-2027



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For over a decade, Oliver Wyman has surveyed aviation and aerospace senior executives and industry influencers about key trends and challenges across the Maintenance, Repair, and Overhaul market.

If you are responsible for maintenance and engineering activities at a carrier, aftermarket activities at an OEM, business operations at an MRO, or a lessor, you may want to participate in our survey. For more information, please contact our survey team at: MROsurvey@oliverwyman.com.

To read last year's survey, please see:

<http://www.oliverwyman.com/our-expertise/insights/2016/apr/mro-survey-2016.html>

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Oliver Wyman's 2017 assessment and 10-year outlook for the commercial airline transport fleet and the associated maintenance, repair, and overhaul (MRO) market marks the 17th year of supporting the industry with informed, validated industry data. This has become the most credible go-to forecast for many executives in the airline and MRO industry as well as for those with financial interests in the sector, such as private equity firms, investment banks and investment analysts.

The global airline industry has made radical changes in the last few years and is producing strong financial results. While the degree of success varies among the world regions, favorable fuel prices and widespread capacity discipline are regarded as key elements in the 2016 record high in global profitability (\$35.6 billion). For an in-depth review of airline profitability, Oliver Wyman's *2016-2017 Airline Economic Analysis* provides comprehensive analysis and insights complementing this publication.

This report focuses on the related airline fleet growth and trends, as well as the resulting impact on maintenance costs and volumes. The outlook reveals significant changes that are important to understand in making business decisions:

- New-generation aircraft (designed and built after 2000) are introducing improved operating costs and new technology that will require significant investment. The technology includes new construction materials (carbon fiber composites, hybrid alloys, and special coatings) as well as new data collection and measurement tools designed to provide advanced prognostication capability. Properly harnessed, the capability for maintenance organizations to take action before a component fails promises to improve reliability and reduce costs. The challenge is that there are not yet proven systems to accept and analyze the data for proactive decision-making.
- The in-service commercial airline fleet is forecast to grow from nearly 25,000 aircraft at the beginning of 2017 to over 35,000 by 2027. Aircraft deliveries to airlines will total about 20,000 over the period, so retirements of older technology will accelerate to about 10,000 during that time.
- The accelerated rate of new aircraft deliveries will result in a massive technology shift over the period. By 2027, 58% of the fleet will be new-generation aircraft.
- Net fleet growth by world region will be uneven, resulting in changes in regional size rankings over the period. The major growth engine will be Asia, especially China and India, which will become the largest region, nearly doubling in in-service fleet and related MRO demand. By contrast, North America will experience little absolute growth, although there will be a significant upgrading of the fleet over the period. North America will slip to the third-largest region, behind Asia and Europe.
- Fleet mix will change appreciably over the period. Narrow-body aircraft will grow faster than the other classes. The regional jets and turboprop fleets will shrink in their share of the fleet, while wide-body aircraft will hold flat. By 2027, the shifts will result in a narrow-body share of 65 percent and wide-body share of 21 percent, while the smaller regional jet and turboprop fleets will slide 10 points to a combined 14 percent share.
- The retirement of aircraft will remain brisk. Having fallen out of favor in recent years, small regional jets and narrow-bodies have been the predominant source of aircraft retirements,

resulting in a surprisingly young retirement age of about 18 years. However, with many of these smaller-capacity aircraft now purged from the fleet, the industry can expect retirement ages to climb again as retirement selections will naturally revert to older, larger-capacity aircraft.

- The significant increase in retirements will continue to fuel the growing Used Serviceable Material (USM) market. Increased USM has the potential of reducing material costs for airlines and MROs.

During this period, each of the fleet complexities translates to significant changes and challenges for the Maintenance, Repair, and Overhaul (MRO) sector. Commercial airline MRO growth will be healthy at 3.8% compound annual growth rate (CAGR) over the 10-year period, growing from the current demand of \$75.6 billion to just over \$109 billion by 2027.

Similar to fleet growth, Asia will experience the bulk of the increase and will be challenged to build the infrastructure and new facilities as well as train a workforce to keep up with the rapidly rising demand. At the same time, the North American MRO industry will stagnate as its growth comes from stealing share or attracting business from other regions.

The up-gauging of aircraft, coupled with the fast growth of new-generation aircraft, presents some very real challenges for the MRO industry worldwide.

In the MRO space, the original equipment manufacturers (OEMs) will increase their share of the aftermarket with shrewd strategies that have proved successful to date. The shift will definitely squeeze the independent MRO sector, particularly the smaller businesses.

Details associated with all the highlighted change are included in the commentary of this report, which has been developed to assist operators and the financial communities with a clear outlook for the industry. This will be an era of disruptive growth, driving companies to carefully develop strategies to maintain relevance and expand.

Oliver Wyman's Market Intelligence team, partners and vice presidents are available to assist with any questions related to this forecast.

REGION	AFRICA	MIDDLE EAST	ASIA PACIFIC	CHINA	INDIA	LATIN AMERICA	NORTH AMERICA	EASTERN EUROPE	WESTERN EUROPE	WORLD
2017 Fleet										
Narrow-body	447	516	1,981	2,316	346	1,066	3,917	716	3,027	14,332
Wide-body	167	709	1,304	328	52	157	1,188	117	978	5,000
Regional jet	143	74	213	111	5	292	1,855	180	492	3,365
Turboprop	294	23	648	0	46	263	714	131	552	2,671
Total	1,051	1,322	4,146	2,755	449	1,778	7,674	1,144	5,049	25,368
2027 Fleet										
Narrow-body	618	841	3,546	5,452	831	1,571	4,960	890	4,419	23,128
Wide-body	277	1,325	1,772	705	102	343	1,434	121	1,342	7,421
Regional Jet	45	28	237	315	60	200	1,444	74	364	2,767
Turboprop	164	69	730	23	73	182	457	47	447	2,192
Total	1,104	2,263	6,285	6,495	1,066	2,296	8,295	1,132	6,572	35,508
Fleet Growth Rates										
2017-2022	0.5%	6.6%	5.2%	10.6%	11.9%	2.8%	0.9%	-0.8%	3.2%	3.9%
2022-2027	0.5%	4.5%	3.4%	7.3%	6.2%	2.4%	0.7%	0.60%	2.2%	3.0%
2017-2027	0.5%	5.5%	4.2%	9.0%	9.0%	2.6%	0.8%	-0.1%	2.7%	3.4%
2017 MRO (US\$ BN)										
Airframe	0.6	1.2	3.0	1.5	0.3	0.8	4.5	0.7	5.0	17.7
Engine	1.6	21.0	4.9	3.4	11.0	2.2	6.2	1.5	5.9	29.6
Component	0.5	1.1	2.9	1.2	0.3	0.8	4.7	0.7	3.3	15.5
Line	0.3	0.9	2.2	1.3	0.2	0.7	3.2	0.6	3.3	12.8
Total	3.0	5.9	13.0	7.5	1.9	4.5	18.7	3.6	17.5	75.6
2027 MRO (US\$ BN)										
Airframe	0.5	1.7	3.8	3.0	0.5	1.0	4.5	0.7	4.7	20.4
Engine	1.7	4.9	8.4	10.0	1.8	4.2	7.7	1.8	7.5	47.9
Component	0.6	2.3	4.7	3.6	0.7	1.2	4.9	0.8	4.2	22.9
Line	0.4	1.4	3.2	3.1	0.5	1.0	3.6	0.6	4.1	18.1
Total	3.1	10.3	20.0	19.7	3.5	7.3	20.7	38.0	20.6	109.2
MRO Growth Rates										
2017-2022	0.0%	6.4%	4.0%	9.0%	7.9%	3.4%	-0.7%	-2.7%	-0.3%	2.4%
2022-2027	1.2%	5.0%	4.7%	11.3%	5.4%	6.8%	2.8%	4.1%	3.6%	5.2%
2017-2027	0.6%	5.7%	4.4%	10.1%	6.7%	5.1%	1.0%	0.7%	1.6%	3.8%

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STATE OF
THE INDUSTRY

Despite unforeseen headwinds and economic turbulence, the airline industry has shown surprising resilience over the last year. Air travel demand has maintained a consistent and upward course. Growth in per capita GDP, unrelenting globalization, and e-commerce allow more accessible and available worldwide air travel. With the recent changes in the global economy, commercial travel is expected to grow steadily but more modestly than previously anticipated. Air travel, as measured by revenue passenger kilometers (RPKs), increased roughly 6.2% in 2016 and is projected to grow about 6.0% annually over the next 20 years.

For a detailed look at world capacity over the past year, see Oliver Wyman's [2016-2017 Airline Economic Analysis](#).

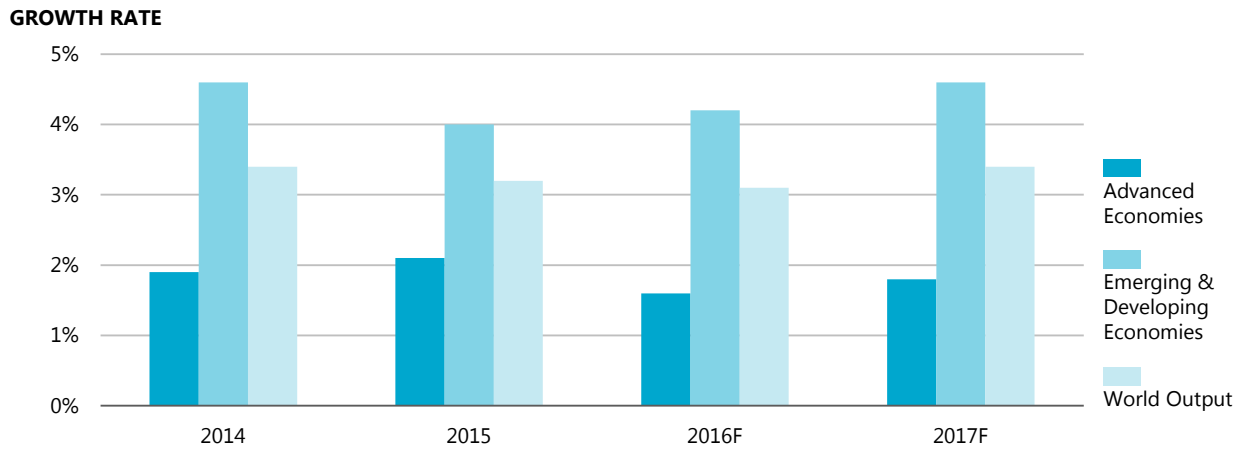


In the past, growth was driven by developed economies building route structures and networks to serve an increasingly global economy and at a lower cost than ever before. In the future, however, growth will depend more on the increasing wealth of developing countries. Emerging consumers represent a staggering 6.2 billion people, 85% of the global population, many of whom will become middle-class citizens in the next two decades. While the same factors of GDP growth and improved, available and accessible travel will drive buying behavior, these new consumers will be more price-sensitive as air travel will be discretionary.

GLOBAL ECONOMIC OUTLOOK

Recent times have seen an increase in financial turbulence, slowing growth in the advanced economies, and continuing headwinds for emerging market and developing economies, creating an environment of a sluggish, fragile recovery for the global economy.

EXHIBIT 1: IMF WORLD ECONOMIC OUTLOOK

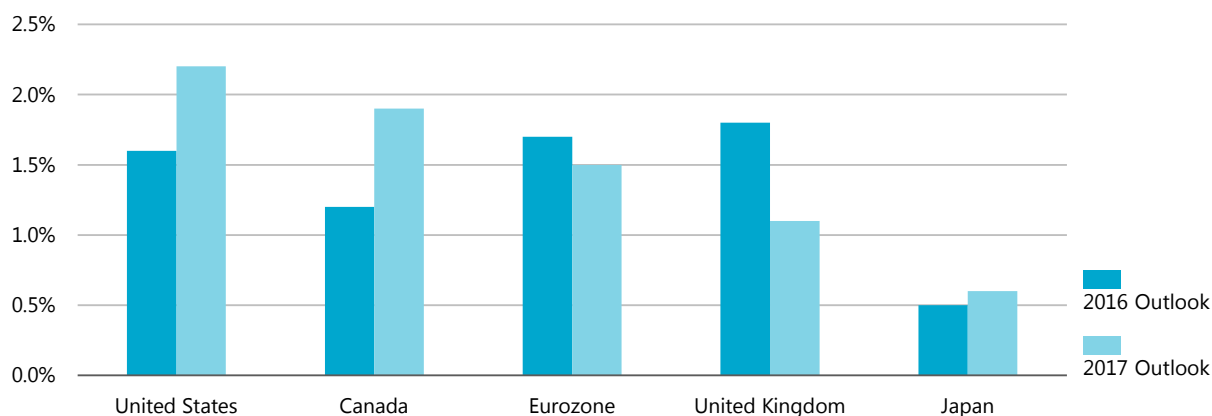


Source: IMF

Global GDP is expected to grow to 3.4% in 2017, a slight increase from the updated 3.1% growth rate for 2016, according to the October 2016 IMF World Economic Outlook. The GDP growth forecast is stronger in 2017 despite the negative impact of the United Kingdom's decision to withdraw from the European Union (Brexit). A major caveat of this improved forecast is the optimistic reliance on several key factors: gradual normalization of economies under stress, success in China's rebalancing efforts, greater activity among commodity exporters, and resilient growth among other emerging market and developing economies.

EXHIBIT 2: IMF ECONOMIC OUTLOOK FOR ADVANCED ECONOMIES

GROWTH RATE



Source: IMF

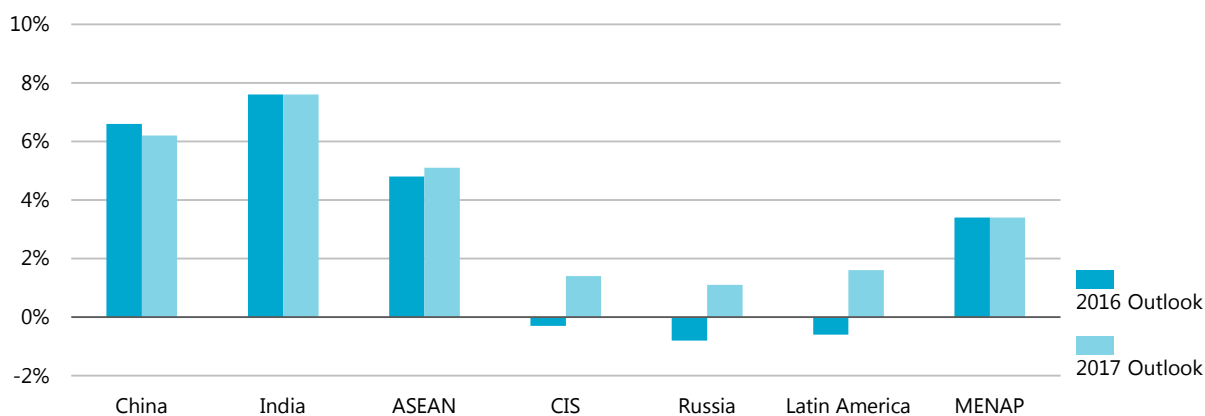
Advanced economies are projected to see GDP growth of 1.8% in 2017, a slight 0.2% increase from 2016. The growth of advanced economies during the first half of 2016 is largely credited to low energy prices and accommodative monetary policies, which have driven the current disinflationary environment and supported domestic demand. Oil prices are expected to remain low but will recover, increasing from an average of \$41 a barrel in 2016 to \$50 a barrel in 2017, and monetary control is expected to tighten, which will result from increasing yields in segments of corporate debt markets and the expected gradual Federal Reserve tightening in the United States.

A majority of advanced economies will have slightly stronger GDP growth in 2017; however, worries continue over the prolonged weak growth rates in advanced economies since the 2008-2009 global financial crisis, leading policymakers to emphasize the necessity for continued structural reforms. The hope is to strengthen aggregate demand in the near term by raising consumer and business confidence and increase potential output over the medium term.

Emerging market and developing economies are forecast to reach 4.6% GDP growth in 2017, a 0.4% increase from 2016, but face a variety of challenges on the horizon. Global trade growth is projected to pick up as a result of stronger domestic demand in developing regions, especially for oil-importing countries; however, in certain instances, countries are facing tighter financing conditions and weak external demand. Furthermore, net capital flows to emerging market and developing economies have shown a weakening trend from an extended growth slowdown in the emerging markets and the first steps toward tighter monetary policy in the US.

EXHIBIT 3: IMF ECONOMIC OUTLOOK FOR EMERGING ECONOMIES

GROWTH RATE



Note: ASEAN is the Association of Southeast Asian Nations; CIS is the Commonwealth of Independent States; MENAP is the Middle East, North Africa, Afghanistan and Pakistan

Source: IMF

Growth in China and India has been broadly in line with projections, but the pace of trade has slowed noticeably because of weaker investment growth across emerging market economies. This slowing not only reflects rebalancing in China from investment to consumption, but also the sharp scaling down of investment in commodity exporters, particularly those facing difficult macroeconomic conditions. Many emerging market economies are expected to struggle with restoring healthy growth until they have diversified their export bases, a process that will take time, especially with many oil-exporting countries facing weak terms of trade.

On a regional basis, growth in the US is expected to increase slightly to 2.2% in 2017, up 0.6% from 2016. Strengthening balance sheets, less fiscal drag, and an improved housing market are projected to offset the downward pressure on net exports from a strong US dollar, gradual Federal Reserve tightening, weaker manufacturing, and the additional decline in energy investment.

Canada's GDP growth is expected to accelerate to 1.9% in 2017, up 0.7% from 2016. A more favorable exchange rate and an expected increase in public investment will outweigh the drag from the struggling energy sector.

The Euro Zone is expected to see a marginal decline in growth in 2017 to 1.5%, down 0.2% from 2016. Decelerating domestic demand, particularly investment, will outweigh the favorable effects of lower energy prices, modest fiscal expansion, and supportive financial conditions. The UK is projected to see a decrease in growth from 1.8% in 2016 to 1.1% in 2017. Slower growth is expected as uncertainty in the aftermath of the Brexit vote weighs on firms' investment and hiring decisions and on consumers' purchases of durable goods and housing. The growth outlook could become even worse, as two optimistic assumptions have been made: Post-Brexit negotiations will be smooth, and there will be a limited increase in economic barriers.

Japan is projected to experience growth of 0.6% in 2017, a modest 0.1% increase from 2016. Postponement of the consumption tax hike, recently announced growth-enhancing measures,

including the supplementary budget, and additional monetary easing will support private consumption in the near term, offsetting the recent appreciation of the yen and weak global growth.

China's growth is projected to slow to 6.2% in 2017, down 0.4% from 2016, which would mark the slowest pace in nearly 15 years. A weakening industrial sector is expected as excess capacity, in which demand for products is less than potential supply, continues to be one of China's biggest problems; meanwhile, non-financial debt is expected to keep rising at an unsustainable pace. The current upside is the service sector, where strong growth is forecast as the economy rebalances from investment to consumption, thanks to high income growth, structural reforms, and a healthy labor market. Given China's role as major player in global trade, difficulties executing this rebalancing process could have substantial spillover effects, primarily on emerging markets.

India's growth is expected to remain 7.6% in 2017, continuing to expand at the fastest pace among major economies. In the short term, private investment will likely be constrained by weakened corporate and public bank balance sheets. But that will be strongly offset by large terms-of-trade gains, positive policy actions, structural reforms, and improved confidence, which will boost demand and investment. The member nations of ASEAN are predicted to experience higher growth, increasing 0.3% to 5.1% from 2016 to 2017, supported by strong domestic demand and a steady increase in exports.

The economic outlook for the Commonwealth of Independent States remains weak, with conflict between Russia and Ukraine still very much an influencing factor. However, growth is expected to recover to 1.4% in 2017, up from -0.3% in 2016 with the help of firming oil prices. Recent growth has been hindered by regional spillovers from the recession in Russia as well as the effect of low crude prices on oil-exporting countries.

Economic activity in Latin America is expected to strengthen in 2017, with growth picking up to 1.6% following a negative growth rate of -0.6% in 2016. South America remains affected by a decline in commodity prices, while Mexico, Central America, and the Caribbean are beneficiaries of the US recovery and lower fuel prices. Mexico is expected to grow at a moderate pace of 2.3% in 2017, supported by healthy private domestic demand and spillovers from the US economy.

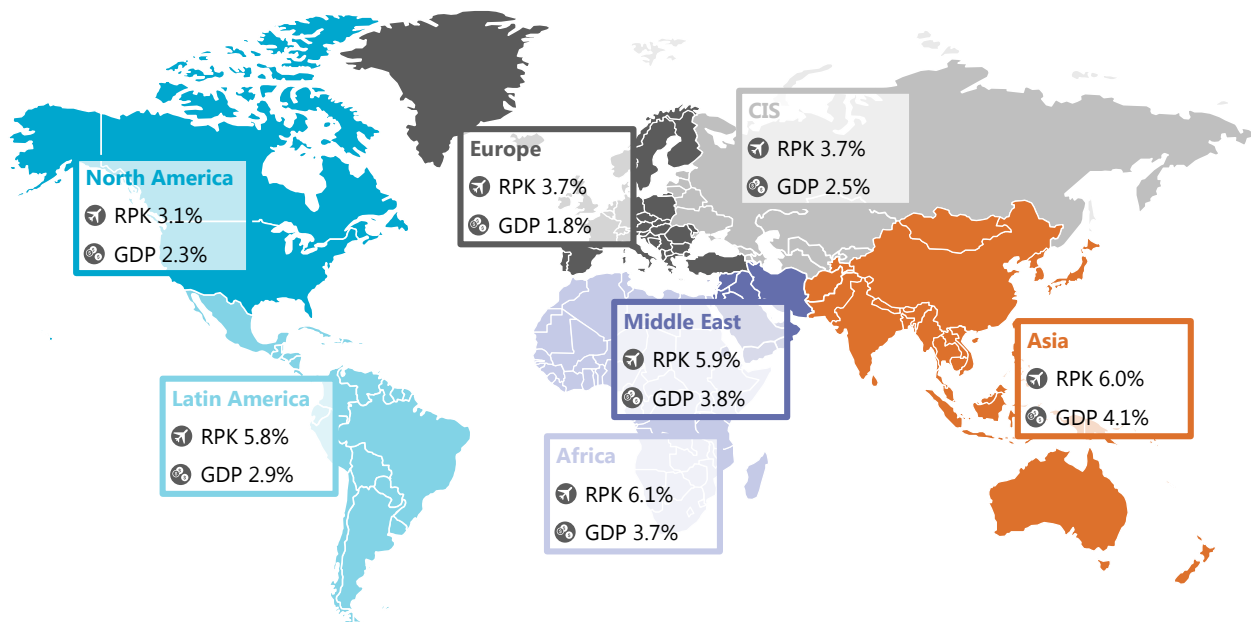
The outlook across the Middle East, North Africa, Afghanistan, and Pakistan, or MENAP, region has weakened considerably in the midst of intensifying conflicts and security risks. Still, growth is projected to remain at 3.4% in 2016, with strife in some Middle Eastern countries expected to ease through 2017 and beyond. Although there has been a recent modest recovery in crude prices, oil revenues are expected to remain low, leading oil-exporting MENAP countries to take considerable measures to restrain government spending, cut subsidies, and raise revenues. Fiscal deficits are projected to widen in the short term despite such efforts.

In general, the world economy is on the road toward recovery, but many regions are vulnerable to lower growth because of a plethora of global uncertainties. Advanced economies are facing slower-than-expected growth rates, underwhelming near-term demand, and tightening financial conditions. Emerging market and developing economies face ongoing headwinds from declining capital inflows and weak exports. With an apparent increase of downside risk facing most economies, there is a sense of urgency for policymakers to safeguard short-term growth and boost potential output as the positive effects of global confidence could be substantial.

ECONOMIC DRIVERS

Although air travel demand is often considered to be closely tied GDP, the International Air Transport Association (IATA) reports that passenger traffic outpaced global GDP for the last nine years. As one would expect, consumers travel more when they have more income, but there also appear to be spikes in demand as open-skies agreements deregulate global travel, service quality improves, and routes are added. The mature regions of North America and Europe have seen these effects over the last 10 years; the developing regions of Africa, Asia, the Middle East, and Latin America will see the largest gains over the next 10 years as these regions benefit from increased incomes and other driving factors outlined here.

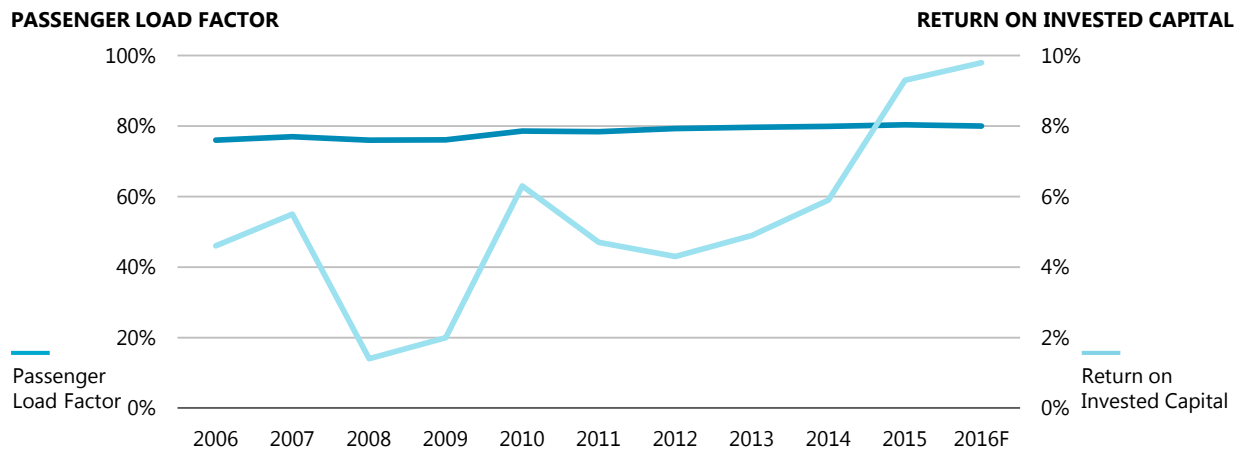
EXHIBIT 4: 20-YEAR GDP AND RPK PROJECTED ANNUAL GROWTH RATES



Source: Boeing

Airlines have responded to the increasing travel demand by posting strong improvements in productivity, allowing the industry to maintain unit labor costs over the past three years. Focus on capacity management has significantly increased passenger load factors and kept yields comparatively high. That has driven airline returns (ROIs) to all-time highs, endowing stronger balance sheets that can feed growth or weather unexpected economic downturns.

EXHIBIT 5: GLOBAL PASSENGER LOAD FACTOR VS. RETURN ON INVESTED CAPITAL



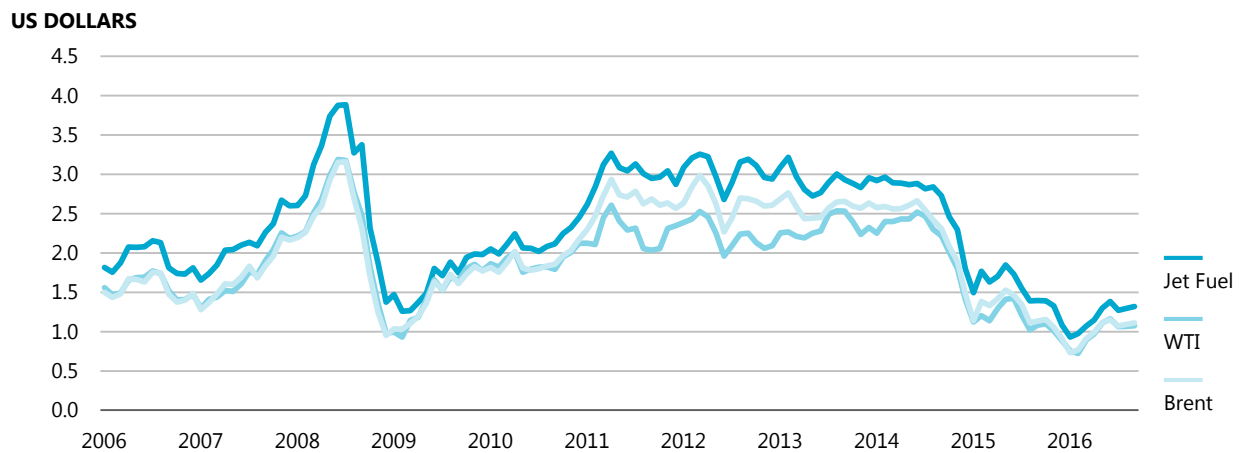
Source: IATA

Industry consensus suggests that improvements in aircraft utilization management demonstrate a newfound financial discipline within the airline industry, drawing the attention of investors and raising valuations and optimism. While this discipline helps drive strong financial results today, this trend must continue in order to minimize oversupply problems should air travel slow or fall sharply like it did during the financial crisis nearly a decade ago.

FUEL

Although rising recently, jet fuel prices are still down approximately 45% over the previous three-year average.

EXHIBIT 6: SPOT PRICES OF CRUDE OIL AND JET FUEL PER GALLON



Source: US Energy Information Administration

Despite signs of economic recovery in the Western world, prices have not been quick to rebound because of hydraulic fracking in North America and sustained output from Saudi Arabia to maintain worldwide market share. These factors will contribute to low oil prices over the next five years.

While low oil prices might spark adjustments to short-term fleet plans (including declining or deferring purchase options in favor of extending existing fleets' lives), there has been no indication of significant strategic shifts by airlines to date. While a short-term strategy change would allow higher returns by delaying expensive investments in new aircraft or costly aircraft restorations, the long lead times in aircraft orders and low interest rates discourage this option.

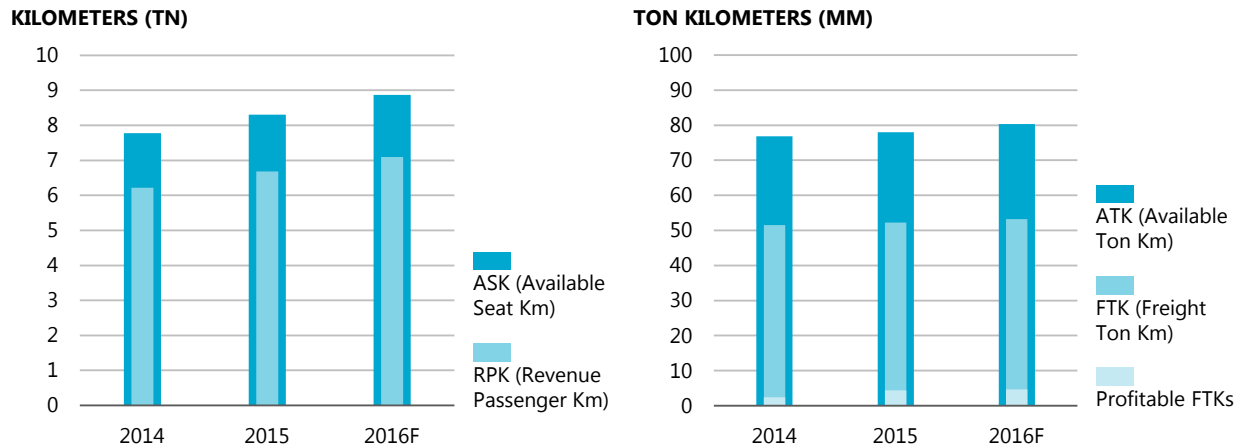
Aircraft deliveries reached 1,633 and 1,641 for the 12-month periods ending August 2015 and August 2016, respectively. With strong order books and OEM production issues on the A320neo and A350 largely resolved, deliveries are expected to increase even more over the next year. This reinforces the projection that new aircraft will be delivered at record rates regardless of oil prices.

Given the expectation that oil prices will return to the recent highs over the long term, operators are expected to focus on 10- and 20-year demand horizons rather than shorter-term oil price fluctuations. Trends will inevitably vary by operator; some may postpone retirement of older aircraft while fuel prices are low, presuming seat demand remains high. In short, carriers can use this strategy to cover particular operational needs for a limited time but not for the long term.

TRAFFIC

The past three years have witnessed significant growth in passenger traffic (RPK 6.8% CAGR) but rather anemic growth in freight traffic (FTK 1.6% CAGR).

EXHIBIT 7: 2014-2016F PASSENGER AND CARGO TRAFFIC

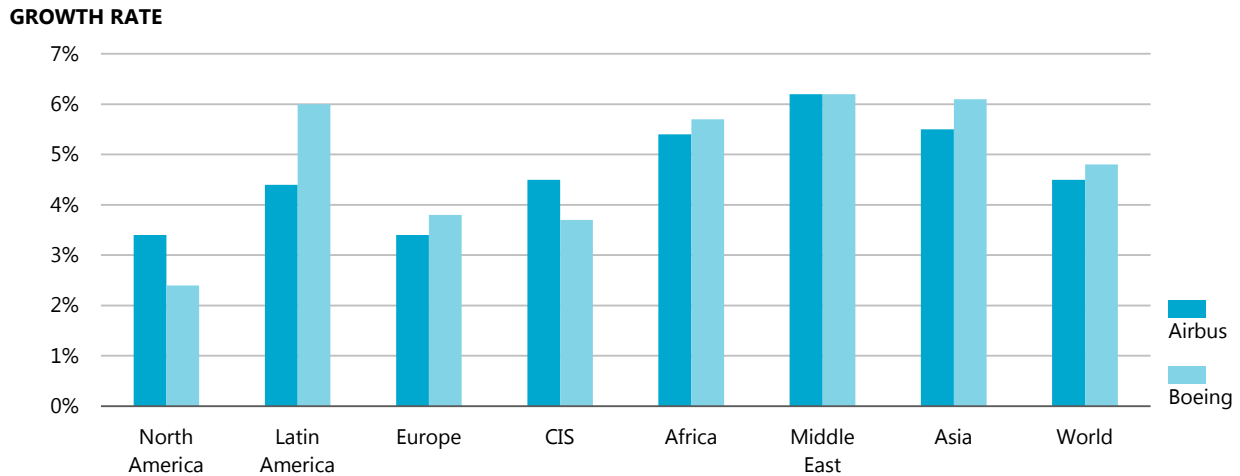


Source: IATA

Passenger traffic growth has matched growth in ASKs (6.8%), while freight traffic growth has fallen behind growth in ATKs (2.2%). This continues a trend for passenger traffic growth, which has grown at more than 5% for five years now, and for freight traffic, which is struggling with oversupply.

Recent trends of increased traffic and greater air travel demand are projected to continue; both Airbus and Boeing predict nearly 5.0% annual growth in RPKs over the next 20 years. Growth will be seen most prominently in the Middle East and Asia, where annual RPKs are expected to grow roughly 6.0% per year on average.

EXHIBIT 8: AIRBUS AND BOEING 20-YEAR PASSENGER TRAFFIC GROWTH RATES



Source: Airbus, Boeing

Increases in regional demand will drive the creation of new routes and will optimize traffic flow through low-cost hubs. Hubs with valuable geographic locations and lower operating costs stand to gain significantly from changes in global demand.

Just in the past year, IATA reported that the number of commercial destinations increased more than 2%, and frequencies between existing destinations are up as well. Network growth expands reach, unlocks greater demand, and, for the second year, leads to the spending of 1% of global GDP (\$740 billion) on air transport.

Concentrating traffic around aviation mega-hubs will lead to significant increases in air and ground congestion, however. As of June 2016, IATA had already deemed 38 of these mega-hubs as World Slot Guidelines (WSG) Level 3 — in other words, conditions “where it makes it impossible to meet demand” — and sees nine more as having the potential for congestion (WSG Level 2).

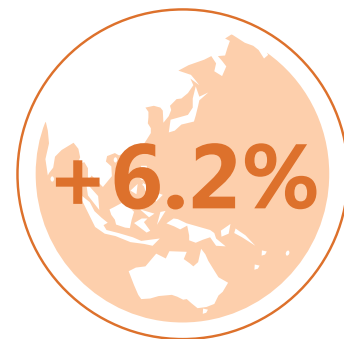
While major hubs prepare for greater traffic and infrastructure improvements, new routes are being created to connect the roughly 6.2 billion people in developing countries. These connections not only represent growth, but also will redistribute the concentration of air traffic around the world.



North Atlantic Traffic



Middle East-Asia Traffic



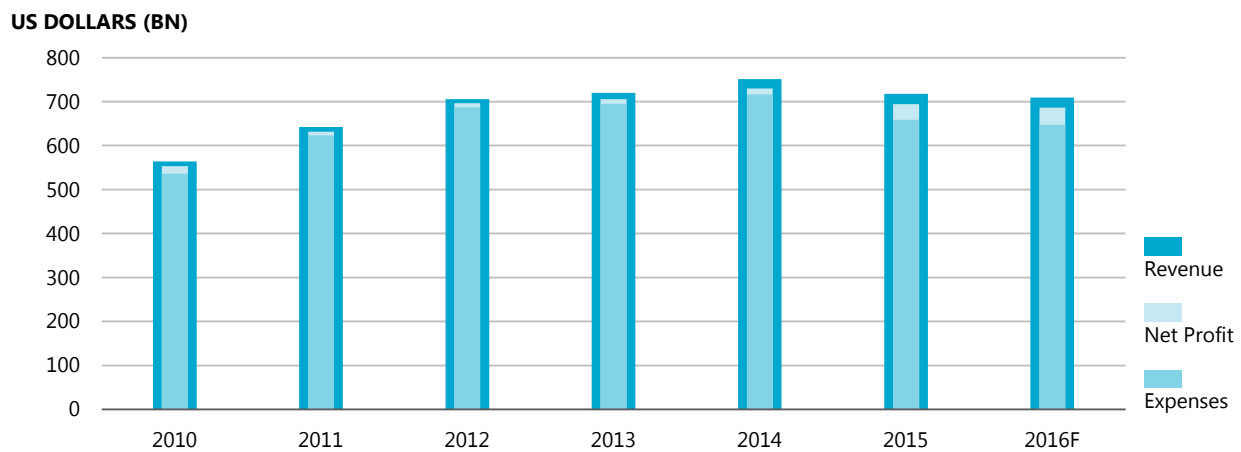
Intra-China Traffic

The next 10 years will see a significant shift in the relative distribution of passenger traffic, moving the epicenter of demand and related fleet activity away from North America. China's emerging middle class will take to the skies, and Middle Eastern airlines will gain long-haul market share through their geographically favorable hubs.

PROFITABILITY

Low fuel prices in conjunction with record passenger traffic have resulted in historically high profits for airlines. Net profits reached \$35 billion in 2015 and were expected to increase to nearly \$40 billion in 2016. Benefiting greatly from industry consolidation and the resulting capacity constraint, the North American airlines are delivering the strongest financial performance, accounting for approximately 60% of global profits over the past two years.

EXHIBIT 9: GLOBAL AIR TRANSPORT INDUSTRY FINANCIAL PERFORMANCE



Source: IATA

Airlines are using their strengthening financial position to improve balance sheets, invest in every detail of the passenger experience, and acquire next-generation aircraft to modernize and prepare for future growth and higher fuel prices.

A large commercial airplane is shown in the process of being assembled inside a vast, multi-story industrial facility. The aircraft is positioned horizontally, with its fuselage and wings visible. The factory's interior is characterized by a complex network of steel beams and multiple levels of walkways and scaffolding, all rendered in a monochromatic blue color. The scene is filled with various pieces of industrial equipment, including ladders, platforms, and storage units, creating a sense of a busy, large-scale manufacturing environment.

3

FLEET FORECAST

IN-SERVICE FLEET FORECAST

While the active global commercial fleet currently stands at 25,368 aircraft, the next 10 years will see 3.4% net annual growth, increasing the number to 35,501. The fleet is forecast to grow 3.8% annually during the first five years, then slow to 3.0% in the second five years as the rate of deliveries decreases and removals remain high. These dynamics will result in a fleet that is younger and larger in average seating capacity. The new fleet is expected to support RPK growth of nearly 5% as operators improve capacity management with the larger average seating capacity.

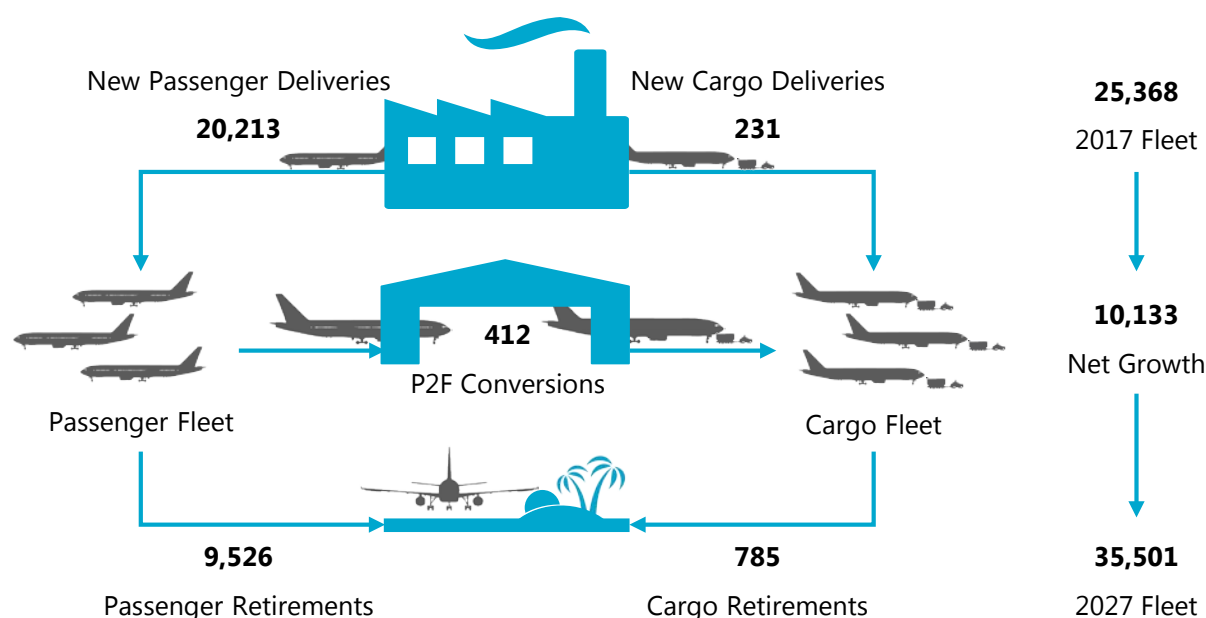
EXHIBIT 10: 2017-2027 GLOBAL FLEET CHARACTERISTICS

	2017	2022	2027
FLEET SIZE	25,368	30,640	35,501
CAGR	N/A	3.8%	3.0%
AVERAGE AGE	11.2	10.3	9.7

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

By 2027, the average age of the active fleet will have decreased from 11.2 to 9.7 years, a significant reduction. Of more than 20,400 new aircraft deliveries, 50% will replace in-service aircraft, a slight reduction from last year’s forecast of 53%.

EXHIBIT 11: 2017-2027 GLOBAL AIRCRAFT DEMAND



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

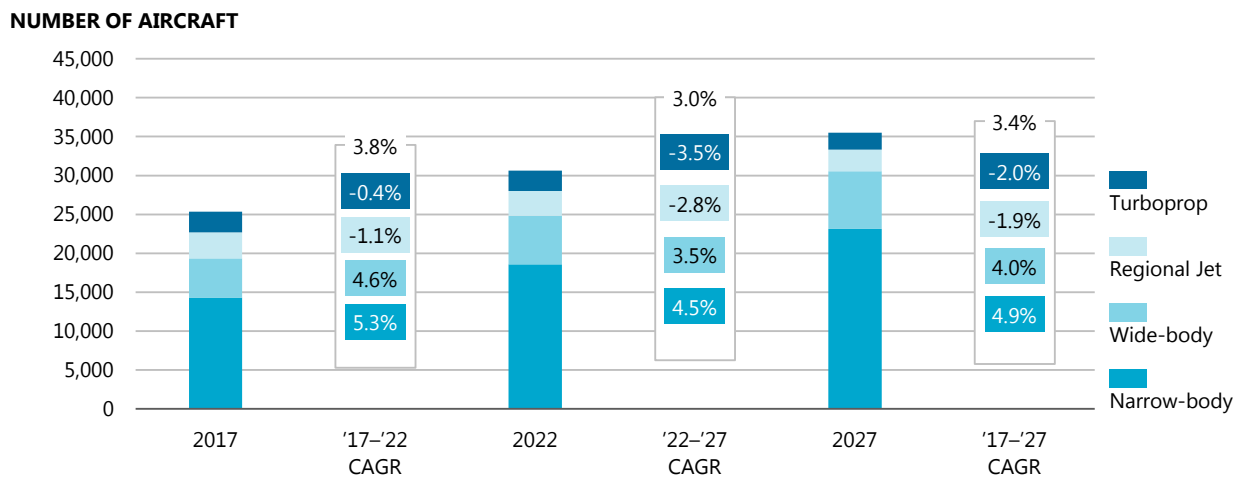
The passenger fleet is forecast to grow nearly 10,300 by 2027, while the cargo fleet is forecast to shrink by roughly 140 aircraft. Just over 1% of new deliveries are forecast to be cargo aircraft. Nearly

two-thirds of the cargo aircraft introduced over the forecast period will be passenger-to-freighter (P2F) conversions.

IN-SERVICE FLEET FORECAST BY AIRCRAFT CLASS

Overall fleet growth is solid, but it is not spread evenly among aircraft classes. Narrow-body aircraft have had the greatest gains in recent years, a trend expected to continue as capacity increases at the expense of regional jets and turboprops.

EXHIBIT 12: 2017-2027 GLOBAL FLEET FORECAST BY AIRCRAFT CLASS



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Narrow-body aircraft are forecast to grow from more than 14,300 aircraft to just over 23,100, an average annual rate of 4.9%. Wide-bodies are the second-fastest growing class, with a 4.0% average annual growth rate; they are forecast to reach a fleet count of over 7,400 by 2027. Regional jets and turboprops are forecast to decrease in fleet size, falling an annual average of 1.9% and 2.0% respectively. The two classes will combine for just over 4,900 aircraft by 2027.

NARROW-BODIES

Historically, low-cost operators have had a strong preference for narrow-bodies, although carriers such as Norwegian and Wow are challenging that thinking with low-cost long-haul services. The majority of back orders are driven by operators adding to fleets and/or trying to improve margins by replacing regional jets and turboprops with a larger, more profitable aircraft. The significant influx of new aircraft will cut the narrow-body fleet age from 10.4 to 9.2 years and raise narrow-bodies' share from 56% to 65%.

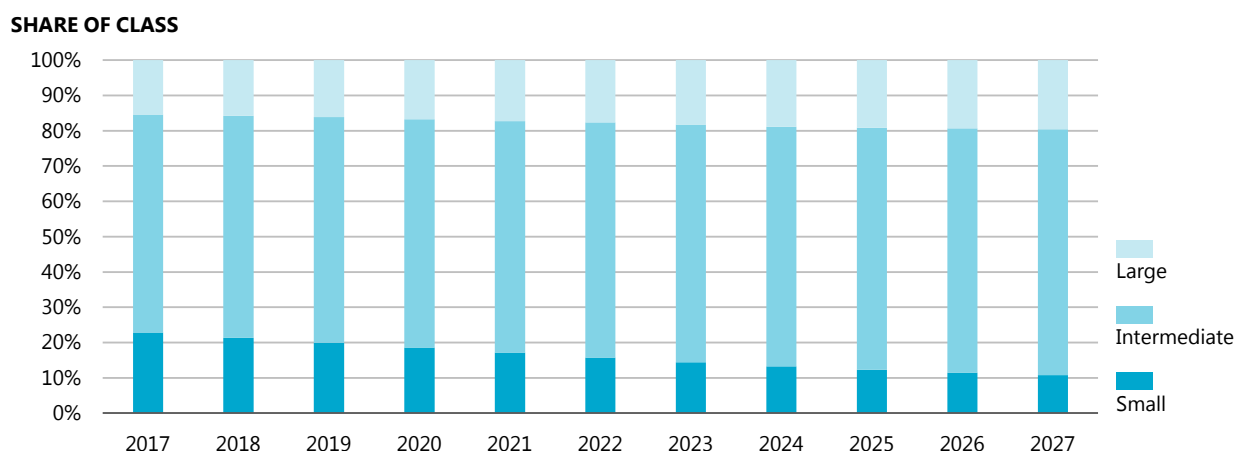
EXHIBIT 13: 2017-2027 NARROW-BODY FLEET CHARACTERISTICS

	2017	2022	2027
FLEET SIZE	14,332	18,580	23,123
CAGR	N/A	5.3%	4.5%
MARKET SHARE	56%	61%	65%
AVERAGE AGE	10.4	9.5	9.2

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

For the first time, Boeing and Airbus narrow-bodies are being challenged by the Bombardier C Series, COMAC's C919 and Irkut's MC-21. However, the C Series program has faced program delays resulting in the first delivery occurring around the same time as that of the re-engined A320neo, surrendering timing and efficiency advantages and contributing to a shortfall in orders. The Chinese C919 and Russian MC-21 will serve only a small portion of operators in their home countries, given certification hurdles in other parts of the world. Even with new competitors, the Boeing 737 and Airbus A320 platforms are forecast to account for 90% of all narrow-body deliveries through 2027.

EXHIBIT 14: 2017-2027 PASSENGER NARROW-BODY FLEET COMPOSITION BY SIZE CATEGORY



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Small narrow-bodies with a seat count ranging between 100 and 150 seats currently make up 23% of the passenger narrow-body fleet. Only 11% of narrow-bodies are forecast to be in this size category by 2027. With the focus on increasing aircraft size commensurate with technological efficiencies, medium-size narrow-body aircraft, such as the 737-8 MAX and A320neo, are expected to represent 70% of the category. These 150- to 175-seat aircraft currently make up 62% of the narrow-body fleet. Narrow-bodies with over 175 seats are also forecast to grow in size relative to the overall fleet.

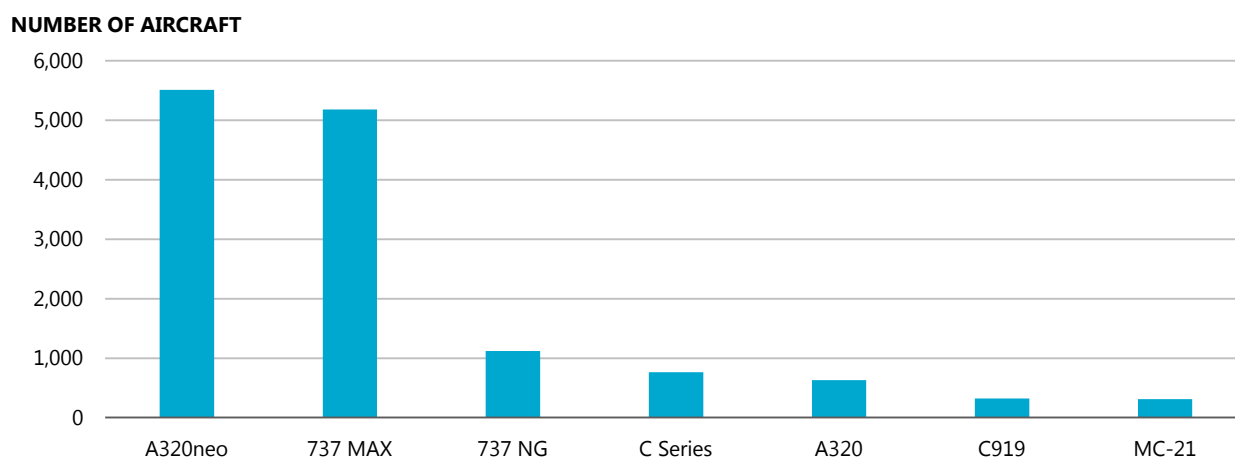
EXHIBIT 15: 2017-2027 NARROW-BODY AIRCRAFT SIZE CATEGORIES

	SMALL	INTERMEDIATE	LARGE
SEAT COUNT	<150	150-175	>175
AIRCRAFT TYPE VARIANT	737-700, 737-7 MAX A319, A319NEO C SERIES IRKUT MC-21 COMAC C919	737-800, 737-8 MAX A320, A320NEO	737-900, 737-9 MAX 737 MAX 200 A321, A321NEO

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

The remaining 737 Classics, 757s and MD-80s will leave the fleet or be converted into freighters. Operators are also forecast to increase the rates of conversion and removal for 737NGs and A320s as they aggressively change out aging fleets.

EXHIBIT 16: 2017-2027 NARROW-BODY DELIVERIES BY AIRCRAFT PLATFORM



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

WIDE-BODIES

The global wide-body fleet is forecast to grow from 5,000 aircraft to over 7,400 by 2027. Market share for the class is expected to remain around 20%, with a 4.0% year-over-year growth rate. Like narrow-bodies, the average wide-body fleet age is expected to decrease from 11.1 years to 9.6 years over the forecast period.

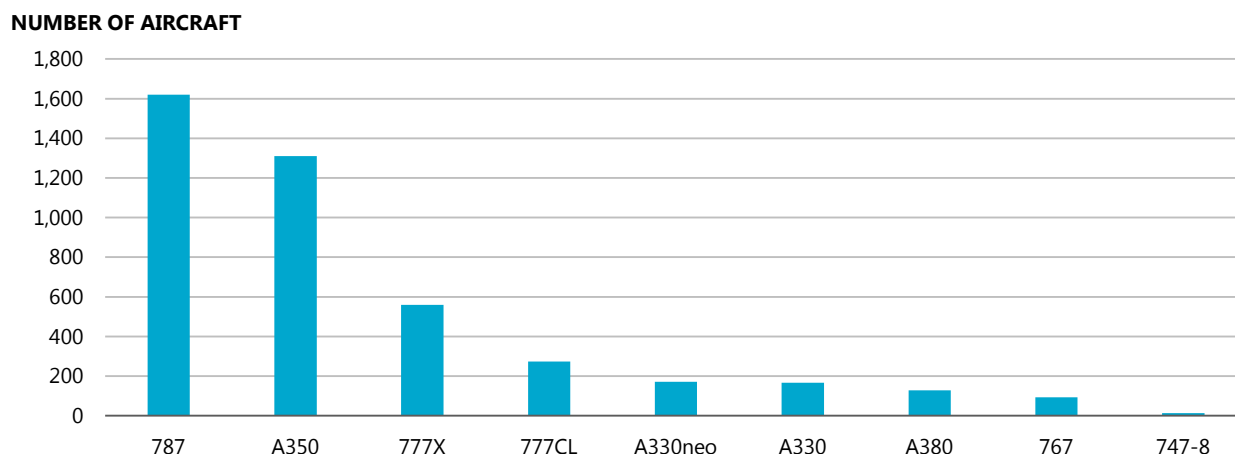
EXHIBIT 17: 2017-2027 WIDE-BODY FLEET CHARACTERISTICS

	2017	2022	2027
FLEET SIZE	5,000	6,262	7,421
CAGR	N/A	4.6%	3.5%
MARKET SHARE	20%	20%	21%
AVERAGE AGE	11.1	10.0	9.6

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Oliver Wyman anticipates that the 787 series will be the most delivered wide-body, followed by the A350. This contrasts with today's fleet, in which the A330/A340 family is the largest fleet, followed by the 777 series. The change, among other things, will create a significantly more fuel-efficient, high-tech fleet. Even though Airbus is introducing the A330neo, improvements in operational costs and efficiencies offered by the 787, A350 and 777X will ultimately outweigh the A330neo's lower acquisition cost. Operators seem to agree, as evidenced by a scarce order book for the aircraft. The A380 is not expected to expand far beyond its current network of operators, with a demand of only about 15 aircraft per year.

EXHIBIT 18: 2017-2027 WIDE-BODY DELIVERIES BY AIRCRAFT PLATFORM



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Over the forecast period, the aircraft platforms most quickly leaving the worldwide commercial fleet will be the 767, 777, and A330/A340, along with most of the remaining 747-400s. Additionally, the 767 will account for the majority of all wide-body freighter conversions.

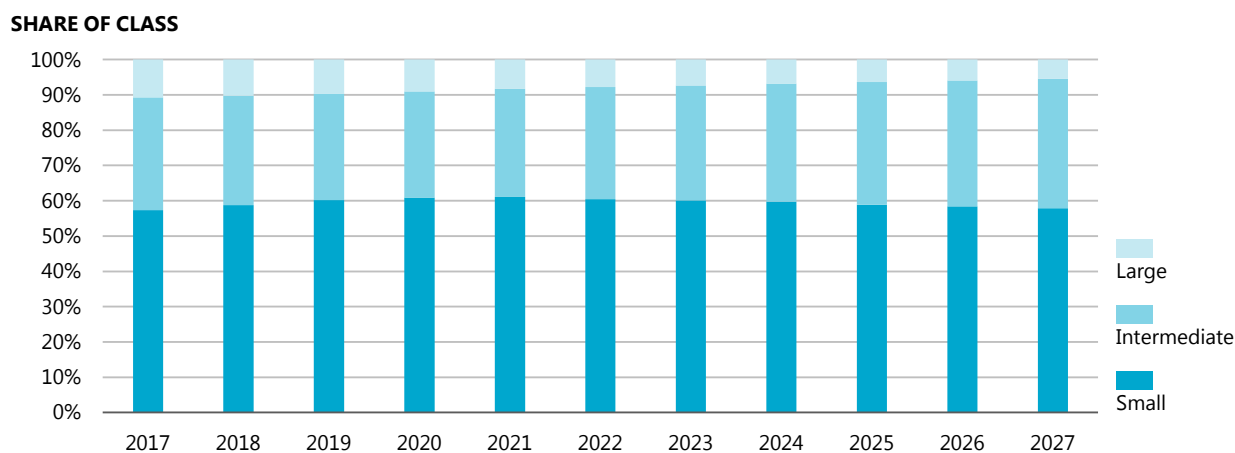
EXHIBIT 19: 2017-2027 WIDE-BODY AIRCRAFT SIZE CATEGORIES

	SMALL	INTERMEDIATE	LARGE
SEAT COUNT	<300	300-400	>400
AIRCRAFT TYPE VARIANT	787-8, 787-9 A330, A330NEO A350-800, A350-900	777, 777X A350-1000	747 A380

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

In contrast to the upsizing trend in the narrow-body fleet, the wide-body fleet is experiencing the opposite phenomenon. Operators are forecast to move quickly toward intermediate and small wide-bodies and nearly abandon orders for huge aircraft. Currently occupying 32% of the wide-body fleet, intermediate twin-aisle aircraft are forecast to grow 37%. This share is taken almost entirely from large wide-bodies, which are expected to account for a mere 6%, sliding from the current share of 11% of the wide-body fleet.

EXHIBIT 20: 2017-2027 PASSENGER WIDE-BODY FLEET COMPOSITION BY SIZE CATEGORY



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

The downsizing of wide-body aircraft suggests a change of philosophy in international capacity decisions, with operators replacing large aircraft with lower capacity twin-aisle aircraft that are more efficient and easier to fill and that provide greater operational flexibility.

REGIONAL JETS

Regional jets will play an interesting though less important role in the future fleet. Even though operators are scaling out of the smaller regional jet market, multiple platforms will enter service. In North America, where over half of all regional jets are domiciled, the role of these aircraft hinges on whether large network carriers and their pilot unions can agree on loosening current weight and seat count restrictions on regional carriers.

The fleet size is forecast to decrease by nearly 600 aircraft to less than 2,800 by 2027, representing an average annual growth rate of -1.9%. The resulting market share of regional jets will fall from 13% to 8%. During the first half of the forecasting period, the average age of a regional jet will increase marginally. This trend will reverse over the second half with the emergence of the E-Jet E2 and MRJ platforms.

EXHIBIT 21: 2017-2027 REGIONAL JET FLEET CHARACTERISTICS

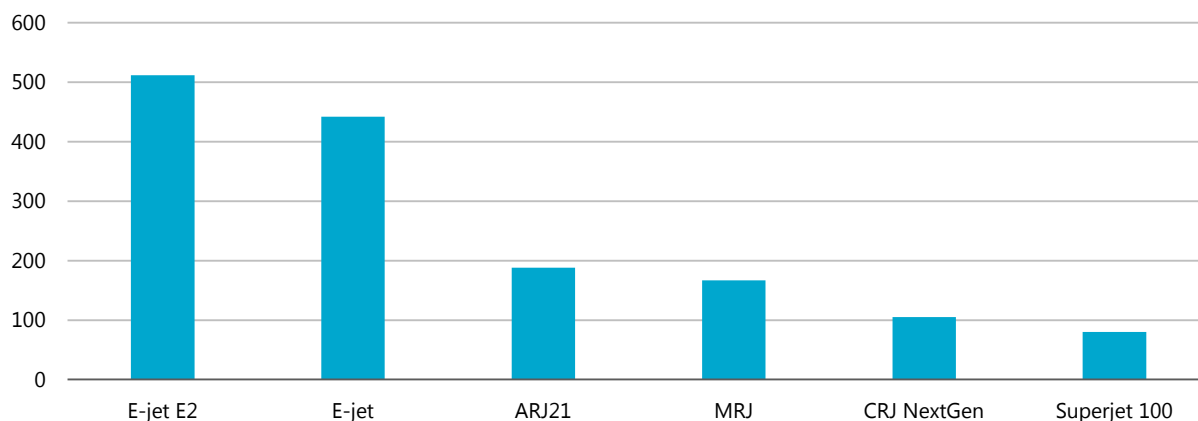
	2017	2022	2027
FLEET SIZE	3,365	3,181	2,767
CAGR	N/A	-1.1%	-2.8%
MARKET SHARE	13%	10%	8%
AVERAGE AGE	10.5	10.8	9.9

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

The Embraer E-jet and E-jet E2 families are forecast to dominate the regional jet delivery schedule over the next decade. The new, more advanced E-jet E2s will connect strategic routes for future investments and provide greater flexibility with their increased range. The regional jet competition appears to be narrowing to a one-platform race. The CRJ order book has fallen dramatically, the Chinese-made ARJ-21 has finally entered service but is unlikely to draw orders from outside China, and Mitsubishi is struggling with certification of the MRJ.

EXHIBIT 22: 2017-2027 REGIONAL JET DELIVERIES BY AIRCRAFT PLATFORM

NUMBER OF AIRCRAFT



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Rapid removal of the CRJ, making up more than 40% of all regional jet removals, is forecast over the next ten years. Many of the remaining ERJ aircraft are also expected to leave the fleet by 2027.

TURBOPROPS

Like the regional jets, turboprops are expected to decline in fleet size and market share. A decrease from nearly 2,700 to just under 2,200 aircraft will result in a 6% share of the market by 2027, down from 11% in 2017. The average age of turboprops will fall from 16.1 years to 15.5 years by 2027. While the turboprop will remain a niche player by providing service to airports not suited for jet aircraft, it loses in head-to-head competition with its jet counterparts.

EXHIBIT 23: 2017-2027 TURBOPROP FLEET CHARACTERISTICS

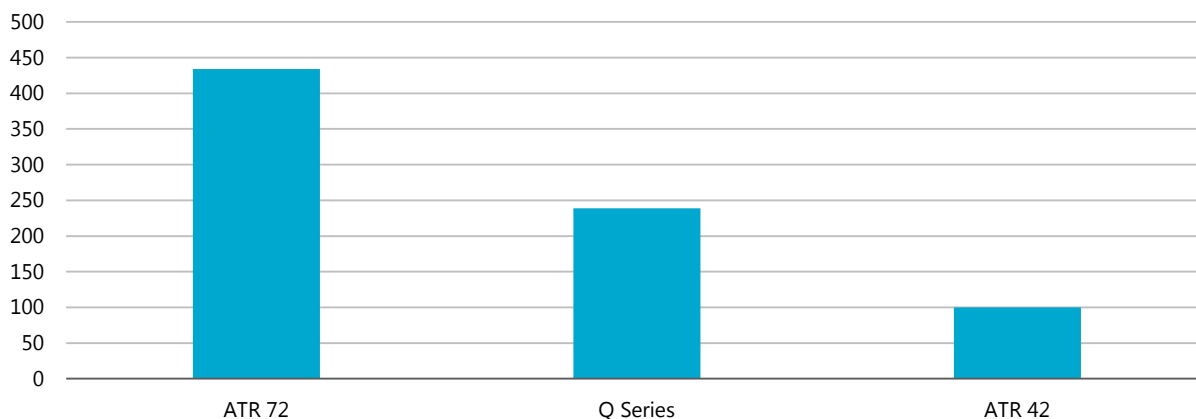
	2017	2022	2027
FLEET SIZE	2,671	2,617	2,190
CAGR	N/A	-0.4%	-3.5%
MARKET SHARE	11%	9%	6%
AVERAGE AGE	16.1	15.4	15.5

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Most older-generation turboprops like the Saab 340s and Fokker 90s will be removed. Bombardier's Q Series, largely uncompetitive because of higher operating costs, is forecast to deliver few aircraft over the next 10 years. As the one remaining niche player, the ATR fleet is projected to grow at an average annual rate of 2.9% over the next ten years.

EXHIBIT 24: 2017-2027 TURBOPROP DELIVERIES BY AIRCRAFT PLATFORM

NUMBER OF AIRCRAFT

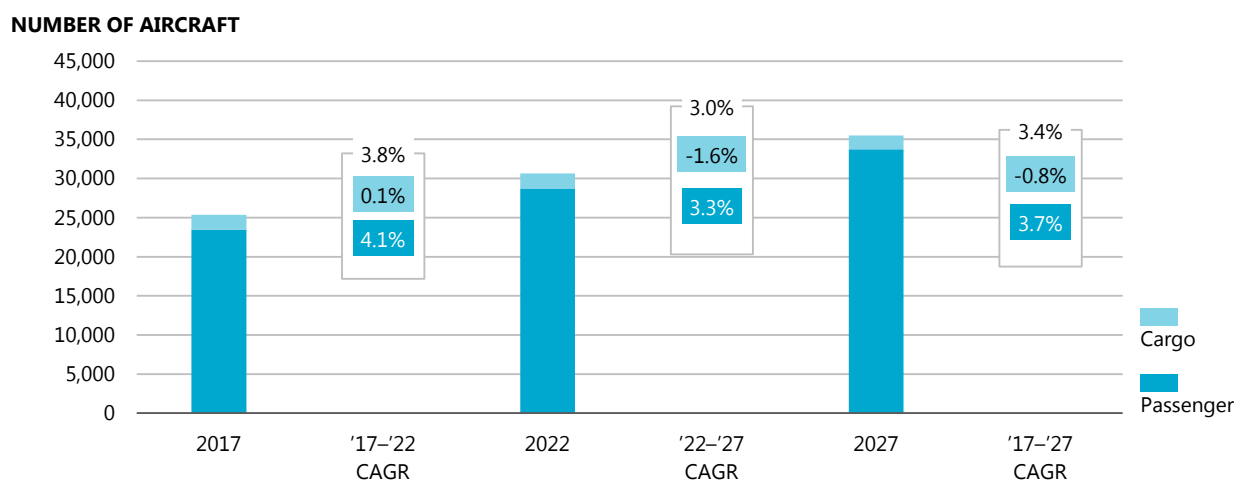


Source: Oliver Wyman Global Fleet & MRO Market Forecasts

IN-SERVICE FLEET FORECAST BY AIRCRAFT USAGE

Although the cargo fleet will fill an important role in air service, its relative share of the commercial airline fleet will decrease from 8% to 5% over the next 10 years. The cargo fleet will shrink at a rate of 0.8% on average, slipping from just over 1,900 aircraft to less than 1,800. This slowdown in demand comes as newer passenger aircraft offer more cargo space and as manufacturers and freight forwarders become more sophisticated at matching cargo and demand with alternate transportation such as ships, rail and trucking.

EXHIBIT 25: 2017-2027 GLOBAL FLEET FORECAST BY AIRCRAFT USAGE



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

As a result of the cargo fleet shrinkage, the passenger fleet is forecast to grow its share from 92% to 95% over the next decade and sustain an average annual growth rate of 3.7%.

EXHIBIT 26: 2017-2027 GLOBAL FLEET AVERAGE AGE BY AIRCRAFT USAGE

	2017	2022	2027
PASSENGER	10.4	9.5	9.1
CARGO	21.3	22.1	22.3
OVERALL	11.2	10.3	9.7

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

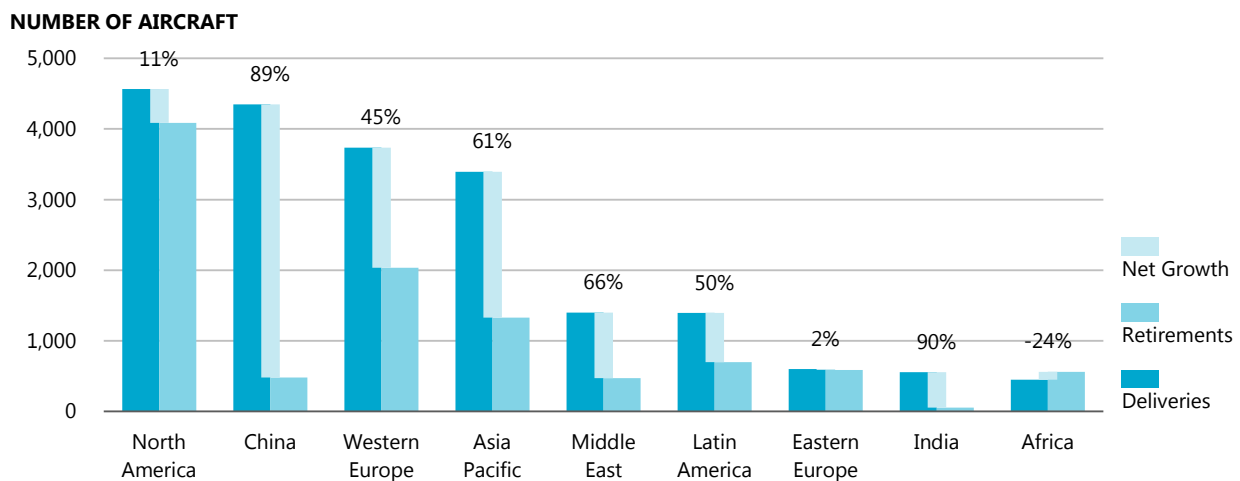
While the passenger fleet will become younger with unprecedented numbers of new deliveries and permanent removals, the average age in the cargo fleet will reach 22.3 years by 2027. It is a direct result of the success of passenger-to-freight conversions and few orders for dedicated cargo aircraft.

REGIONAL IN-SERVICE FLEET CHARACTERISTICS

While numerous changes are occurring across the fleet, some of the most interesting are in regional growth. North America will lead the world in both deliveries and removals but overall will have anemic growth. With the increasing passenger demand in Asia, China’s fleet is expected to grow by over 3,700 aircraft, a net 136% increase. China alone will rank third in the world in operating aircraft numbers, behind regional leaders North America and Western Europe. More impressive, much of that country’s growth will come from new deliveries, reducing the average aircraft age significantly.

China is not the only region expected to see high growth. The remainder of India is expected to grow 137%, the Middle East 71%, and Asia Pacific (excluding China and India) 51%.

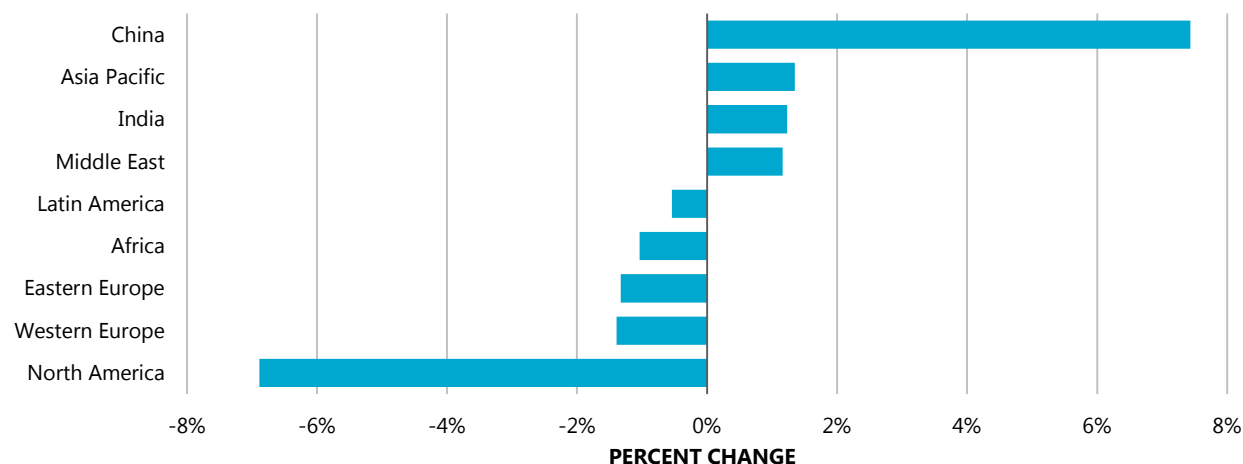
EXHIBIT 27: 2017-2027 FLEET GROWTH BY REGION



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

The influx of new aircraft into Asia is occurring rapidly. Combined, the Asia Pacific, China, and India regions will operate more aircraft than any other in just a year’s time. By the end of the forecast period, Asia will domicile nearly 40% of the global fleet. This will shift the epicenter of fleet activity away from the mature North America and Western Europe regions, which traditionally have had the largest, most established fleets.

EXHIBIT 28: 2017-2027 FLEET SHARE CHANGE BY REGION



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Not surprising, China will see the largest jump in fleet distribution ranking as it accommodates a growing middle class. Nearly all other regions are projected to remain relatively stable, moving in concert with overall trends and maintaining their share of the in-service fleet.

EXHIBIT 29: 2017-2027 FLEET GROWTH RATES BY REGION

	2017-2022	2022-2027	2017-2027
AFRICA	0.5%	0.5%	0.5%
ASIA PACIFIC	5.1%	3.4%	4.2%
CHINA	10.6%	7.3%	9.0%
EASTERN EUROPE	-0.8%	0.5%	-0.1%
INDIA	11.9%	6.2%	9.0%
LATIN AMERICA	2.8%	2.4%	2.6%
MIDDLE EAST	6.6%	4.5%	5.5%
NORTH AMERICA	0.9%	0.7%	0.8%
WESTERN EUROPE	3.2%	2.2%	2.7%

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

North America will experience modest growth, with an average annual growth rate of 0.8%. Western Europe, despite the uncertainty over Brexit, will grow at an average annual rate of 2.7%. China and India are forecast to be the fastest-growing regions, averaging 9.0% growth per year. The Middle East, at 5.5%, and Asia Pacific, at 4.2%, will be the third- and fourth-fastest growing regions, even with both slowing during the second half of the decade. In particular, India will grow rapidly, at 11.9% during the first five years, because of its relatively small fleet. The rate will slow substantially in the second five years because of expected challenges in further developing the country's infrastructure and building a robust middle class.

EXHIBIT 30: 2017-2027 AVERAGE AGE OF FLEET BY REGION

	2017-2022	2022-2027	2017-2027
AFRICA	14.6	14.0	12.3
ASIA PACIFIC	9.3	9.3	9.8
CHINA	6.1	6.6	7.8
EASTERN EUROPE	12.0	11.7	10.5
INDIA	6.9	8.1	10.2
LATIN AMERICA	11.2	9.7	9.0
MIDDLE EAST	9.6	8.8	8.8
NORTH AMERICA	14.0	12.8	11.0
WESTERN EUROPE	11.1	10.6	10.0

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

As fleets grow in each region, the average aircraft age will change, with most of the world's aircraft getting younger. But in China and India, the fleets will age as aircraft stay in service to meet increased demand, leading to greater emphasis and importance for aircraft maintenance programs. In contrast, the Middle East and Africa will see a decrease in fleet age as new aircraft replace older ones.

Historically, Africa and other developing nations acquired most of their fleets through migrations of older aircraft from mature regions such as North America and Western Europe. That trend appears to be changing as new aircraft orders have become the dominant source of growth. The surge of newer aircraft has driven a dramatic shift in migrations between the regions, fueled by new low-cost acquisition options through aircraft lessors and export credit financing.

EXHIBIT 31: 2017-2027 NET AIRCRAFT REGIONAL MIGRATIONS

Source: Oliver Wyman Global Fleet & MRO Market Forecasts

In 2016, there were 390 total migrations of older aircraft worldwide, resulting in 126 net migrations. Many of these aircraft left developing regions for North America and Western Europe. Latin America, probably because of its current economic difficulties, sent several aircraft away, many of which ended up in Western Europe. With similar moves likely, 950 net migrations are forecast over the next 10 years.

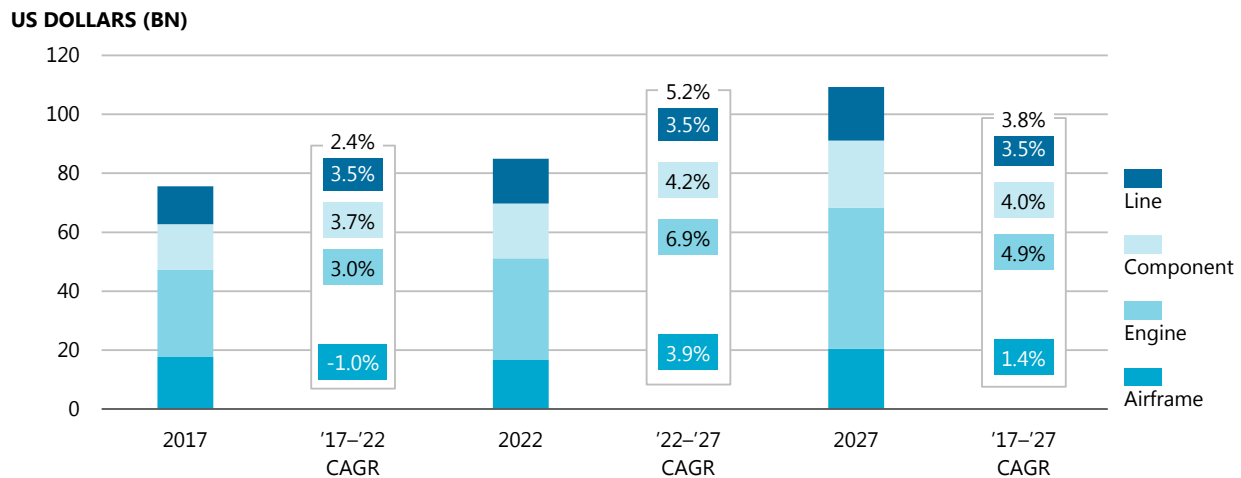
A photograph of a worker in blue overalls and safety glasses working on a large aircraft engine in a factory. The worker is positioned on the right side of the frame, looking down at the engine. The engine is a large, complex piece of machinery with a prominent, conical, light-colored component in the center. The background shows the interior of a large industrial facility with various structures and equipment. The entire image has a blue color overlay.

4

MRO MARKET
FORECAST

The commercial air transport MRO market will revolve around the growth and changes of the global fleet. The total MRO spend in 2017 is expected to be \$75.6 billion. It will rise to \$84.9 billion by 2022, representing a 2.4% CAGR over the five-year period. The growth rate will increase modestly to 5.2% annually in the second half of the forecast period. Over the full 10-year period, the global air transport MRO market will grow on average 3.8% annually, rising to \$109.2 billion by 2027.

EXHIBIT 32: 2017-2027 MRO MARKET FORECAST BY MRO SEGMENT



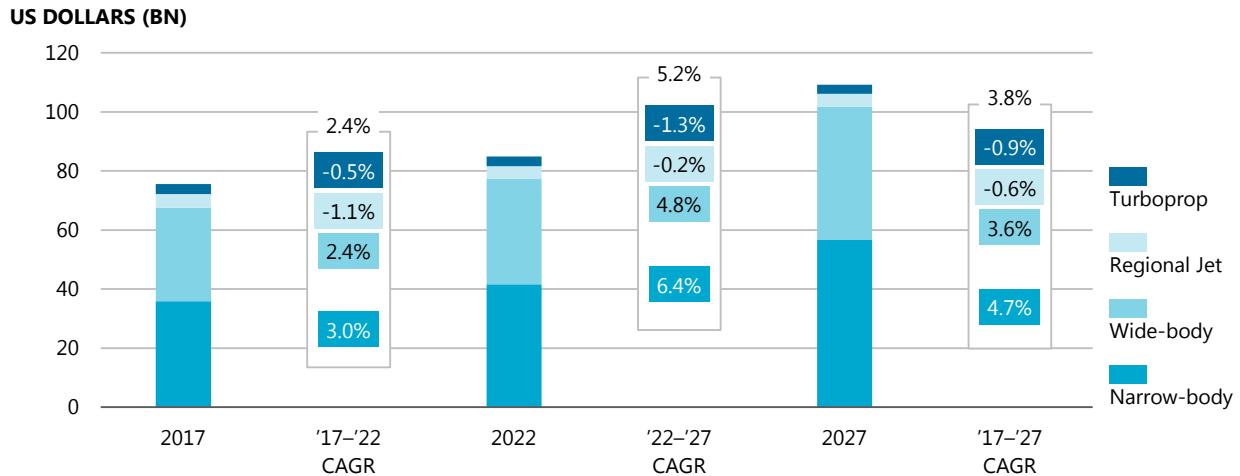
Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Airframe maintenance will continue its trend of lower unit costs, driven primarily by heavy maintenance visit intervals stretching to 12 years. This is possible through the increased use of composites and hybrid alloys in new-generation aircraft, providing better fatigue and corrosion resistance than previous generations.

Engines, while much more fuel-efficient, are operating at ever higher temperatures and pressures, resulting in more expensive shop visits to restore and replace increasingly exotic and expensive materials – hence the 4.9% average annual growth rate in engine MRO.

There is little change expected in the relative mix of component and line MRO spend over the forecast period.

EXHIBIT 33: 2017-2027 MRO MARKET FORECAST BY AIRCRAFT CLASS



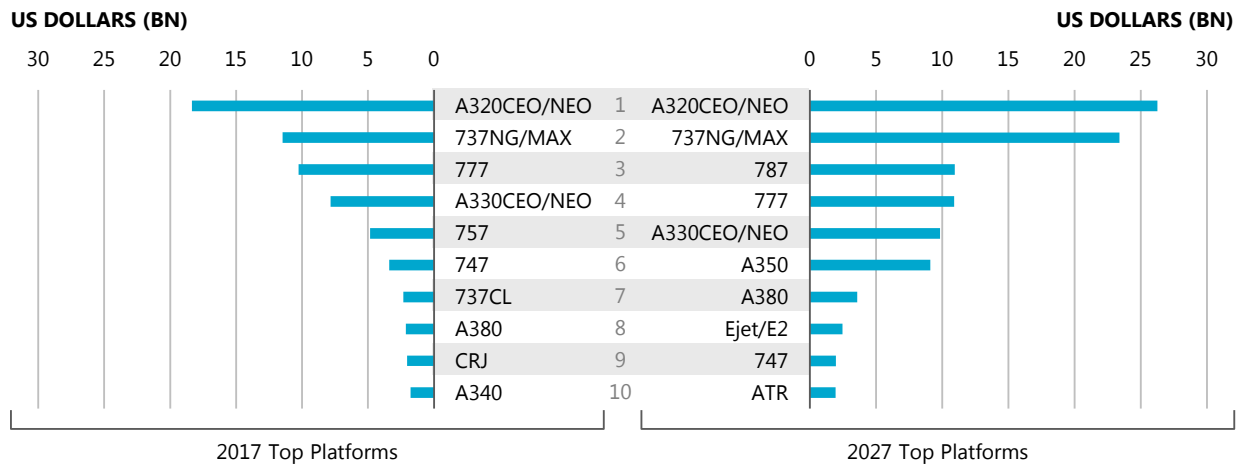
Source: Oliver Wyman Global Fleet & MRO Market Forecasts

Globally, MRO spend related to narrow-body and wide-body aircraft will comprise \$67.5 billion of the \$75.6 billion total, with regional jets and turboprops combining for an MRO spend of just \$8 billion. For 2017, the narrow-body MRO market share mirrors that of the fleet itself – that is, roughly 50%. Wide-body MRO, on the other hand, makes up just 20% of the global fleet but represents more than 40% of the MRO spend because the aircraft are more maintenance-intensive in size and complexity.

Over the next ten years, Oliver Wyman forecasts a significant shift of spend away from regional jets and turboprops and toward narrow-body aircraft. Narrow-body MRO spend will see a nearly \$21 billion increase to \$57 billion by 2027, with its overall market share rising to 52%. This share is taken almost entirely from regional jets and turboprops, as their combined share decreases to just 7% with a total MRO spend of \$7.4 billion. The wide-body MRO market share remains stable at 41% with a total market of almost \$45 billion by 2027.

The additional narrow-body and wide-body spend is significant, but it will not be distributed evenly. The total MRO market is expected to become increasingly concentrated within a handful of aircraft platforms.

EXHIBIT 34: TOP AIRCRAFT PLATFORMS BY TOTAL MRO SPEND

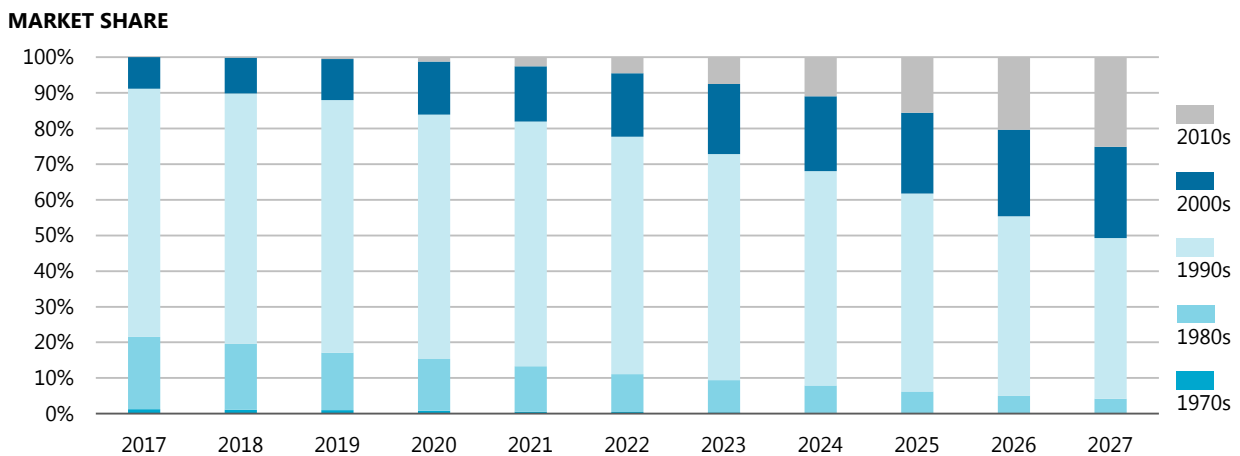


Source: Oliver Wyman Global Fleet & MRO Market Forecasts

In 2017, the top 10 aircraft platforms will comprise 85% of the total MRO market. By 2027, the top 10 aircraft platforms will represent 92% of the market.

More important, the 2000s and 2010s vintage fleets will grow from a 9% share of the global MRO market in 2017 to more than half of the market by 2027.

EXHIBIT 35: TOTAL MRO SPEND BY AIRCRAFT VINTAGE



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

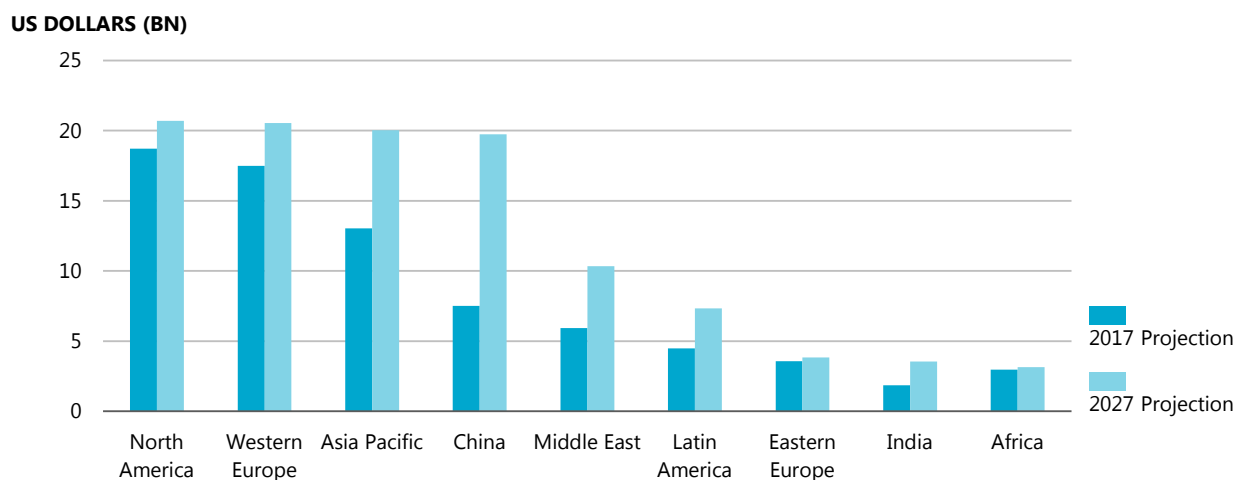
Given the rapid transition to new-generation aircraft over the next decade, it is clear that MRO providers must be prepared for the type of work associated with the newer fleet types or focus their strategy to capture end-of-life markets. From an airframe MRO perspective, providers must be able to handle the new composite and metal matrix materials dominant in the newest-generation aircraft, such as the 787 and A350. The newer technology includes much more sophisticated avionics and systems that are able to interface with health monitoring systems, designed to recognize pending

system or component failures. This new era of “big data” capture and processing will require a clear strategy to take full advantage of its potential.

Challenges extend to component and line maintenance MRO providers as well. Component MROs need the capital to acquire testing equipment and licenses to access OEM manuals and data for these new parts. Line maintenance providers will experience challenges related to training and use of the new aircraft health monitoring systems, fault isolation systems, and software configuration protocols.

Regionally, as fleet growth shifts to Asia and other developing economies, MRO spend will also shift to those regions. By 2027, the combined MRO demand in the Asia Pacific, China, and India will be more than double that in North America.

EXHIBIT 36: TOTAL MRO SPEND BY REGION



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

North America MRO spend is forecast to shrink from \$18.7 billion in 2017 to \$18.0 billion by 2022, then rebound to \$20.7 billion by 2027 – overall, relatively flat growth with 1.0% CAGR. Latin America MRO spend, which currently represents 6% of the total market, is expected to grow 5.1% annually, from \$4.5 billion to \$7.3 billion, and increase market share by 1 point over the period.

Similar to North America, European MRO spend is expected to stagnate. Western Europe MRO, as it grows at 1.6% annually, will lose 4 points of market share and add \$3.1 billion to its current \$17.5 billion MRO demand. Eastern Europe, continuing to suffer from economic sanctions placed on Russia, is forecast to grow 0.7% annually.

Growing at a 5.7% average annual rate, the Middle East is expected to add nearly \$4.4 billion in MRO demand and will constitute 9% of the global MRO market by 2027. Africa, highly subject to terrorism and political unrest, is expected to grow 0.6% per year and will lose 1% market share.

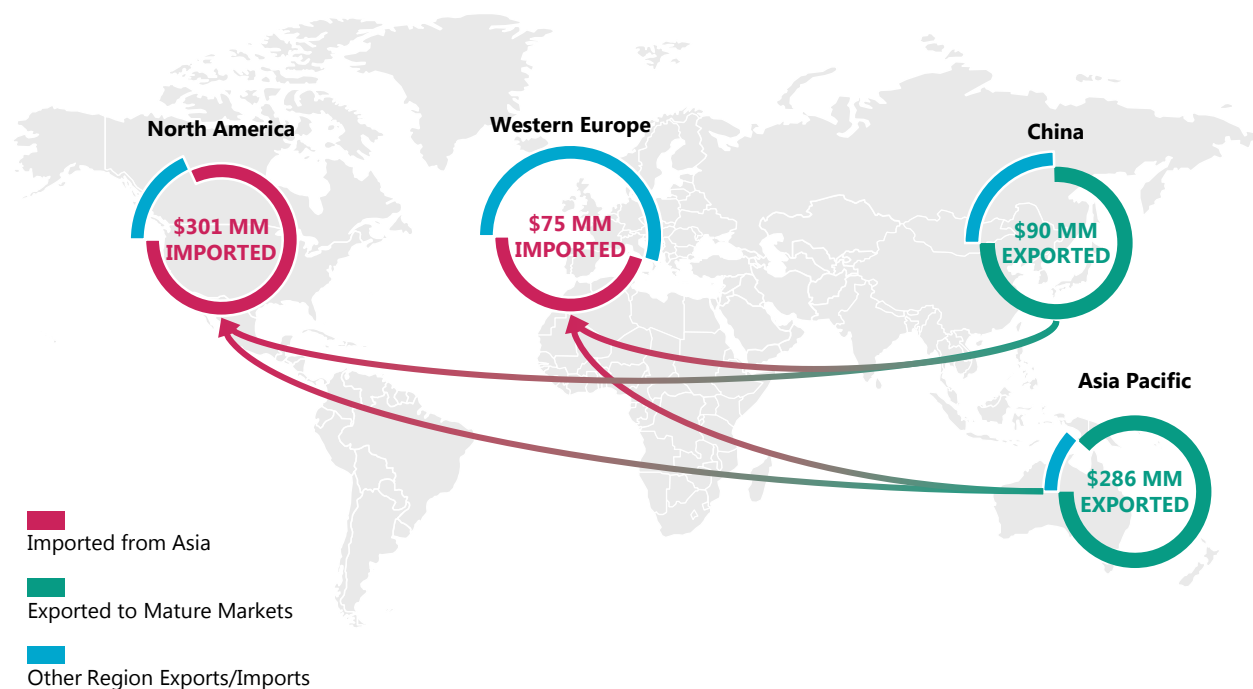
Asia, as has been the case for years, remains the driver of MRO growth. India is forecast to grow 6.7% annually but will represent a small share of the total market (2%-3%). Asia Pacific countries will grow

at a healthy 4.4% annually, with MRO demand levels rising to equal those of Western Europe and North America. China, forecast to grow 10.1% annually, is expected to increase market size by more than 160%, the largest net growth in the world.

While China will be the key driver of MRO spend growth in Asia, rising labor costs, coupled with temporary infrastructure and capacity constraints, are likely to force Chinese operators to look to countries south and east to fulfill maintenance needs.

Complicating the demand in Asia Pacific and China, operators around the world are currently sending nearly 30% of wide-body heavy airframe maintenance needs to the region. There will be an inflection point when capacity growth within Asia cannot keep pace with the MRO demand of its own countries plus that of foreign operators, particularly those in the mature North American and Western European regions. Operators will have to look elsewhere for their MRO needs, presenting opportunities in North America, Western Europe and Latin America.

EXHIBIT 37: NORTH AMERICA AND WESTERN EUROPE WIDE-BODY HEAVY AIRFRAME MAINTENANCE IMPORTED FROM ASIA



Source: Oliver Wyman Global Fleet & MRO Market Forecasts

MROs can target wide-body work currently performed by Asia-based MROs with the introduction of new capacity and the development of the necessary technical skills. As regional labor rates move toward global parity, MROs that invest in new wide-body capabilities and can deliver a high-quality, on-time product will be positioned to capture market share from operators that get squeezed out of the Asia market.

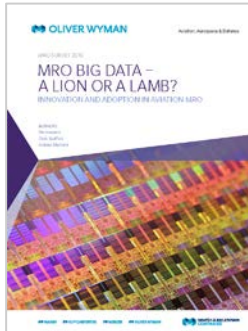
Notwithstanding the potential, capturing market share will not be simple. Even when labor rate parity is reached, Asian MROs have demonstrated the capacity and skills to secure long-term contracts. While MROs in developing regions do have wide-body capability, investment in facilities, equipment, tooling, and training is essential. Paying the cost of capital for expansion will be a necessity to compete.

The repatriating of wide-body heavy maintenance work will create some revenue growth in otherwise stagnant MRO markets in North America and Western Europe; a global focus is needed to meet the growing demand being generated in Asia.

MROs are already expanding facilities to increase capacity and opening operations closer to their Asian customers. Adding and improving facilities is not a silver bullet; better use of process analysis and production methodology to reduce errors, rework, turn times, and to expedite material or repair delivery will increase capacity and competitiveness. Increasing capacity, capability, and efficiency can be combined with partnerships for engineering and workforce development to maximize growth in any market, particularly a better-positioned region.

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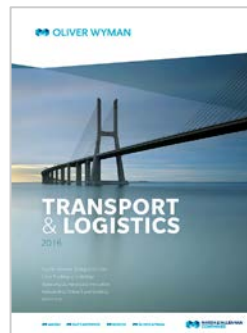
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The practice also includes CAVOK, an aviation services and consulting firm that supports certification, safety, and operational initiatives for clients worldwide. For more information, visit www.cavokgroup.com.

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