

GLOBAL FLEET & MRO MARKET FORECAST COMMENTARY

2019–2029

AUTHORS

Tom Cooper, Vice President
Ian Reagan, Manager
Chad Porter, Technical Specialist
Chris Precourt, Technical Analyst

FOREWORD

Oliver Wyman's *Global Fleet & MRO Market Forecast Commentary 2019–2029* marks our firm's 19th assessment of the 10-year outlook for the commercial airline transport fleet and the associated maintenance, repair, and overhaul (MRO) market. We're proud to say that the annually produced research, along with our *Airline Economic Analysis (AEA)*, has become a staple resource of aviation executives—whether in companies that build aircraft, fly them, or service them, as well as for those with financial interests in the sector through private equity firms and investment banks.

This research focuses on airline fleet growth and related trends affecting aftermarket demand, maintenance costs, technology, and labor supply. The outlook reveals significant changes that are important to understand when making business decisions and developing long-term plans.

As you will see from the report, the next decade holds great opportunities and challenges for the industry as both technological innovation and the move away from traditional energy sources redefine business as usual across industries and the globe. This will be an era of disruptive growth, driving companies to ask tough, fundamental questions about what it will take to stay relevant and expand.

In conjunction with the *Global Fleet & MRO Market Forecast 2019–2029*, we conduct an annual survey on hot topics, critical issues, and new opportunities in MRO. To participate in the 2019 survey, please contact the research team at MROsurvey@oliverwyman.com.

Oliver Wyman's Aviation Competitive & Market Intelligence team, partners, and vice presidents are available to assist with any questions about this forecast, as well as the AEA. We hope you find the data and insights valuable as you refine your business models and develop strategies for moving forward.

Best regards and wishes for a wonderful 2019,

A handwritten signature in black ink that reads "Tom Cooper". The signature is fluid and cursive, with the first name "Tom" and last name "Cooper" clearly legible.

Tom Cooper
Vice President and Study Leader

January 14, 2019

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An aerial night photograph of a city, showing a dense network of streets and buildings illuminated by warm yellow and orange lights. The lights create a complex, web-like pattern across the dark landscape. In the foreground, a large, dark, circular lens or camera element is visible, partially obscuring the view of the city. The lens has a bright orange-red glow at its bottom edge.

1

EXECUTIVE
SUMMARY

EXECUTIVE SUMMARY

The aviation industry and the businesses that support it are experiencing another year of unparalleled growth, thanks to an expansion in the global population able to afford air travel. Rising incomes and consumer spending are pushing passenger travel to record levels and fueling the largest year-over-year increase of the in-service fleet since 2008.

Looking ahead a decade, air travel demand is anticipated to be equally robust, with an additional 200 million people expected to enter the middle class across the planet. Growth in revenue passenger kilometers (RPK) will regularly exceed the annual expansion of gross domestic product (GDP) in most economies—particularly in high-growth areas like China and India. Even amid global trade tensions, the projections for commercial air travel remain optimistic across all regions of the world.

Consequently, the persistent demand is spawning record growth in the global fleet. For the beginning of 2029, our forecast projects a total fleet of 39,175 aircraft, up more than 11,600 from the 2019 total of 27,492. Between 2019 and the beginning of 2024, we anticipate the in-service fleet will grow annually at 3.9 percent—a pace that will slow to 3.3 percent for the next five years.

The order book and the corresponding delivery schedule associated with this expansion are translating into significant business for the world's leading airframe manufacturers, Boeing and Airbus. The bulk of the fleet expansion will be narrowbody jets, such as Boeing's 737 MAX and Airbus' A320neo. By 2029, nearly 13,800 737 MAX and A320neo aircraft will have been delivered, at which time narrowbodies will represent over two-thirds of the entire global fleet.

To satisfy airline needs, Boeing and Airbus plan to ramp up already historically high monthly production. Airbus has publicly committed to producing 63 A320s per month in 2019 and eventually increasing that to 75 per month sometime in the 2020s. Boeing also has announced its intention to boost production of its 737 MAX by nearly 10 percent to 57 per month in 2019 and has said it is studying ways to increase the monthly rate to between 63 and 70 in 2020.

Perhaps not surprisingly, the ramp-up has proved disruptive, particularly to the supply chain of the two original equipment manufacturers (OEMs). Late deliveries of fuselage components and engines have caused OEM production delays and, in turn, late deliveries to airlines. The unfulfilled orders have prompted carriers to defer formal retirements and even pull aircraft out of storage to keep up with the demand for air travel.

RISING COSTS AND EMISSIONS

However, there are complications from delaying the replacement of older aircraft with the new, more fuel-efficient series becoming available. By retaining older aircraft to meet capacity needs, airlines have been unable to reduce jet fuel consumption at an important time. Driven by crude oil production cuts by the Organization of Petroleum Exporting Countries (OPEC) and economic turmoil in Venezuela, jet fuel prices have been climbing since 2016. They hit a three-year high in October 2018 before falling over 25 percent during the fourth quarter. Despite this end-of-year dip, jet fuel prices have begun to make a dent in airline profitability, adding more than \$31 billion in operating costs during the year and shrinking margins by almost a full percentage point.

Decisions to keep older planes in service have also slowed airline efforts to cut greenhouse gas emissions. All airlines with international service started monitoring carbon emissions on January 1, 2019, in compliance with a landmark climate change agreement brokered by the International Civil Aviation Organization that requires reductions in airline emissions beginning in 2021. By 2029, new aircraft are expected to make up 42 percent of the fleet which, on average, will produce between 15 and 20 percent fewer emissions than their predecessors. That said, high travel demand will complicate the ability of the aviation industry to meet emission targets.

Labor costs also have been on the rise as contracts are negotiated in an environment of strong profitability and a tight labor market. Upward pressure on wages is expected to escalate as the gap grows between the number of pilots and trained aviation maintenance technicians available and the number needed. Labor and fuel are the industry's two largest operating expenses, representing almost half of total operating costs.

Boeing projects that the aviation industry will need 635,000 new commercial pilots by 2037 to satisfy growing demand within the sector. Currently, there are roughly 550,000 full-time commercial pilots, but because of the heavy contingent of baby boomers (born between 1946 and 1964) among them, a significant percentage are expected to retire within the next 10 years.

A similar situation affects aviation maintenance technicians (AMTs) who, like pilots, are on average older than workers in other industries, such as technology, retail, and healthcare. The challenge of being a mechanic in today's environment also is more difficult, requiring the ability to service older aircraft built before 2000 as well as newer planes with more sophisticated technology.

Combined, these increased operating expenses are already putting pressure on what has been an unprecedented period of airline profitability. Since 2011, US airline profits have increased with each successive year. That turns out not to be the case in 2018, when cumulative net profits for North American carriers are expected to slip to \$14.7 billion versus the \$18.7 billion earned in 2017—a drop of more than 20 percent.

Additionally, the International Monetary Fund (IMF) indicated in its October 2018 outlook that growth in the largest global economies may have peaked, even as the world GDP growth rate is expected to remain at 3.7 percent for 2019. The agency described the global economy as “fragile,” with increased risk and declining odds for upside surprises. The United States and the European Union will both expand at below three percent this year and at less than two percent in 2020, according to the IMF. China, while still growing at more than six percent, will also see economic growth slow over the next two years.

Weakening Western European economies and the rising prospect of no Brexit deal by the March 29, 2019, deadline may cause problems for the region's aviation industry. While the United Kingdom has pledged to recognize certificates, approvals, and licenses issued by the European Aviation Safety Agency (EASA) for at least two years whether a deal is in place or not, the EU has publicly stated it would not recognize UK certificates, approvals and licenses in the same way. This could cause a substantial disruption in air travel in and out of the UK.

Meanwhile, European airlines are likely to consolidate, with several smaller European carriers going out of business this year and several more teetering. While disruptive, the closures and the consolidation that will inevitably follow should be positive for carriers, as it was for the US industry a decade ago.

MORE CARGO AND MRO

Like passenger air travel, cargo volume also has been growing, driven primarily by the double-digit expansion of e-commerce sales in recent years. Air cargo demand as measured by freight tonne kilometers (FTK) saw an estimated 3.8 percent increase in 2018, while cargo capacity, measured by available freight tonne kilometers, saw an estimated 4.4 percent increase, after a slight contraction in 2017. (FTK measures metric tonnes of cargo per kilometer.)

Yet, for incumbents, there is potential disruption ahead with the entry into the delivery space of e-commerce giant Amazon. The internet retailer is building a \$1.5 billion international air cargo hub in Cincinnati, Ohio. The 1,100-acre complex is anticipated to eventually support a fleet of more than 100 Amazon Air Cargo aircraft; the company has already acquired 40.

Besides air delivery by jets, Amazon is also testing a drone delivery service. Much of the drone testing by Amazon and other tech companies has occurred outside the US because of strict federal and state aviation rules that limit drone use. Google, for instance, recently started a pilot drone delivery service in Finland. Within the decade, we expect to see commercial drone delivery develop, although it may not be initially in the US.

With the expansion of business in the commercial aviation industry, the maintenance, repair, and overhaul (MRO) market that supports it is also expected to grow. Total MRO spend is expected to rise to \$116 billion by 2029, up from \$81.9 billion in 2019. Aside from the growth in the fleet, the increase will be driven by more expensive maintenance visits and technology enhancements.

The annual average growth rate for the MRO market will be 3.5 percent over the decade. More of this growth will take place between 2024 and 2029, when MRO spend will grow \$19 billion versus \$15 billion between 2019 and the start of 2024. The slower initial five years will be driven by the escalating number of newer-generation aircraft that enter the fleet. These aircraft have longer maintenance intervals and replacement thresholds for such things as life-limited parts than older jets.

Growth in aviation will be more concentrated in Asia and the developing world, particularly China and India. By 2035, the Civil Aviation Administration of China projects, the number of airports in the nation will almost double, reflecting this spike in demand and the government's big push to fund the necessary infrastructure. By the end of the decade, China will become the biggest global market for air travel and Asia will be the new center of global aviation activity.

FLEET AND MRO FORECAST SUMMARY

REGION	AFRICA	MIDDLE EAST	ASIA PACIFIC	CHINA	INDIA	LATIN AMERICA	NORTH AMERICA	EASTERN EUROPE	WESTERN EUROPE	WORLD
2019 FLEET										
NARROWBODY	460	564	2,152	2,819	460	1,085	4,208	896	3,294	15,938
WIDEBODY	179	781	1,383	414	67	177	1,277	153	1,057	5,488
REGIONAL JET	159	66	220	143	4	273	1,905	241	466	3,477
TURBOPROP	327	29	655	-	73	236	643	124	502	2,589
TOTAL	1,125	1,440	4,410	3,376	604	1,771	8,033	1,414	5,319	27,492
2029 FLEET										
NARROWBODY	749	906	3,803	6,146	1,177	1,582	5,493	1,169	4,752	25,777
WIDEBODY	340	1,278	1,817	780	149	364	1,694	240	1,383	8,045
REGIONAL JET	73	47	415	261	13	277	1,624	252	365	3,327
TURBOPROP	163	46	594	22	208	164	436	82	311	2,026
TOTAL	1,325	2,277	6,629	7,209	1,547	2,387	9,247	1,743	6,811	39,175
FLEET GROWTH RATES										
2019–2024	1.5%	5.0%	4.9%	9.6%	12.1%	2.7%	1.3%	2.6%	2.7%	3.9%
2024–2029	1.8%	4.4%	3.4%	6.2%	7.7%	3.4%	1.6%	1.7%	2.3%	3.3%
2019–2029	1.6%	4.7%	4.2%	7.9%	9.9%	3.0%	1.4%	2.1%	2.5%	3.6%
2019 MRO (US\$ BILLIONS)										
AIRFRAME	\$0.9	\$1.5	\$3.7	\$2.2	\$0.7	\$1.1	\$5.2	\$1.3	\$4.6	\$21.1
ENGINE	\$0.9	\$5.6	\$7.1	\$2.2	\$0.7	\$1.5	\$7.8	\$1.6	\$6.0	\$33.4
COMPONENT	\$0.4	\$0.9	\$2.2	\$1.3	\$0.3	\$0.8	\$4.1	\$0.7	\$2.9	\$13.8
LINE	\$0.3	\$1.0	\$2.3	\$1.5	\$0.3	\$0.7	\$3.4	\$0.7	\$3.4	\$13.7
TOTAL	\$2.6	\$9.0	\$15.3	\$7.2	\$2.0	\$4.1	\$20.5	\$4.3	\$16.9	\$81.9
2029 MRO (US\$ BILLIONS)										
AIRFRAME	\$0.8	\$2.1	\$4.7	\$4.2	\$0.9	\$1.2	\$5.2	\$1.2	\$4.7	\$25.0
ENGINE	\$1.3	\$8.0	\$8.5	\$7.3	\$1.6	\$2.3	\$10.3	\$2.0	\$8.7	\$50.0
COMPONENT	\$0.7	\$1.5	\$3.6	\$3.6	\$0.9	\$1.2	\$4.7	\$1.1	\$3.7	\$21.0
LINE	\$0.5	\$1.5	\$3.4	\$3.3	\$0.7	\$1.0	\$4.2	\$0.9	\$4.4	\$20.0
TOTAL	\$3.4	\$13.1	\$20.3	\$18.3	\$4.0	\$5.6	\$24.5	\$5.2	\$21.5	\$116.0
MRO GROWTH RATES										
2019–2024	1.4%	3.8%	3.6%	11.0%	6.0%	3.1%	1.1%	2.1%	2.4%	3.4%
2024–2029	4.1%	3.9%	2.1%	8.5%	8.2%	3.3%	2.5%	1.9%	2.5%	3.7%
2019–2029	2.7%	3.9%	2.9%	9.7%	7.1%	3.2%	1.8%	2.0%	2.5%	3.5%



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STATE OF THE
INDUSTRY



STATE OF THE INDUSTRY

Economic performance has been impressive in most regions of the world over the last five years, largely the result of greater consumer buying power, moderate fuel prices, low interest rates, rising equity markets, and industry consolidation. Despite the Brexit vote, North Korean nuclear threats, and the rise of nationalist rhetoric and protectionism, global markets have remained relatively stable.

Over the long term, however, aviation industry growth has been—and will continue to be—driven by the ever-expanding global middle class. According to the International Air Transport Association (IATA), current trends suggest that the number of global airline passengers could double by 2037. In addition to rising standards of living around the globe, air travel is becoming more accessible because of lower transportation costs, additional routes, and globalization.

The burgeoning demand aside, there are some clouds on the horizon. First, there is the recent erratic stock market behavior: In 2018, US equities suffered their worst December since 1931 with the S&P 500 down nine percent and the Dow Jones Industrial Average off 8.7 percent. While there are no signs of a significant downturn, there are indications that the industry may experience a slowdown—particularly in the world's largest economies. It shouldn't come as a surprise, given the duration of the current economic boom, which is slated to reach the 10-year mark in the US in June. We are starting to see the positive trends become less so, with both interest rates and tensions among global trading partners on the rise. There is also intensifying concern over the rate at which climate change is advancing, which may mean increased regulation and forced cutbacks.

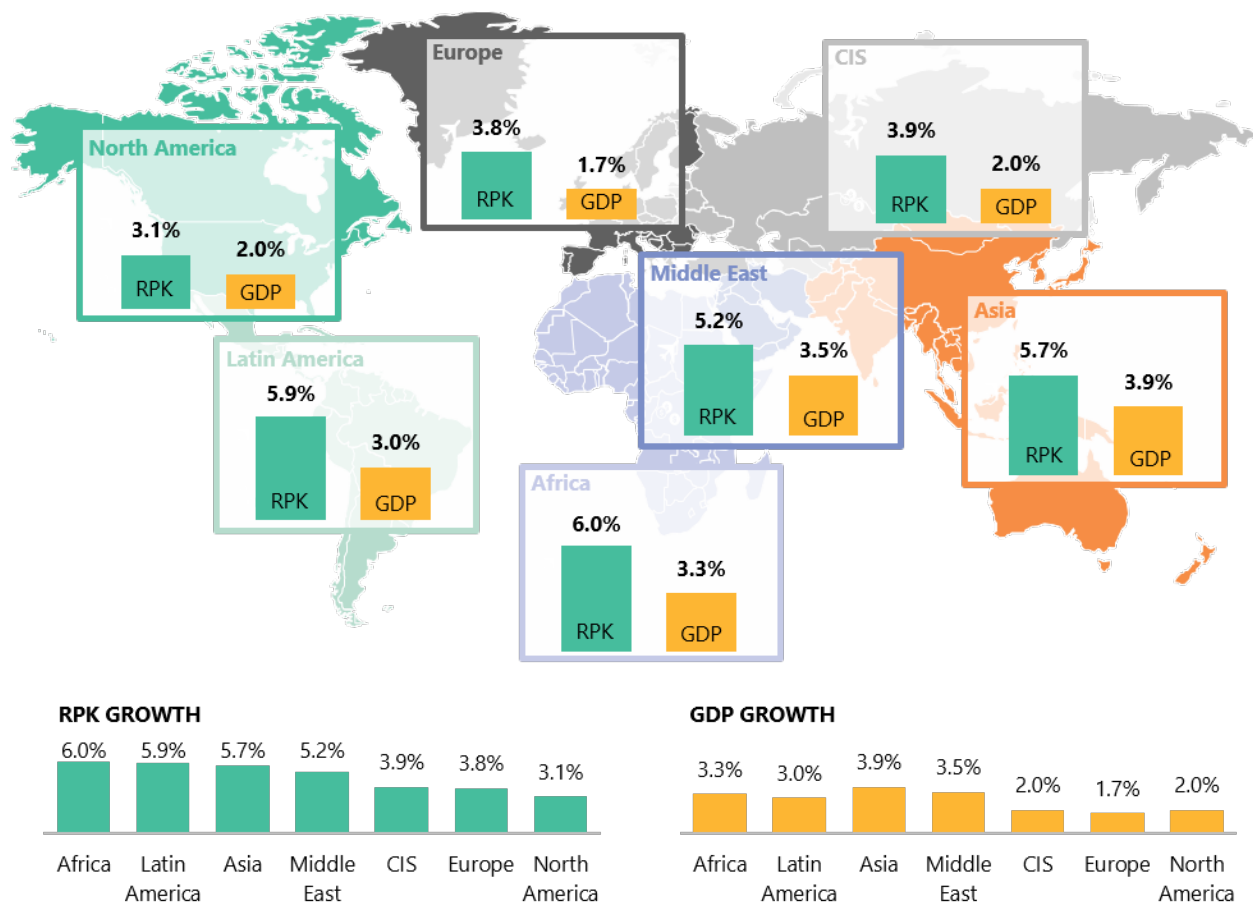
Bottom line? Despite the steady expansion of demand for air travel, the global aviation industry may see fewer profits over the next 10 years as economic growth slows worldwide and operating costs increase.

ECONOMIC DRIVERS

Although demand for air travel has traditionally been closely tied to GDP growth, passenger traffic has, in fact, outpaced it globally for over a decade. IATA has estimated that at the end of 2018, the world will have spent \$854 billion on air transportation, representing one percent of global GDP; that spending pattern should be expected to continue as a burgeoning middle class opts to use its new disposable income on travel.

Aside from improved living standards, factors driving increased demand include deregulation of global travel through open-skies agreements, better service quality, and the expanded number of routes. While the mature regions of North America and Europe have experienced these effects over the last 10 years, the developing regions of Africa, Asia, the Middle East, and Latin America are just beginning to feel their impact. This is where the largest gains will occur over the next decade as the number of people in these regions with money to travel expands.

EXHIBIT 1: 20-YEAR RPK AND GDP ANNUAL GROWTH RATE PROJECTIONS



Note: The 20-year period ends in 2037

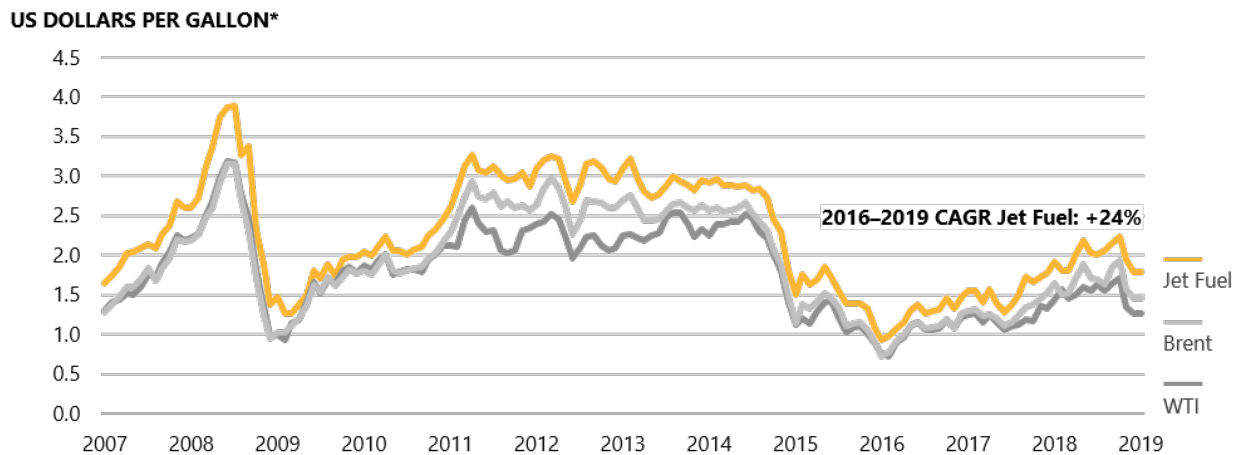
Source: Boeing

FUEL AND LABOR

Representing between 20 and 25 percent of operating expenses, the price of jet fuel has always played a pivotal role in determining the profitability of airlines. This coming decade will be no exception.

Over the past two years, fuel prices have steadily increased from the lows of 2016 until hitting a three-year high in September 2018. Despite hedging by some airlines, the escalating cost began to eat away at airline profitability. In October and November of 2018, the price per gallon dipped 25 percent as supply increased, thanks to US shale production. Yet, even with that big drop, fuel was expected to increase global airline operating costs in 2018 by more than \$30 billion over the previous year.

EXHIBIT 2: SPOT PRICES OF CRUDE OIL AND JET FUEL PER GALLON



*Crude prices are calculated by dividing the price by the number of gallons in a barrel

Note: CAGR stands for compound annual growth rate

Source: US Energy Information Administration

Strong air travel demand and delivery delays of next-generation jets also compelled carriers to defer the retirement of many older, less fuel-efficient aircraft and, in certain cases, to pull aircraft out of storage. That made it harder for carriers to cut fuel consumption to offset the rising price throughout the year.

This constraint is expected to be short-lived as aircraft manufacturers catch up on delivery commitments and accelerate production. Airlines are likely to reduce fuel usage and curb operating expenses by retiring additional older aircraft and replacing them with more fuel-efficient models. Over the next 10 years, newer aircraft with the latest engine technology hold the potential to cut over 40 billion gallons of fuel consumption.

Besides cutting costs and consumption, the newer, more fuel-efficient jets will help limit the amount of carbon dioxide (CO₂) and other greenhouse gas emissions produced by the industry. Over the next decade, these new aircraft could cut more than 400 million cubic tons of CO₂ emissions that would have otherwise been produced from the operation of older jets. The complication for the industry lies in the fact that while new aircraft are more fuel-efficient and environmentally friendlier than older jets, the acceleration in air travel demand means more miles and more emissions. Currently, air transport accounts for two percent of global man-made CO₂ emissions.

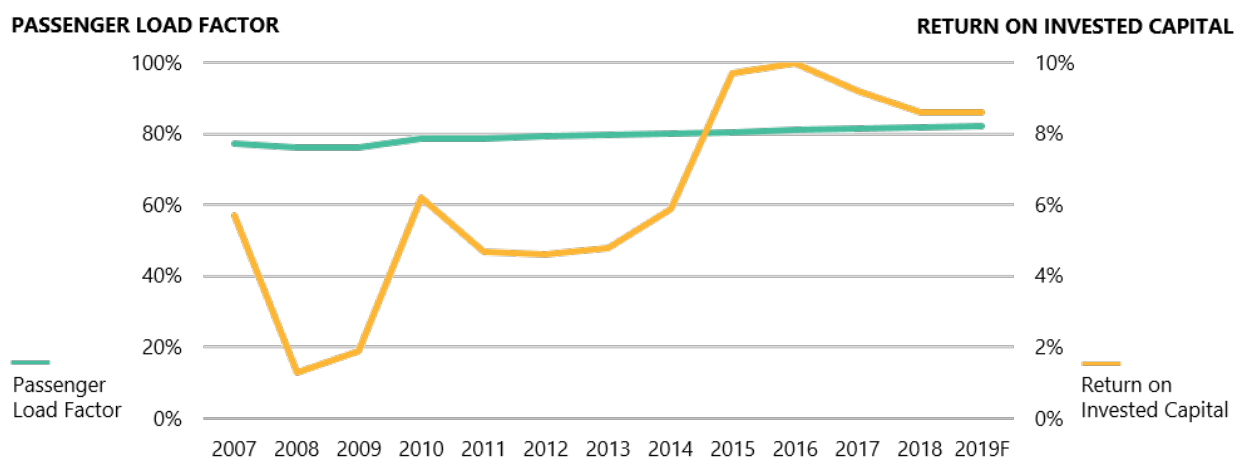
The other critical operating expense for airlines is labor, which, like fuel, makes up about a quarter of their operating costs. Restrained labor and fuel costs have long helped airlines, particularly in the US, report attractive profits. That began to change in 2018.

To accommodate rising demand for air travel, airlines have hired additional employees: In 2018, industry employment grew by 3.1 percent, pushing total airline employment above 2.8 million workers. Although airlines also continued to post improvements in productivity, the recent hiring and labor contracts signed in 2017 increased year-over-year unit labor costs by 2.2 percent in 2018 after many years of stable costs. Moving forward, the projected shortage of certain skilled aviation workers, including pilots and mechanics, could exacerbate this trend.

Carriers that have been marginally profitable may find themselves in negative territory in 2018 and again this year, with some never to return to the black. This scenario began to play out in Europe, where several operators, including Skywork, Cobalt Air, Small Planet Airlines, VLM, and Primera Air, announced they would cease operations.

These new economic pressures are likely to drive additional consolidation among European carriers, which should end up being a positive development for the region's industry. Compared with the strong balance sheets of North American airlines, the European aviation sector has struggled with more fragmentation and less profitability. Industry consolidation should help solve the problems of insufficient scale and poor yields that have plagued some European carriers.

EXHIBIT 3: GLOBAL PASSENGER LOAD FACTOR VERSUS RETURN ON INVESTED CAPITAL



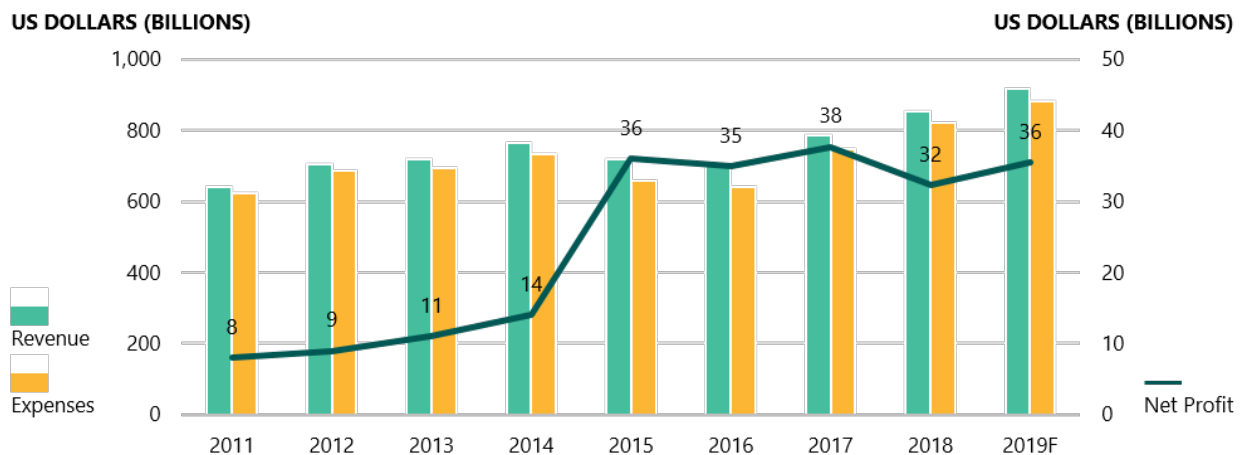
Note: Passenger Load Factor is a measure of capacity utilization that is calculated as the percentage of available seats filled

Source: IATA

DECLINING PROFITABILITY

Given rising costs, the industry's net profits for 2018 are estimated to be \$32.3 billion, down 14.3 percent from the \$37.7 billion reported in 2017. While industry consolidation and strong load factors have helped limit margin degradation, the 5.7 percent net margin in North America in 2018 is nevertheless more than two percentage points below the 7.9 percent achieved in 2017. The region still has the strongest financial performance, but its share of global profits has dropped modestly from 50 percent in 2016 to an estimated 45 percent in 2018.

EXHIBIT 4: GLOBAL AIRLINE INDUSTRY FINANCIAL PERFORMANCE



Note: The net profit totals have been rounded to the nearest whole number

Source: IATA

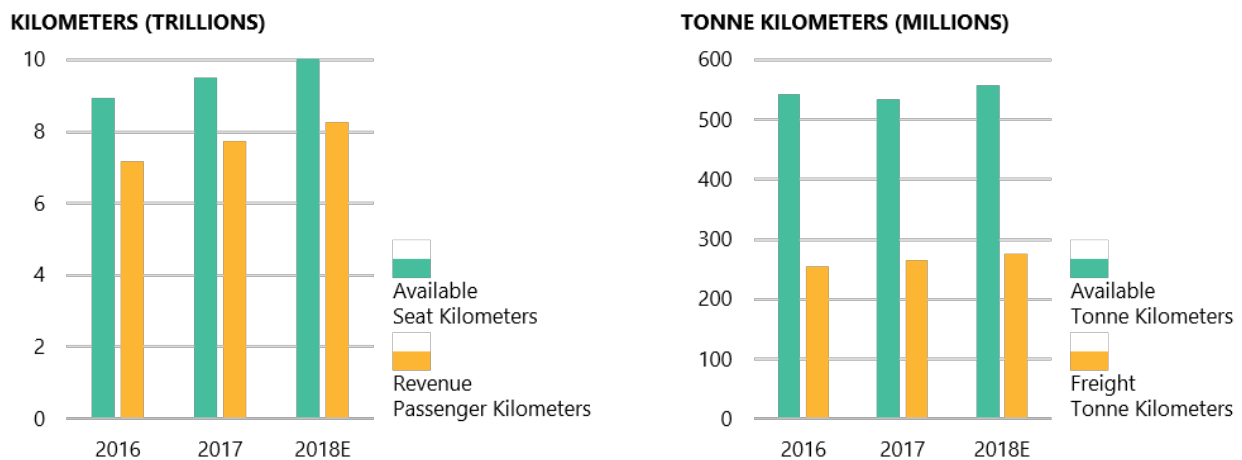
Until 2017, airlines posted strong enough improvements in productivity to maintain flat unit labor costs. In 2018, costs rose an estimated 2.2 percent. Compounding the challenge, airlines are experiencing a shortage of pilots and maintenance technicians. In Asia, where the bulk of the growth in the aircraft fleet is expected to take place, the potential shortfall may begin to affect business sooner.

With large contingents of baby boomers in both job categories, shortages are expected to develop as more and more approach retirement age, which could force wages to rise. In five years, the US demand for mechanics will start outpacing supply—a situation where the jobs will be available, but the people to fill them will not. That gap will persist and widen at least through 2027, when it is expected to reach nine percent. To date, millennials have not shown enough interest in becoming either a pilot or an aviation maintenance technician to offset the anticipated surge in retirements.

TRAFFIC AND INFRASTRUCTURE

In addition to economic growth, other factors have played important roles in the increased demand for air travel throughout the world. Market liberalization, service quality improvements, route additions, increased competition, and lower fares are all factors that have benefited both mature and developing regions across the globe. As government deregulation allowed new players to enter markets, low-cost and ultra-low-cost carrier business models have picked up market share, particularly in emerging markets. Besides suppressing fares, they offer more choices for passengers.

EXHIBIT 5: PASSENGER AND CARGO TRAFFIC, 2016–2018E



Note: 2018 year-end data are estimated

Source: IATA

The last three years have seen strong global expansions in passenger and freight traffic. Compound annual growth for revenue passenger kilometers (RPKs) was 7.3 percent, and compound annual growth for freight tonne kilometers (FTKs) was 4.1 percent. Passenger capacity and traffic have grown in tandem for the past two years. In contrast, freight capacity saw a slight contraction in 2017 before rebounding in 2018.

From a regional standpoint, Asia Pacific has recorded the fastest annual growth in both RPKs and available seat kilometers (ASKs), with 8.5 percent and 7.6 percent respectively in 2018. That's followed by Europe, which grew RPKs at 6.4 percent and ASK at 5.7 percent.

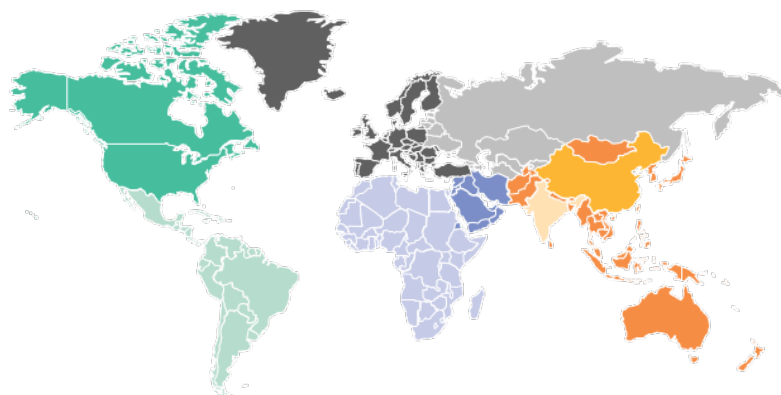
EXHIBIT 6: THE 10 FASTEST-GROWING AIRPORTS IN 2017

PASSENGERS HANDLED

Rank	Name	Region	Growth
1	Antalya, TR (AYT)	Western Europe	38.2%
2	Lisbon, PT (LIS)	Western Europe	18.8%
3	Moscow, RU (SVO)	Eastern Europe	17.8%
4	Nanjing, CN (NKG)	China	15.5%
5	Milan, IT (MXP)	Western Europe	14.2%
6	New Delhi, IN (DEL)	India	14.1%
7	Brussels, BE (BRU)	Western Europe	13.6%
8	Xi'an, CN (XIY)	China	13.2%
9	Bangalore, IN (BLR)	India	12.9%
10	Hangzhou, CN (HGH)	China	12.6%

CARGO HANDLED

Rank	Name	Region	Growth
1	Johannesburg, ZA (JNB)	Africa	39.3%
2	Cincinnati OH, US (CVG)	North America	27.3%
3	Moscow, RU (SVO)	Eastern Europe	25.8%
4	Muscat, OM (MCT)	Middle East	23.8%
5	Kuwait, KW (KWI)	Middle East	23.3%
6	Hangzhou, CN (HGH)	China	20.8%
7	Campinas, BR (VCP)	Latin America	20.7%
8	Mumbai, IN (BOM)	India	18.1%
9	Nairobi, KE (NBO)	Africa	18.0%
10	Madras, IN (MAA)	India	17.2%

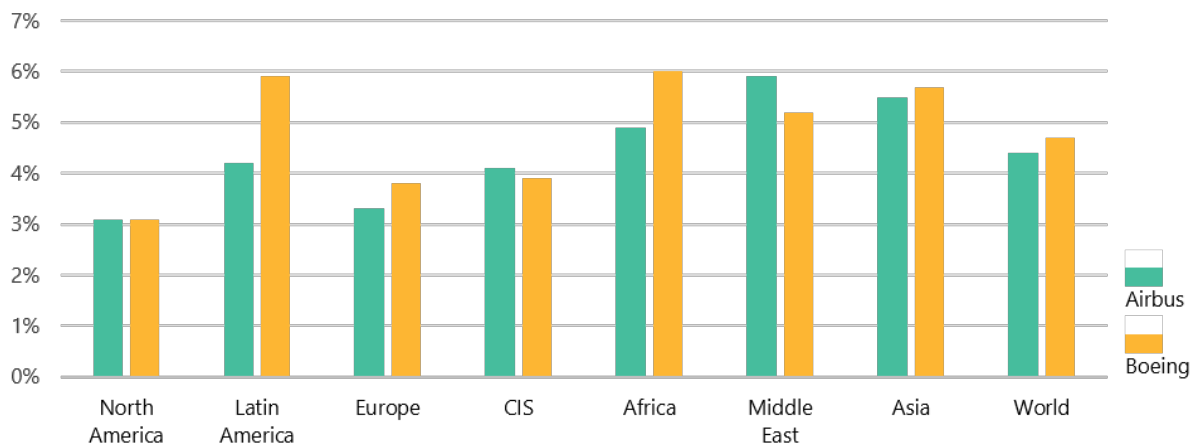


Source: IATA

Both Airbus and Boeing predict nearly five percent average annual expansion in RPK globally over the next 20 years. The Middle East and Asia are expected to lead this trend. In fact, Asia is already home to 13 of the 30 busiest passenger airports and is expected to claim more spots on that list. Meanwhile, China's growth will mean it replaces the US as the largest domestic travel market in the world by 2022.

EXHIBIT 7: AIRBUS AND BOEING 20-YEAR PASSENGER TRAFFIC GROWTH FORECAST

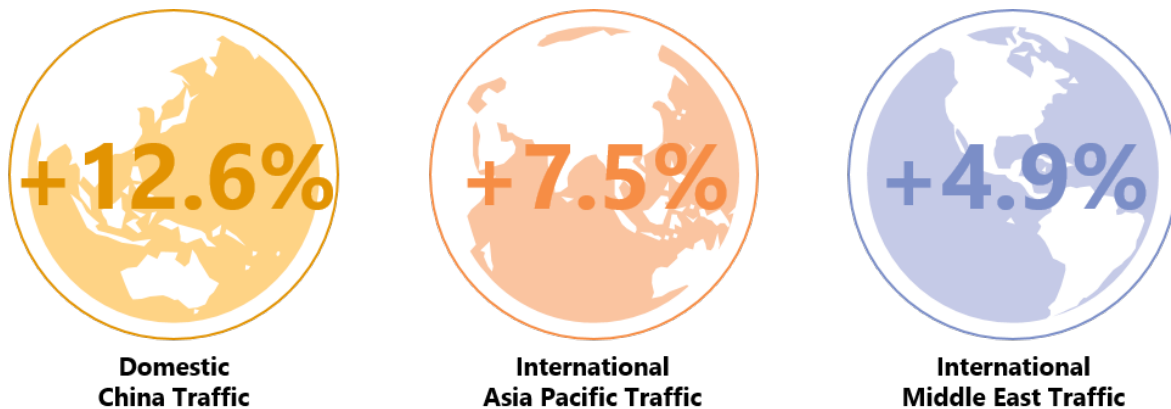
GROWTH RATE



Note: The 20-year period ends in 2037

Source: Airbus, Boeing

EXHIBIT 8: 2018 PASSENGER TRAFFIC GROWTH IN DEVELOPING ECONOMIES*



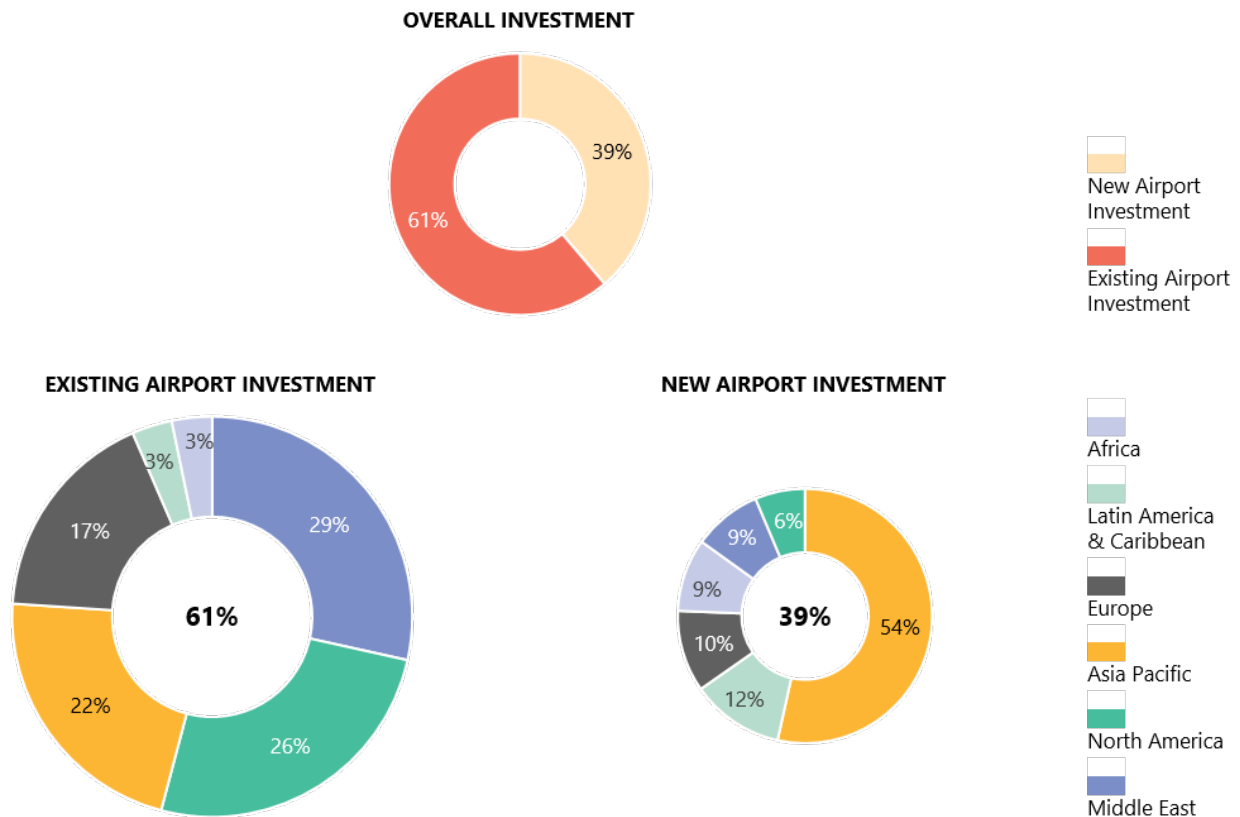
Note: 2018 year-end data are estimated

Source: IATA

Continued infrastructure investments will be required in Asia to accommodate anticipated growth. Many hubs are already operating beyond capacity, which has resulted in a high volume of delays over the past several years. Most major airports in the region are planning to build or are already adding runways and passenger terminals. The Civil Aviation Administration of China released a report at the end of December that estimated China would have 450 airports by 2035, nearly twice what it has now. In fact, Asia will account for almost 35 percent of planned airport investment scheduled to take place primarily over the next decade, according to Business Monitor International, with a large chunk going into greenfield airports.

Despite the investment planned in Asia, the spend will not be evenly distributed across countries. For instance, despite growing demand, India is far behind in infrastructure investment, yet is expected to spend less than one-fifth of what China has planned. As demand in the region continues to accelerate, it will be important to have the proper infrastructure to accommodate these passengers.

EXHIBIT 9: PLANNED AIRPORT INVESTMENT FOR EXISTING AIRPORTS VERSUS NEW AIRPORTS



Source: Business Monitor International

An aerial, high-angle photograph of a large fleet of Boeing 737 aircraft lined up on a runway. The planes are arranged in a long, straight line, receding into the distance. The perspective is from directly above, looking down the length of the runway. The aircraft are white with blue and red accents. The runway is a light gray color with yellow markings. The sky is clear and blue.

3

FLEET
FORECAST

IN-SERVICE FLEET FORECAST

The active global commercial fleet stood at 27,492 aircraft as of August 1, 2018. Driven by high demand for air travel, the fleet will grow 3.6 percent annually on average over the next 10 years, supporting RPK growth of nearly 4.7 percent over the same period. During the first five years of the decade, the compound annual growth rate (CAGR) for the fleet is expected to be 3.9 percent. As the rate of deliveries stabilizes, the fleet CAGR will slow to 3.3 percent over the second five years.

EXHIBIT 10: 2019–2029 GLOBAL FLEET CHARACTERISTICS

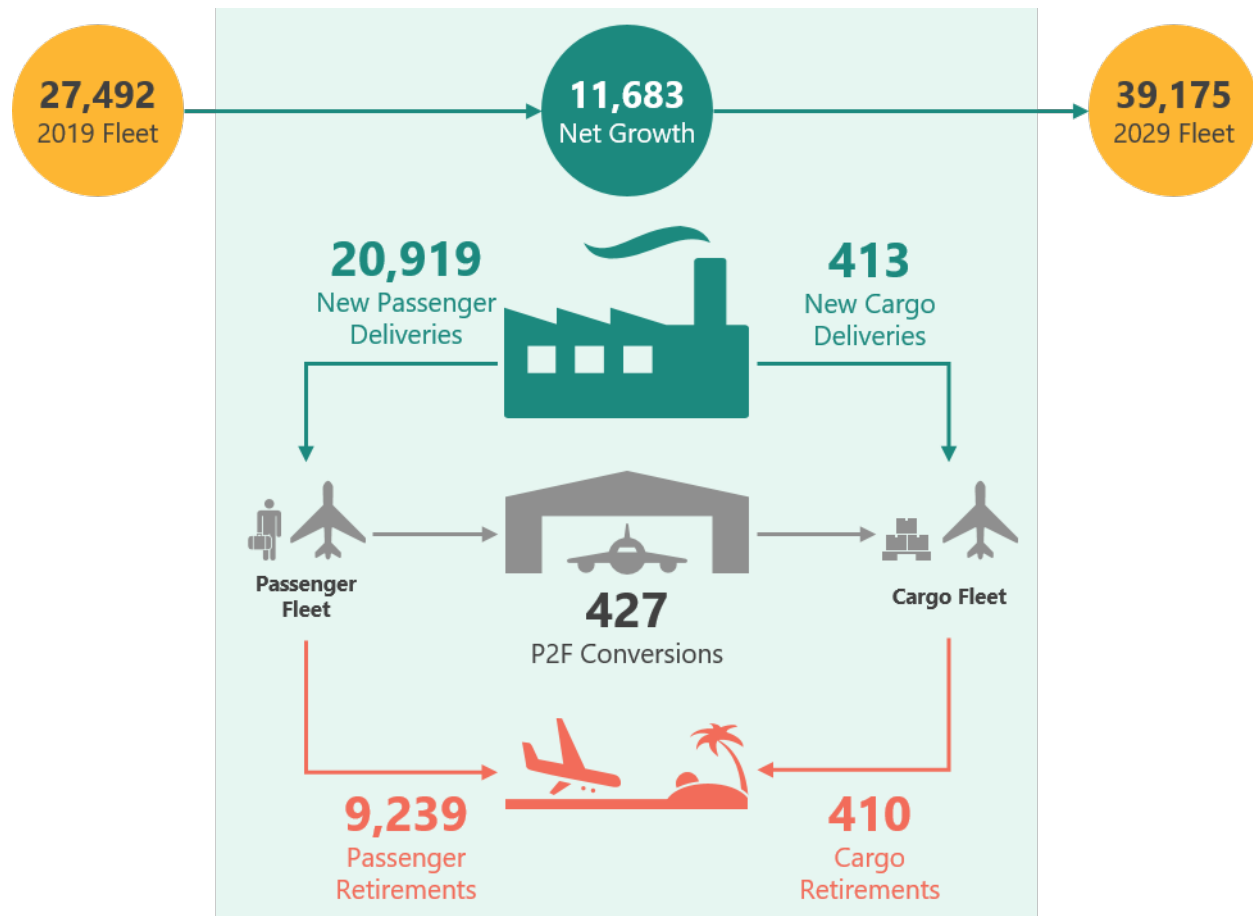
	2019	2024	2029
FLEET SIZE	27,492	33,295	39,175
5-YEAR CAGR	N/A	3.9%	3.3%
AVERAGE AGE	11.3	10.9	10.7

Note: CAGR stands for compound annual growth rate

Source: Oliver Wyman

As new deliveries replace older aircraft, the average age of the fleet will drop five percent from 11.3 years old today to 10.7 in 2029. In total, the reduction in age trims 22,000 total years of service from what the global fleet would have otherwise accumulated by 2029. That amounts to more than \$3.3 billion of spending on MRO. Of the more than 21,000 aircraft deliveries anticipated in the decade, 45 percent will replace in-service aircraft; the rest represent additions to the fleet. The result is a more efficient fleet that is larger in average seating capacity and has lower maintenance costs, particularly over the short to medium hauls.

EXHIBIT 11: GLOBAL AIRCRAFT DEMAND, 2019–2029



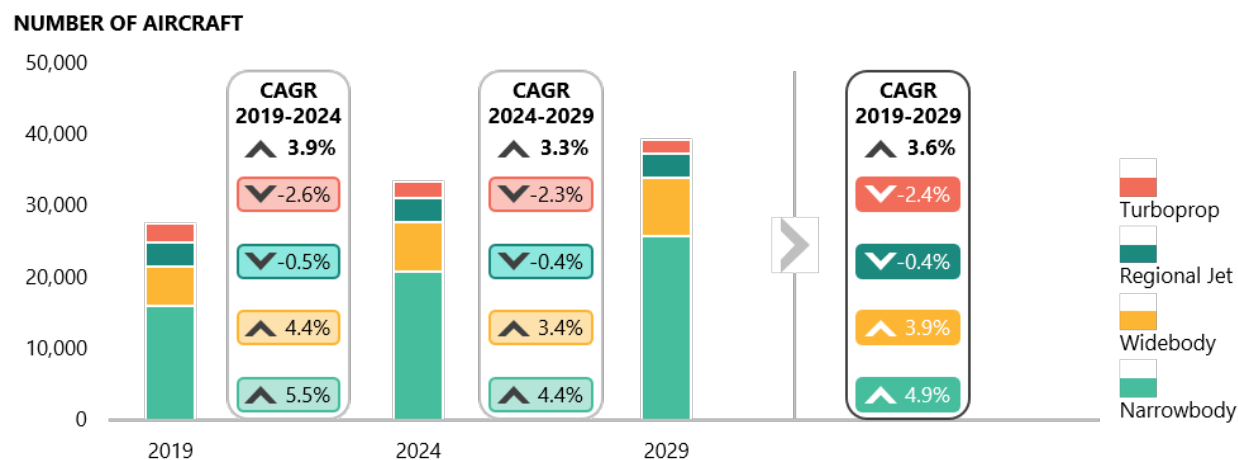
Source: Oliver Wyman

The passenger fleet is projected to grow by nearly 11,300 aircraft by 2029, while the cargo fleet is forecast to grow by 430. Most of these additional cargo aircraft will be passenger-to-freighter (P2F) conversions.

IN-SERVICE FLEET FORECAST BY AIRCRAFT CLASS

Overall fleet growth is not spread evenly among aircraft classes. Narrowbody aircraft have been enjoying the greatest gains in recent years, a trend expected to continue as performance improvements and greater operational and revenue flexibility drive capacity increases at the expense of regional jets and turboprops.

EXHIBIT 12: GLOBAL FLEET FORECAST BY AIRCRAFT CLASS, 2019–2029



Source: Oliver Wyman

Growing at an average annual rate of 4.9 percent, the number of narrowbody aircraft in the fleet will top 25,700 by 2029, up from around 15,900 at the beginning of 2019. Widebody aircraft are the second-fastest growing class, with a projected 3.9 percent average annual growth rate. Their representation will increase to around 8,000 by 2029, up from 5,500 in 2019. By contrast, the numbers of regional jets and turboprops are forecast to decrease over the next decade, falling annually on average 0.4 percent and 2.4 percent, respectively. The two classes will have a combined total of 5,353 aircraft by 2029 versus 6,066 in 2019.

NARROWBODIES

The share of narrowbodies will increase from 58 percent to 66 percent by 2029. Most are new additions to the fleet or are replacing regional jets and turboprops as a more economically attractive alternative. Narrowbodies fit the business model of most low-cost carriers because of their extended ranges, fuel efficiency, and higher maximum takeoff weight. For instance, the newest high-quality narrowbodies will include 180-minute extended operations approval, permitting trans-Atlantic routes. Narrowbodies accommodate these benefits while still using standard-size gates at airports.

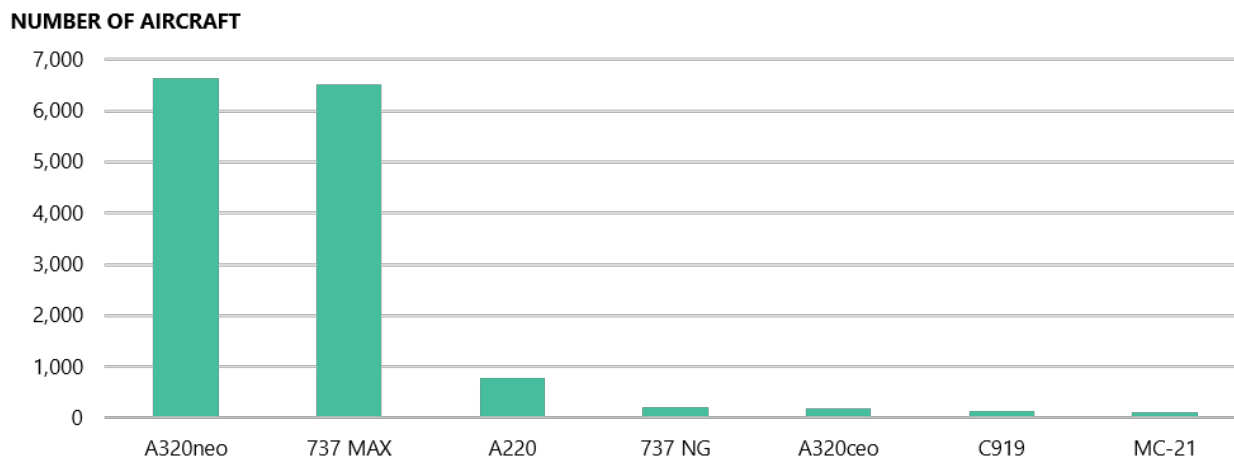
EXHIBIT 13: NARROWBODY FLEET, 2019–2029

	2019	2024	2029
FLEET SIZE	15,938	20,816	25,777
5-YEAR CAGR	N/A	5.5%	4.4%
MARKET SHARE	58%	63%	66%
AVERAGE AGE	10.5	10.2	10.2

Source: Oliver Wyman

After Airbus’ acquisition of the C Series program (renamed the A220) from Bombardier, competition in the narrowbody space beyond Airbus and Boeing is effectively non-existent. Together, Airbus and Boeing are forecast to represent 98 percent of all narrowbody deliveries through 2028. After production delays in the summer of 2018, Boeing and Airbus appear to be back on track with their manufacturing schedules for the 737 MAX and A320neo. Both manufacturers expect to increase output in 2019.

EXHIBIT 14: NARROWBODY DELIVERIES BY AIRCRAFT PLATFORM, 2019–2028



Source: Oliver Wyman

EXHIBIT 15: NARROWBODY AIRCRAFT SIZE CATEGORIES

	SMALL	INTERMEDIATE	LARGE
SEAT COUNT	< 140	140–190	> 190
AIRCRAFT TYPE VARIANT	737-700 A319 A220 SERIES	737-7 MAX, 737-800, 737-8 MAX, 737-900 A319neo, A320, A320neo Irkut MC-21 COMAC C919	737-9 MAX, 737-10 MAX, 737 MAX 200 A321, A321neo

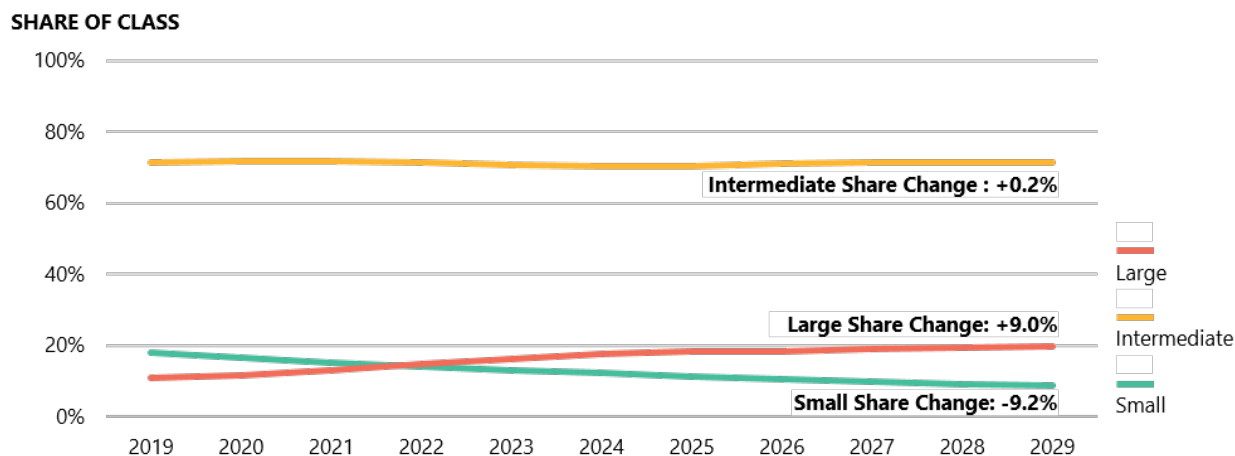
Source: Oliver Wyman

Small narrowbodies with a seat count below 140 currently make up 18 percent of the narrowbody fleet and will account for just nine percent of the class by 2029. Because of strong operator preference for larger narrowbody aircraft and their improved operating efficiency, intermediate narrowbody aircraft with 140 to 190 seats, such as the 737-8 MAX and A320neo, are expected to represent 71 percent of the narrowbody fleet by 2029. Narrowbodies with over 190 seats are forecast to grow in share, with projections that they will reach 20 percent by the end of the decade.

This preference toward larger narrowbody aircraft bolsters the argument that a middle-of-the-market aircraft will be successful moving forward. This aircraft would need the potential to carry more than 230 passengers while having intercontinental range—a spiritual successor to the range and capacity that the 757 filled in the previous generation of aircraft. That is not a consensus,

however. Airbus believes its A321neoLR has the range and capacity to fill this segment. Boeing has contended that several thousand aircraft in this capacity range would find demand while still maintaining narrowbody economics. A firm decision from Boeing on the launch of a new aircraft will likely come in the near future.

EXHIBIT 16: PASSENGER NARROWBODY FLEET COMPOSITION BY CATEGORY, 2019–2029



Source: Oliver Wyman

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 A320neos as they aggressively change out aging fleets.

WIDEBODIES

The global widebody fleet is forecast to grow from 5,488 aircraft to 8,045 by 2029. Market share for the class is expected to remain about 20 percent over the forecast period, with a 3.9 percent CAGR. The average age of the widebody fleet is expected to remain at about 11 years over the forecast period.

EXHIBIT 17: WIDEBODY FLEET, 2019–2029

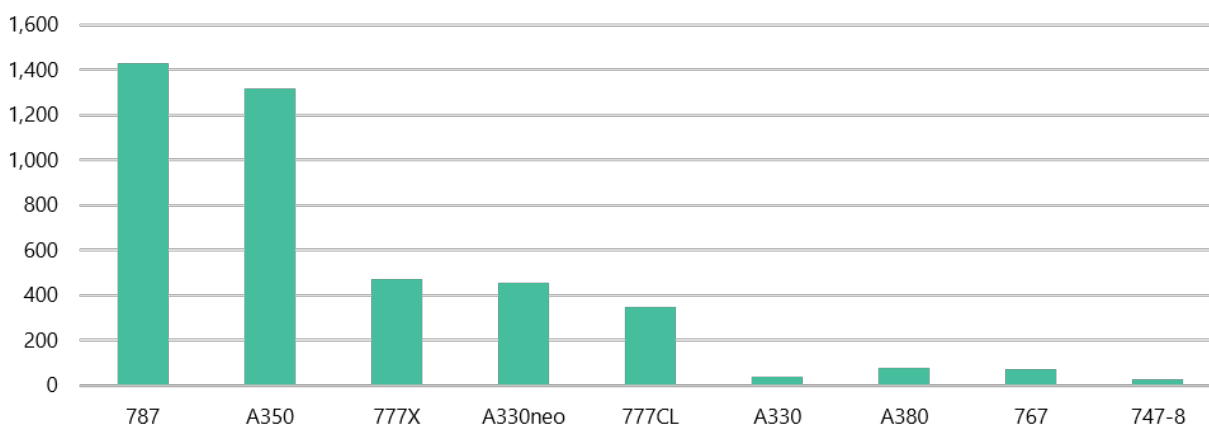
	2019	2024	2029
FLEET SIZE	5,488	6,811	8,045
5-YEAR CAGR	N/A	4.4%	3.4%
MARKET SHARE	20%	20%	21%
AVERAGE AGE	11.0	10.8	11.0

Source: Oliver Wyman

Boeing’s 787 series and Airbus’ A350 are clear favorites of airlines in the widebody class and will dominate deliveries over the forecast period. The 787 series alone will comprise about a quarter of the widebody fleet by 2029. That represents a change from the current widebody breakdown in which Airbus’ A330/A340 family and the Boeing 777 series each make up 26 percent of the fleet. The changeover, among other things, will create a significantly more fuel-efficient, high-tech fleet. Even though Airbus is introducing the A330neo widebody with a lower sticker price, improvements in operational costs and efficiencies offered by the 787, A350 and 777X are expected to ultimately outweigh the A330neo’s acquisition cost. Order books already indicate that preference. There is speculation within the market that Airbus may produce a freighter version of the A330neo.

EXHIBIT 18: WIDEBODY DELIVERIES BY AIRCRAFT PLATFORM, 2019–2028

NUMBER OF AIRCRAFT



Source: Oliver Wyman

Over the forecast period, the aircraft platforms most quickly retiring will be the 767, 777-200, and A330/A340, along with most of the remaining 747-400s. The 767 will account for the majority of all widebody freighter conversions.

EXHIBIT 19: WIDEBODY AIRCRAFT SIZE CATEGORIES

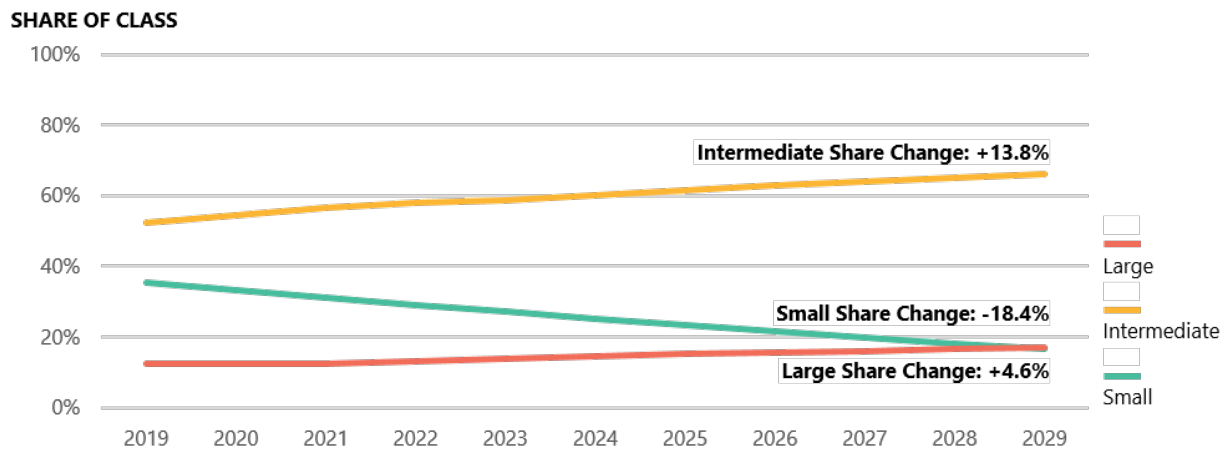
	SMALL	INTERMEDIATE	LARGE
SEAT COUNT	<275	275–350	>350
AIRCRAFT TYPE VARIANT	787-8 A330-200, A330-800neo A350-800	777 787-9, 787-10 A330-300, A330-900neo A350-900	747 777X, 777-300ER A350-1000 A380

Source: Oliver Wyman

The widebody fleet is experiencing a similar phenomenon to the upsizing trend in the narrowbody fleet previously discussed. Operators are expected to move quickly toward intermediate widebodies and away from the smaller variants. The market share of these small widebodies will shrink considerably as new-generation narrowbodies with increased range can cover most of the routes that these smaller widebodies traditionally fly.

Currently comprising 53 percent of the widebody fleet, intermediate twin-aisle aircraft are forecast to boost their share to 66 percent by 2029. This additional share is taken almost entirely from small widebodies, which are expected to drop to 17 percent from the current 35 percent of the widebody fleet. The share of large widebodies will increase marginally from 12 percent to 17 percent by 2029.

EXHIBIT 20: PASSENGER WIDEBODY FLEET COMPOSITION BY CATEGORY, 2019–2029



Source: Oliver Wyman

REGIONAL JETS

Regional jets will play a less important role in the future fleet, despite the fact that multiple new platforms will enter service over the next several years. In North America, where over half of all regional jets are domiciled, the role these aircraft will play hinges on whether large network carriers and their pilot unions can agree on loosening weight and seat count restrictions on regional carriers.

EXHIBIT 21: REGIONAL JET FLEET, 2019–2029

	2019	2024	2029
FLEET SIZE	3,477	3,393	3,327
5-YEAR CAGR	N/A	-0.5%	-0.4%
MARKET SHARE	13%	10%	8%
AVERAGE AGE	11.2	11.7	10.9

Source: Oliver Wyman

The regional jet fleet is forecast to decrease by 150 aircraft over the next 10 years, an average annual decline of 0.4 percent. Overall market share of the class is expected to fall from 13 percent to eight percent.

EXHIBIT 22: REGIONAL JET FLEET CATEGORIES

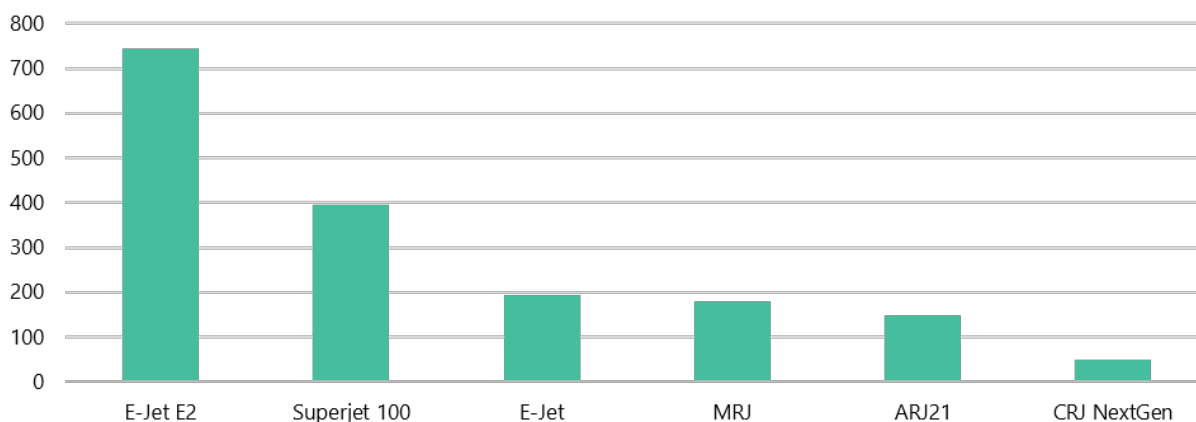
	MEETS SCOPE	EXCEEDS SCOPE	REGULATORY LIMITS
SEAT COUNT	<100 AND	>100 OR	N/A
MTOW LIMIT	<86,000 LB	>86,000 LB	
AIRCRAFT TYPE VARIANT	CRJ ERJ E-JET	E-JET E2 MRJ	SUPERJET 100 ARJ

Source: Oliver Wyman

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 provide greater flexibility with their increased range. In fact, global regional jet competition could narrow to a one-platform race, with the Bombardier CRJ order book falling dramatically and the Mitsubishi MRJ struggling to get certified. The Chinese-made ARJ21 has entered service but is unlikely to draw orders from outside China because of stricter certification requirements in other regions of the world. The aircraft also hasn't shown signs of ramping up production rates to an export-size level. The Superjet 100 could become more than a niche player after building a customer base in Western Europe and Latin America and raising production capabilities to around 30 aircraft per year.

EXHIBIT 23: REGIONAL JET DELIVERIES BY AIRCRAFT PLATFORM, 2019–2028

NUMBER OF AIRCRAFT



Source: Oliver Wyman

Many of the smaller regional jets are expected to be removed from the fleet over the next decade. CRJ retirements will accelerate quickly during the first half of the forecast period, representing nearly 40 percent of all regional jet removals for the entire forecast period. There will be very few Embraer ERJ left in the fleet by 2029, as there will be no new deliveries and many of the current aircraft will be retired over the 10 years.

The end of CRJ manufacturing and the potential for Bombardier to divest the program altogether (as the company did with the Q400) could have significant aftermarket support implications if Bombardier retreats from the commercial market entirely.

TURBOPROPS

Turboprop aircraft are no longer expected to have much of a presence in the global fleet. The class is forecast to decline 2.4 percent annually over the next 10 years. That leaves the fleet size at just over 2,000 jets, or about five percent, of the global fleet by 2029, serving special purpose and highly specialized routes.

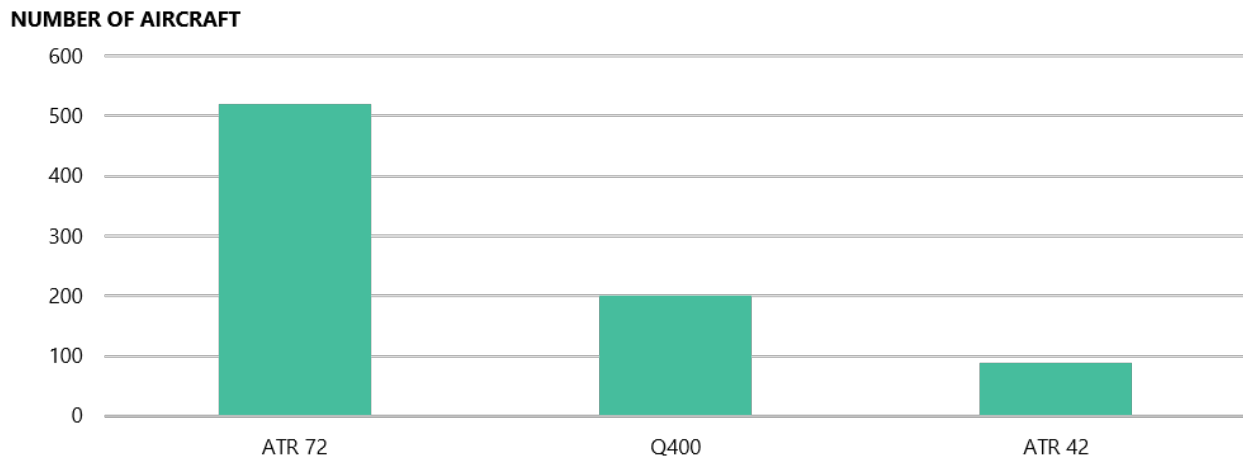
EXHIBIT 24: TURBOPROP FLEET, 2019–2029

	2019	2024	2029
FLEET SIZE	2,589	2,275	2,026
5-YEAR CAGR	N/A	-2.6%	-2.3%
MARKET SHARE	9%	7%	5%
AVERAGE AGE	16.6	16.2	15.2

Source: Oliver Wyman

Many of the older-generation turboprops, such as Saab 340s and Fokker 50/70s, will disappear from the global fleet over the forecast period. The Q400 program, largely uncompetitive in recent years because of higher operating costs, was sold in late 2018 by Bombardier to Canadian airframe manufacturer Viking Air. As the one remaining relevant player, the ATR fleet will make up most deliveries and is projected to grow at an average annual rate of 2.8 percent over the next 10 years.

EXHIBIT 25: TURBOPROP DELIVERIES BY AIRCRAFT PLATFORM, 2019–2028

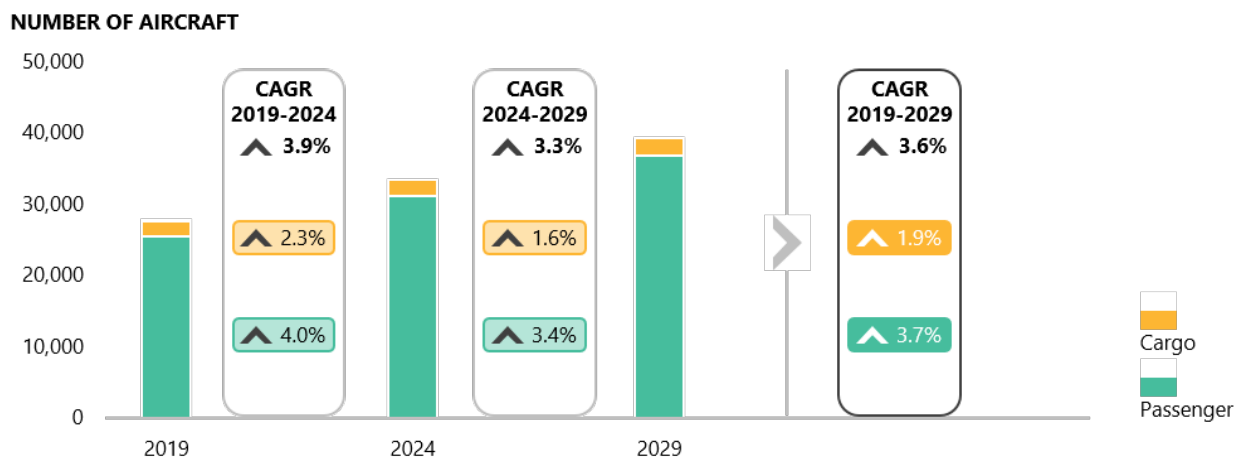


Source: Oliver Wyman

IN-SERVICE FLEET FORECAST BY AIRCRAFT USAGE

The global cargo fleet, currently about seven percent of the global fleet, is expected to grow at a modest rate of 1.9 percent over the next decade, reaching over 2,400 aircraft by 2029. The passenger fleet is forecast to grow at a healthier 3.7 percent annually, increasing its share to 94 percent of the global fleet.

EXHIBIT 26: GLOBAL FLEET FORECAST BY AIRCRAFT USAGE, 2019–2029



Source: Oliver Wyman

Through 2024, the cargo fleet will grow 2.3 percent, reflecting deliveries of 767 aircraft on order from FedEx. However, the growth is expected to slow to just 1.6 percent annually between 2024 and 2029. One challenge facing cargo operators is the continued increase of cargo space in the undercarriage of new-generation passenger aircraft. Over the last five years, freight carried in passenger aircraft has increased 24 percent. Trucking growth is also a strong competitor in domestic markets.

EXHIBIT 27: GLOBAL FLEET AVERAGE AGE BY AIRCRAFT USAGE, 2019–2029

	2019	2024	2029
PASSENGER	10.4	9.9	9.8
CARGO	22.2	23.3	24.2
OVERALL	11.3	10.9	10.7

Source: Oliver Wyman

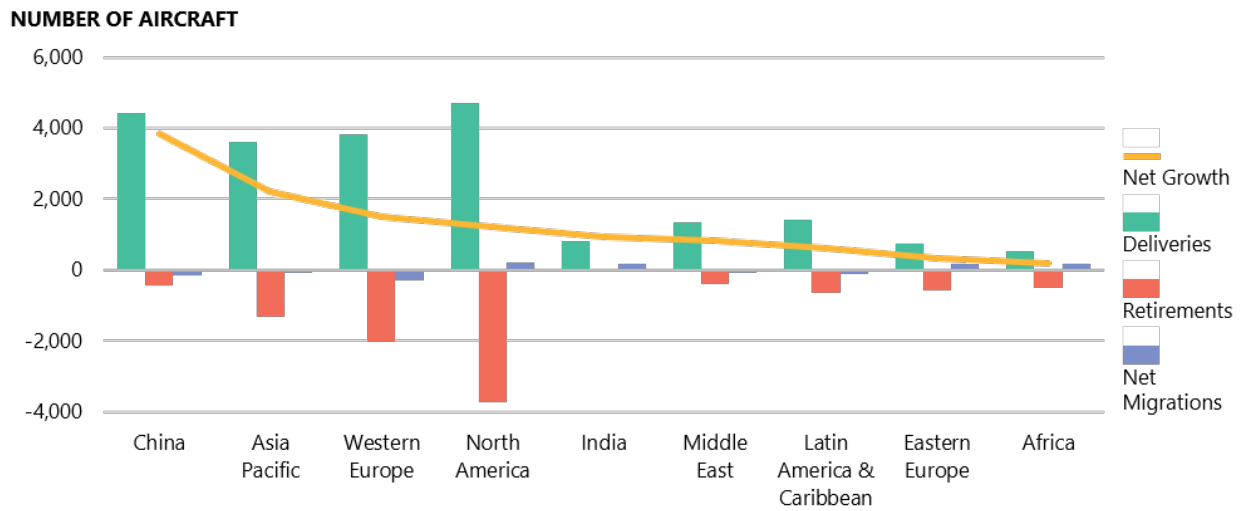
The average age of passenger aircraft is forecast to decrease slightly from 10.4 years to 9.8 over the next 10 years, as thousands of newly delivered aircraft hit the market and older aircraft are removed from the fleet. However, the average age of cargo aircraft is forecast to increase from 22.2 years to 24.2 by 2029. Cargo aircraft are remaining in service longer than ever, driven by the success of passenger-to-freight conversions that keep older passenger aircraft flying.

REGIONAL IN-SERVICE FLEET CHARACTERISTICS

No doubt, China is one of the principal growth engines behind the rising size of the fleet. Between 2019 and 2029, China is forecast to receive 3,981 more deliveries than retirements, an increase in fleet size of 114 percent. Asia Pacific is expected to see a 50 percent net increase in aircraft over the same decade. While North America will accept the most aircraft deliveries in absolute terms over the next 10 years, the region's fleet will grow only 15 percent, as most deliveries will replace jets being retired.

India will accept the third fewest deliveries of the major world regions, yet its national fleet will soar in size by 156 percent between 2019 and 2029. All the new jets will be additions to its current numbers because almost no aircraft will be retired. By 2029, the Asia Pacific fleet, including China and India, will account for nearly 40 percent of the global fleet.

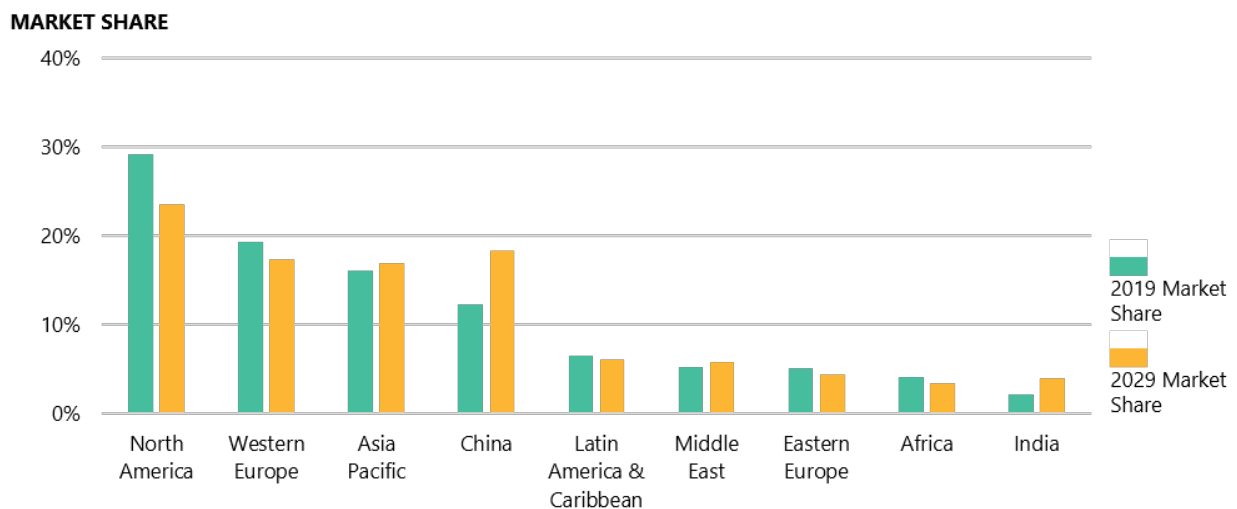
EXHIBIT 28: FLEET GROWTH BY REGION, 2019–2029



Source: Oliver Wyman

The delivery and retirement patterns will result in a change in overall global distribution of aircraft that favors Asia. China will increase fleet share by more than six percent by 2029, which reflects the nation’s efforts to satisfy the desires of its burgeoning middle class to travel. Asia’s gain will result in a decline in share primarily in North America and Western Europe.

EXHIBIT 29: FLEET SHARE CHANGE BY REGION, 2019–2029



Source: Oliver Wyman

EXHIBIT 30: THE FLEET'S AVERAGE ANNUAL GROWTH RATES BY REGION, 2019–2029

	2019–2024	2024–2029	2019–2029
AFRICA	1.5%	1.8%	1.6%
ASIA PACIFIC	4.9%	3.4%	4.2%
CHINA	9.6%	6.2%	7.9%
EASTERN EUROPE	2.6%	1.7%	2.1%
INDIA	12.1%	7.7%	9.9%
LATIN AMERICA	2.7%	3.4%	3.0%
MIDDLE EAST	5.0%	4.4%	4.7%
NORTH AMERICA	1.3%	1.6%	1.4%
WESTERN EUROPE	2.7%	2.3%	2.5%

Source: Oliver Wyman

The mature regions of North America and Western Europe are forecast to experience relatively modest growth over the next 10 years, growing at just 1.4 and 2.5 percent annually. Asia represents the highest levels of growth, with the regions of China, India, the Middle East and Asia Pacific growing at annual rates of 7.9 percent, 9.9 percent, 4.7 percent, and 4.2 percent over the next 10 years. After a short-term rebound in fleet size, Eastern Europe is forecast to return to lower growth levels of just over two percent per year, while Africa is expected to continue to struggle to modernize and grow the infrastructure needed to increase the regional fleet.

EXHIBIT 31: AVERAGE AGE OF FLEET BY REGION, 2019–2029

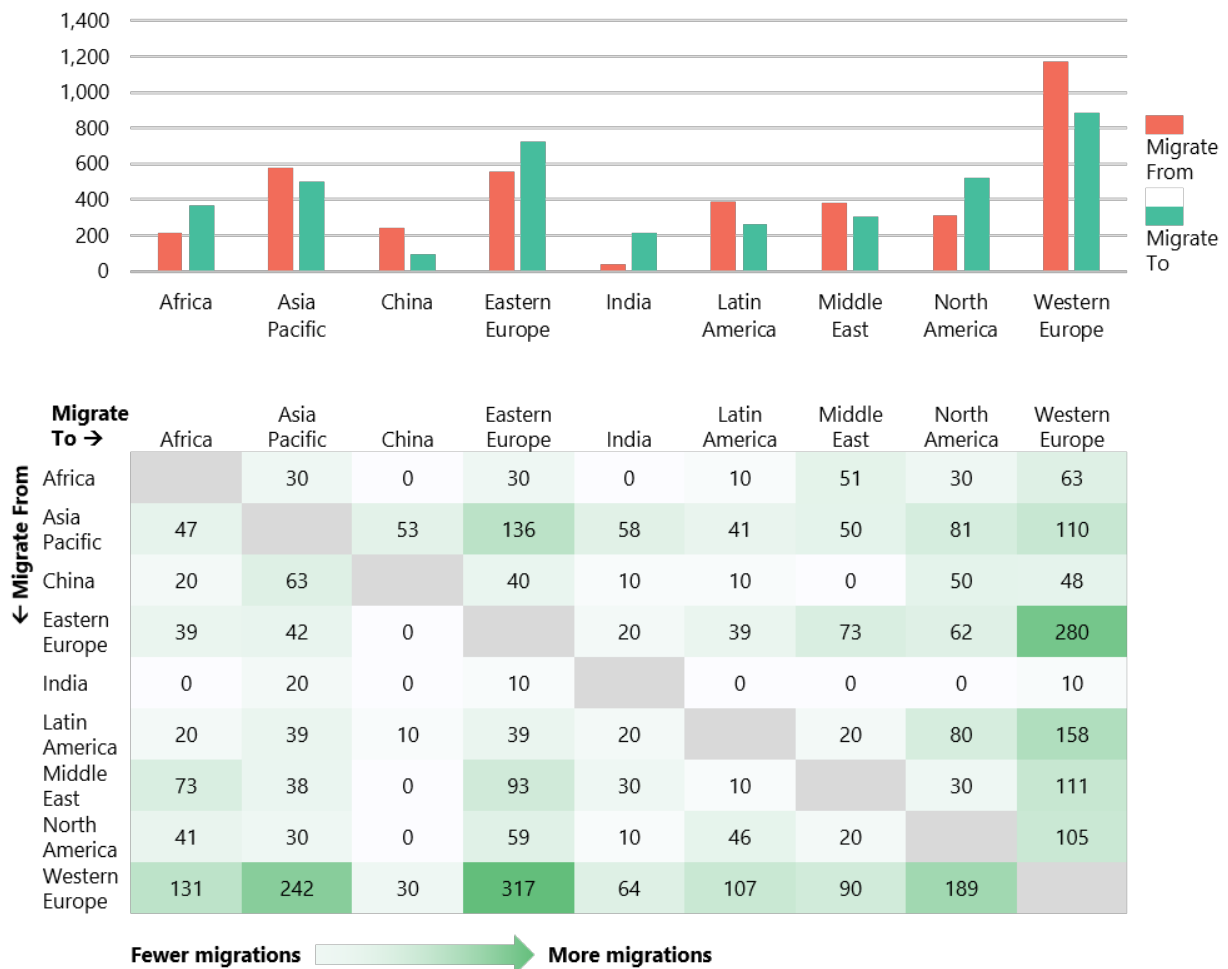
	2019	2024	2029
AFRICA	15.5	14.7	13.4
ASIA PACIFIC	9.7	9.8	10.3
CHINA	6.4	7.6	9.0
EASTERN EUROPE	11.6	12.0	12.6
INDIA	7.1	8.8	10.7
LATIN AMERICA	11.4	10.7	9.9
MIDDLE EAST	9.3	9.1	9.6
NORTH AMERICA	14.1	13.3	12.1
WESTERN EUROPE	11.4	11.1	10.6

Source: Oliver Wyman

As fleets grow, the average aircraft age will vary among regions. North America, Western Europe, Latin America, and Africa will see the age decrease as older fleets are replaced with new deliveries. In contrast, the fleets in China, India, Eastern Europe and Asia Pacific will age as aircraft stay in service to meet increased demand, leading to greater emphasis and importance for aircraft maintenance programs.

EXHIBIT 32: NET AIRCRAFT MIGRATIONS BY REGION, 2019–2029

NUMBER OF AIRCRAFT



Source: Oliver Wyman

Outside of deliveries, aircraft are also sold between regions, and this migration of jets is another way that regional fleet size changes. That said, Africa is the only region where a significant percentage of fleet growth—about 75 percent—is the result of migrations. Most regional fleet growth is not substantially affected by migrations. Over the next 10 years, there are expected to be 1,440 net migrations.



4

MRO MARKET FORECAST

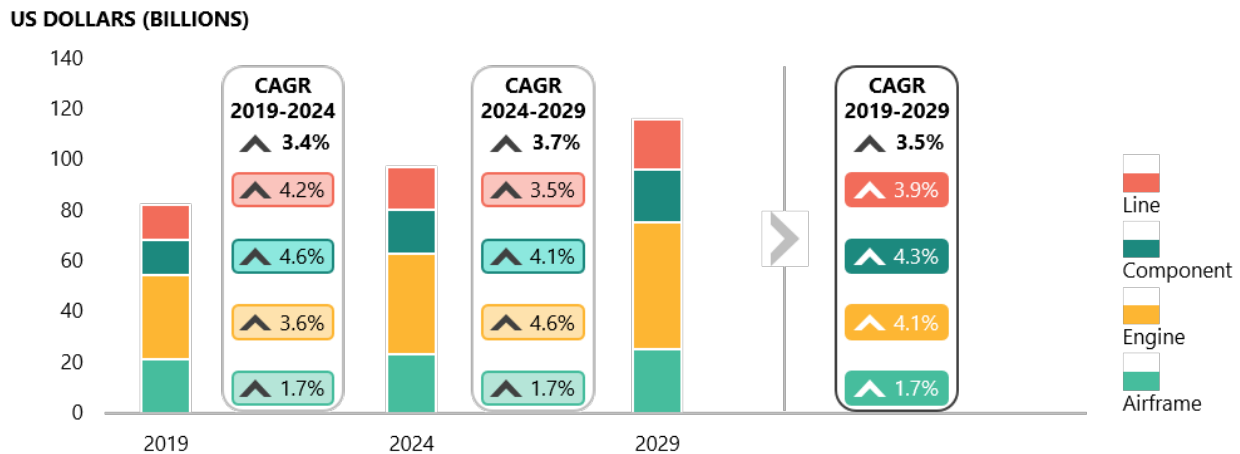
MRO MARKET FORECAST

The commercial air transport MRO market, valued around \$82 billion in 2019, will be driven by the growth and changing composition of the global fleet. New-generation aircraft, equipped with more fuel-efficient engines and sophisticated technology, will begin to represent a larger share of in-service aircraft.

Most of these aircraft will be larger narrowbodies, as airlines move toward aircraft with improved operational flexibility. The goal is to accommodate more passengers with airplanes that are cheaper to operate than the larger, less flexible widebody aircraft that tend to dominate long-haul flights. This transition also reflects a greater willingness by passengers to accept smaller cabins on long-haul flights than what was the norm just 10 years ago. This move to replace older-generation aircraft will slow MRO spend in the first half of the next 10 years, as the number of expensive late-life maintenance events declines with the retirement of aging aircraft and as the intervals between scheduled maintenance lengthen for the newest jets.

Between 2019 and 2024, the MRO market will grow at a CAGR of 3.4 percent, increasing MRO spend to \$96.9 billion. The market in the next five years will accelerate slightly—3.7 percent annually on average—as the new-generation aircraft reach the stage when life-limited parts need replacement and the number of other scheduled maintenance events rises. By the beginning of 2029, MRO spend is expected to total \$116 billion. Over the full 10-year forecast period, the global air transport MRO market will average 3.5 percent growth annually.

EXHIBIT 33: GROWTH OF MRO SPEND, 2019–2029



Source: Oliver Wyman

The growth of airframe maintenance costs will slow because of the increased use of proven design materials such as composites, titanium, and advanced aluminum alloys that reduce the need for fatigue-related inspections and corrosion-related maintenance checks. These new, more advanced technologies and materials can reduce overall fatigue and corrosion maintenance tasks by 60 percent for certain aircraft. Over the course of the forecast period, airframe will be the slowest-growing MRO segment, with an average annual growth rate of 1.7 percent.

The pace of growth for engine MRO will vary over the decade. In the first five years, new engines are expected to lengthen the interval between shop visits with less need to replace life-limited parts and to conduct other scheduled maintenance. Over those years, the CAGR for engine MRO is expected to be 3.6 percent. That will rise to 4.6 percent in the second five years of the decade.

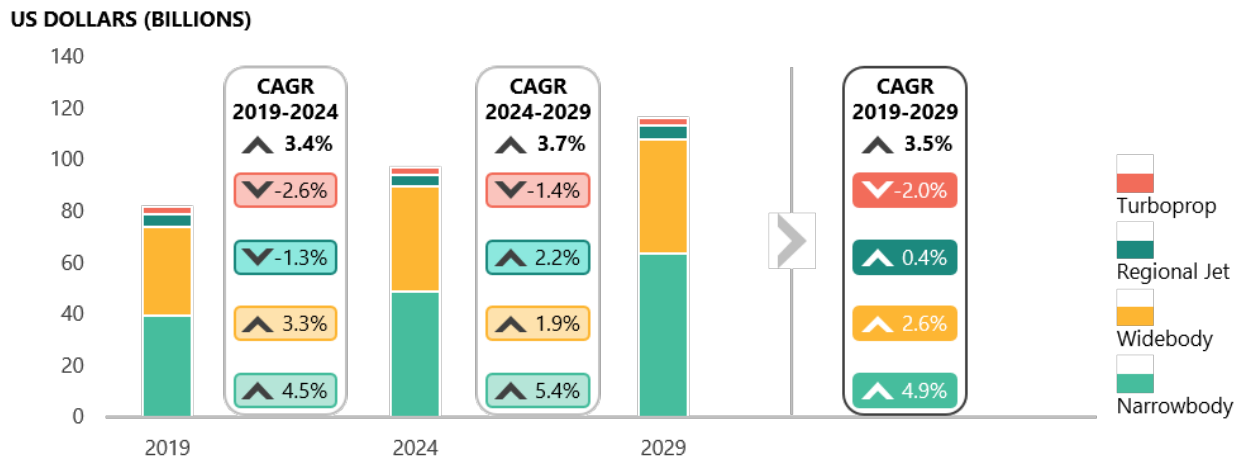
The latest-generation engines, while much more fuel-efficient, also use increasingly exotic and expensive materials and more complex technologies—particularly related to life-limited parts. While their resilience tends to make them last longer and be less problematic in general, they can be quite expensive to replace or repair when the time comes.

The landscape and strategy of the component MRO market are changing because OEMs are becoming more prominent within the sector. For instance, manufacturers of complex components are offering long-term service packages to aircraft purchasers in order to increase their participation in the aftermarket. Additionally, larger parts manufacturer approvals (PMA) providers are working to gain control over the design, development, and manufacturing of their parts. PMA is an emerging segment that has undergone a lot of merger and acquisition activity, which has ended up helping the bigger players.

Line maintenance remains an attractive market, considering the number of new-generation aircraft in the global fleet that require less heavy-maintenance hangar work. STS Aviation Group's line maintenance business has set up multiple new stations in the past two years, coinciding with it acquiring many of the 17 locations offloaded by HAECO Americas in October 2016. The company now has more than 30 stations operating across the US and the Bahamas. Europe has experienced healthy line maintenance growth the last few years, with Monarch Aircraft Engineering adding stations to its network. FL Technics established four new line stations, and Magnetic MRO opened more locations in 2018.

Despite all this, there is little change expected in the relative share of component and line MRO spend over the forecast period. The labor and material costs associated with routine maintenance and ATA chapter spend is also consistent across the next 10 years.

EXHIBIT 34: MRO MARKET FORECAST BY AIRCRAFT CLASS, 2019–2029



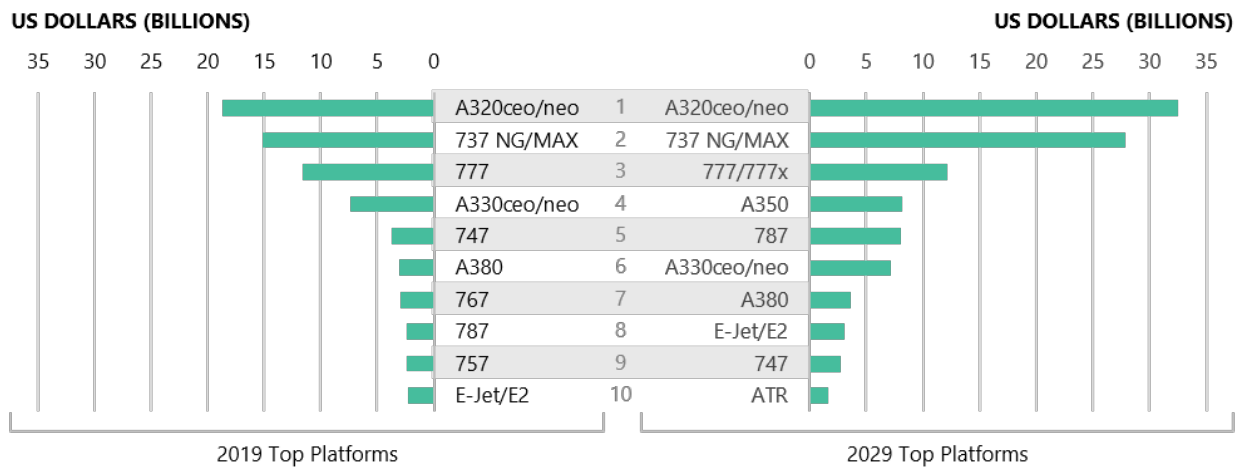
Source: Oliver Wyman

Globally, MRO spend related to narrowbody and widebody aircraft is expected to account for \$73.6 billion of the \$81.9 billion MRO market total; regional jets and turboprops compose the rest at \$8.3 billion. In 2019, narrowbodies are expected to make up 58 percent of the global fleet and 48 percent of MRO market share, an increase of one percent and three percent over last year. Widebodies are expected to make up 20 percent of the global fleet at the beginning of 2019 and represent more than 42 percent of MRO spend because of their complex and maintenance-intensive nature. That represents a slight decline from the start of 2018, when they accounted for 44 percent of the MRO spend and 20 percent of the fleet.

Oliver Wyman forecasts a significant shift in MRO spend away from regional jets and turboprops and toward narrowbody aircraft over the next 10 years. Over the forecast period, narrowbody MRO spend will climb \$24.2 billion, from \$39.1 billion to \$63.3 billion by 2029. Overall, the MRO market share for narrowbodies is expected reach nearly 55 percent by the end of the forecast period, largely driven by their increased representation across the fleet. By 2029, widebody MRO market share will drop to 39 percent, totaling \$44.8 billion, and regional jets and turboprops will combine for seven percent of MRO spend, totaling \$7.9 billion.

Within the categories of narrowbodies and widebodies, MRO spend will be concentrated on a handful of aircraft platforms. In 2019, the top 10 aircraft platforms will make up 87 percent of the total MRO market; by 2029, the top 10 will represent more than 93 percent.

EXHIBIT 35: TOP AIRCRAFT PLATFORMS BY TOTAL MRO SPEND

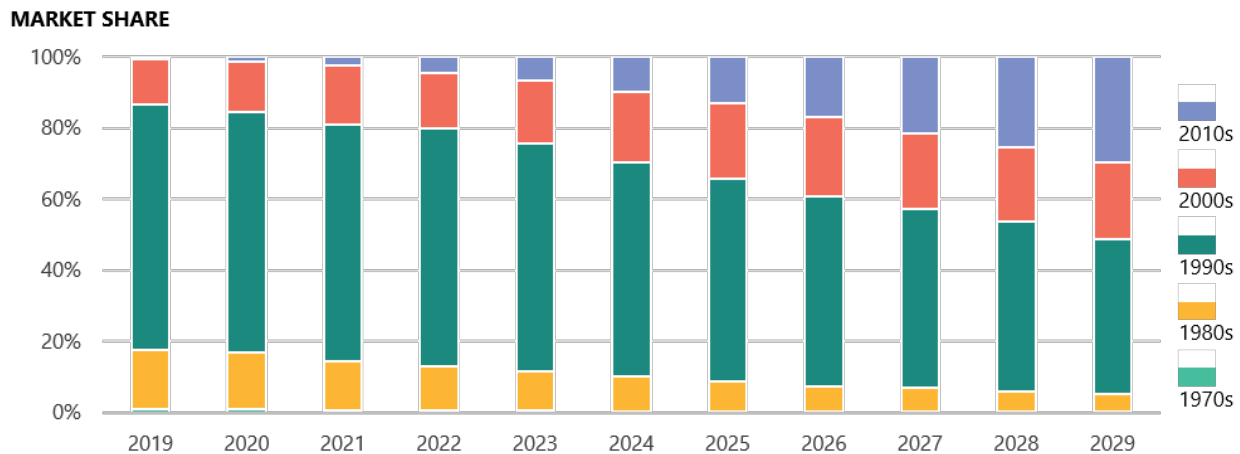


Source: Oliver Wyman

The fleet composition by vintage is expected to undergo the most dramatic shift in priorities related to MRO expenditures. Driven by the upgrade and expansion of the fleet, new-generation aircraft will grow from 13 percent of total MRO spend in 2019 to 52 percent by 2029. There is no doubt that this changeover will pose many challenges for MRO providers as they handle new materials and technologies in sophisticated next-generation airframes and engines used on aircraft like the 737 MAX and A320neo series. To service the new generation of aircraft adequately, airlines and MRO providers would benefit from making investments in training, digital capabilities, and the infrastructure their top priorities.

Many MROs have stated plans to implement technologies such as paperless shops and hangars, predictive maintenance, virtual maintenance training, and drone-supported maintenance within the next three years. This will allow more thorough and efficient aircraft monitoring, improve technician efficiency and productivity, and pay off in greater reliability performance in later years.

EXHIBIT 36: TOTAL MRO SPEND BY AIRCRAFT VINTAGE, 2019–2029



Source: Oliver Wyman

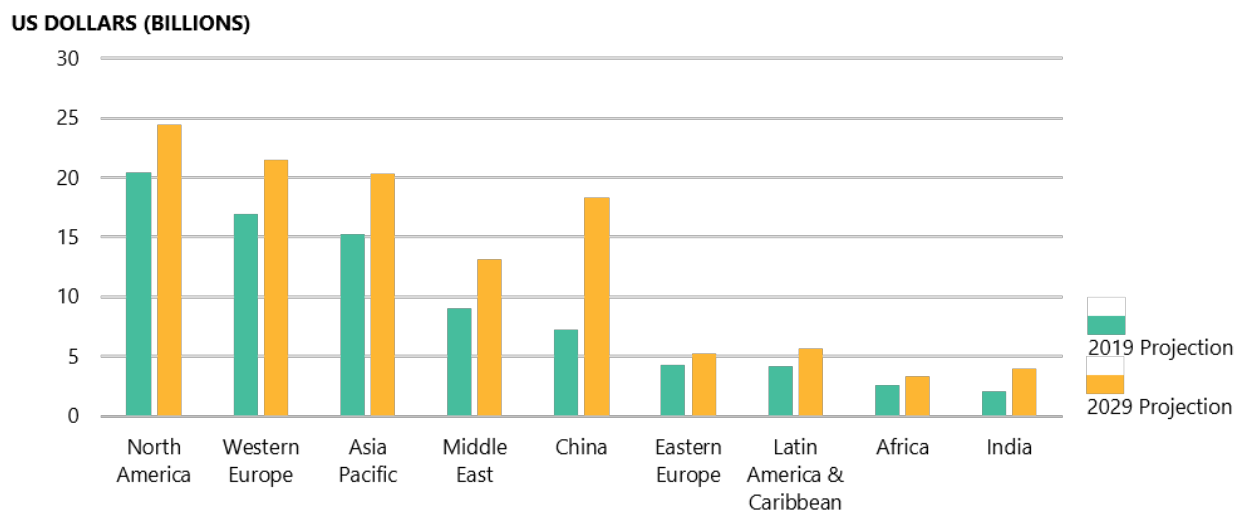
From an MRO perspective, a diverse global fleet requires airlines to form MRO strategies that complement varying business model needs. From low-cost carriers—and the recently introduced long-haul low-cost carriers—to airlines with an established global presence, operators can focus on maintenance intervals that fit well with their fleet mix and flight schedules.

In addition to the heightened competition for qualified technicians, there is the potential for increased competition in the engine aftermarket following the agreement between CFM International and IATA. After years of OEMs controlling the engine parts and services aftermarket, this agreement has the potential to loosen their hold on supply chains. The pact aims to clarify ambiguity in contracts and warranties that affect PMA and designated engineering representative (DER) repairs. While prospects for PMAs may improve modestly with this agreement, it is too early to know for sure how much growth will be realized. Airlines and MROs, however, will be able to explore all options to best leverage a broadened supply chain to reduce material costs.

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, software/firmware, and data for these new parts. Line maintenance providers will need to improve training and expand the use of the newest aircraft health-monitoring and fault isolation systems, as well as software configuration protocols.

As fleet growth shifts to Asia and other developing economies, so will MRO spend, especially given those regions' labor rate and supply chain advantages. By 2029, the combined MRO demand in Asia Pacific, China, and India will be almost double that for North America.

EXHIBIT 37: TOTAL MRO SPEND BY REGION, 2019 VERSUS 2029



Source: Oliver Wyman

Our forecast shows slow growth in North American MRO spend, rising from \$20.5 billion in 2019 to \$21.6 billion in 2024, before accelerating slightly in the next five years. It is expected to reach \$24.5 billion by 2029. Growth over the entire 10-year forecast period will average 1.8 percent annually.

European MRO spend will experience the same slow growth. Despite a surprising increase in the Eastern European fleet this year, the long-term trend of low single-digit fleet growth is expected to continue, depressing growth for MRO spend. In Western Europe, the MRO market will grow 2.5 percent annually on average, but will end the decade by shrinking more than two percentage points in global market share.

Despite rising demand in the region, African fleet growth is expected to be constrained over the next decade by geopolitical tensions, unreliable safety records, high airport fees and taxes on jet fuel. Still, the MRO market in the region will grow from \$2.6 billion to \$2.8 billion over the next five years, a CAGR of 1.4 percent. As the existing fleet ages during the second half of the forecast period, annual MRO spend will increase to \$3.4 billion for an average growth rate of 2.7 percent over the entire forecast period.

Latin America MRO is expected to slightly exceed the market average, with 3.2 percent growth annually. The region is forecast to increase MRO spend by \$1.5 billion, reaching \$5.6 billion by 2029 and representing almost five percent of the global MRO market, a small increase in share from today.

The Middle East, currently the fourth-largest MRO demand market in the world, will be surpassed by China and fall to fifth by 2024. The drop will be from rapid growth in China rather than a deceleration in the Middle East, where the MRO spend will still achieve a CAGR of 3.9 percent over the next decade. That growth is faster than the market average for the forecast period. By 2029, the Middle East will add \$4.1 billion in MRO spend and represent more than 11 percent of the global market.

Asia, as has been the case for years, remains the driver of MRO growth. China, the largest and fastest-growing nation in the region, will more than double its annual MRO spend by 2029, with an \$11.1 billion increase to \$18.3 billion. At that point, it will represent 16 percent of the total global MRO market.

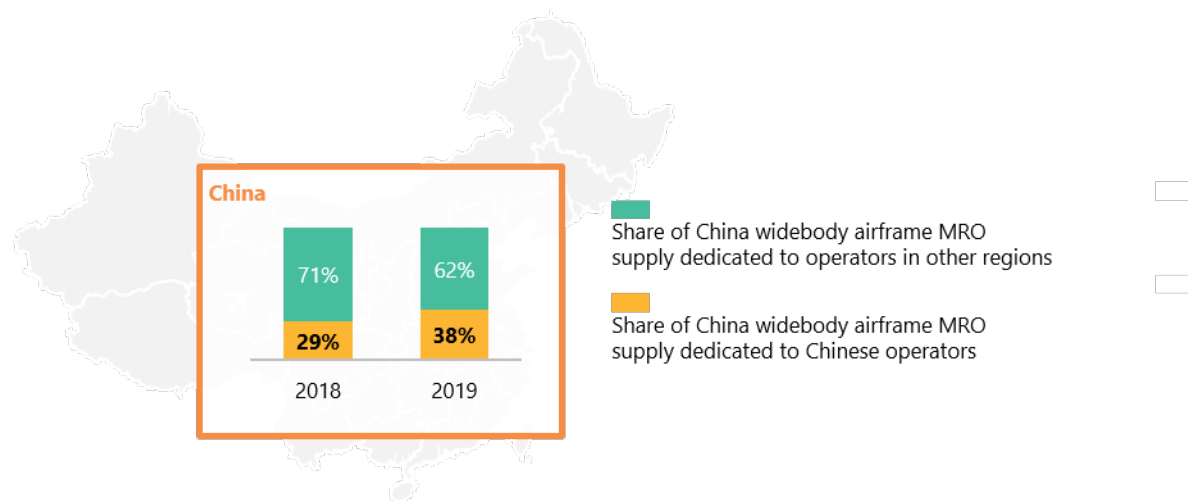
India, growing at 7.1 percent annually, also is expected to exceed the market average and end the decade representing more than three percent of the market. While the small percentage shows the relative size of India's absolute MRO spend, it also suggests the potential for continued growth, given the size of its burgeoning middle class.

Although growth in the Asia Pacific region—which includes Japan, Australia, Indonesia and South Korea, among others—will average only 2.9 percent annually, the MRO market will almost equal that of Western Europe by 2029. The market will grow almost \$5 billion to \$20.3 billion.

While China will be the key driver of MRO spend growth in Asia, rising labor costs, coupled with temporary infrastructure and capacity constraints, have shifted the global trade of MRO services.

In 2018, operators around the world sent nearly 24 percent of widebody heavy airframe maintenance to Asia Pacific and China. Given the infrastructure and capacity constraints, the industry is approaching an inflection point where capacity within Asia cannot accommodate both the growing MRO demand within the region and the work being sent there by other regions, particularly from North America and Western Europe.

EXHIBIT 38: CHINA WIDEBODY HEAVY AIRFRAME MRO, DOMESTIC OPERATORS VERSUS FOREIGN



Source: Oliver Wyman

We have observed a shift in how the supply of China widebody MRO is allocated on a global level. There is an increased share of maintenance work being completed for operators in-country and less MRO work being performed for operators outside the region, particularly those in the mature North America and Western Europe regions.

An aerial photograph of a coastline, showing a narrow strip of land between the sea and a larger body of water. The sky is a deep blue, and the water is a warm orange-brown. The land is a mix of green and brown, with some buildings visible. The image is overlaid with a semi-transparent blue rectangle on the left side, which contains the number '5' and the text 'ECONOMIC SENSITIVITY ANALYSIS'.

5

ECONOMIC SENSITIVITY ANALYSIS

ECONOMIC SENSITIVITY ANALYSIS

Forecasting, particularly over the long term, is complex and subject to many external variables. This baseline analysis reflects Oliver Wyman's view of the most likely scenarios facing the industry, but slight changes in assumptions relating to the political and economic landscape can lead to considerable differences in the size and complexion of the global fleet and MRO market when the effects are amplified over time. It takes only one significant global event to alter the course of the air transport industry.

When looking at external variables such as GDP, passenger traffic growth, jet fuel cost, and long-term interest rates, the understanding should be that these are not independent of each other. They are more representative of the overall economic and industry environment. How these environments influence the decisions of airlines on fleet size is ultimately what drives future MRO spend. Given the degree of uncertainty surrounding economic and political variables over time, numerous scenarios are possible, each resulting in disparate fleet and MRO market predictions based on key factors.

EXHIBIT 39: FACTORS AFFECTING FORECASTING



ECONOMIC HEALTH



TRAFFIC



FUEL PRICES



INTEREST RATES

Source: Oliver Wyman

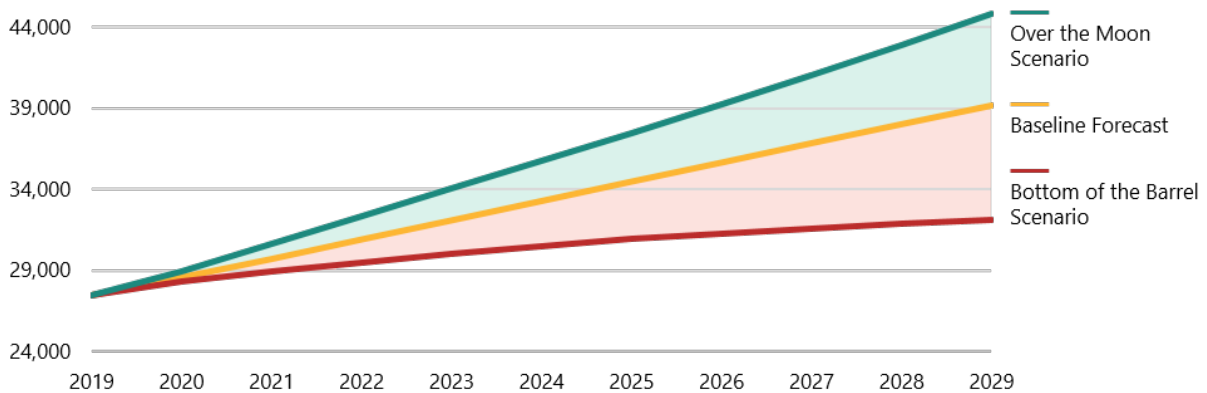
In our analysis and in general, economic health, passenger traffic growth, jet fuel prices, and long-term interest rates are the four primary factors affecting growth in the global fleet and MRO market. These elements influence demand and therefore can alter airline fleet planning, ultimately affecting the delivery rate of new aircraft and the retirement rate of in-service aircraft. A strong global economy and the factors that drive increased traffic growth—such as consumer confidence and increased wages—would lead to greater demand for additional aircraft. If the opposite occurs—a slowdown in large economies, for instance—operators would likely alter fleet plan growth, potentially scaling back to more closely align with demand. Alternatively, a significant, long-term jump in jet fuel prices would encourage airlines to increase retirements of old, less fuel-efficient aircraft and, where possible, meet demand with new, more efficient aircraft. Like cheap fuel, low interest rates benefit operators and lessors, as the cost of financing new aircraft falls. As interest rates rise and this cost increases, operators might stick with their current fleets and retire aircraft at a slower rate.

These four factors impact the global fleet and MRO market, but to different degrees and in different ways. Over the forecast period, the world's economic health and its impact on traffic volume are ultimately most pivotal in determining fleet expansion or contraction. If passenger and cargo traffic growth is soaring, operators are going to supply the world with the appropriate number of seat and tonne miles to handle demand, regardless of fuel prices and interest rates. If the economy is strong, airlines could raise ticket prices to offset the higher fuel cost while still meeting the increased demand.

The factors in the scenarios below represent the best case and worst case for the market in relation to the values used in our baseline forecast. For example, if the economy grows faster than our baseline, the metrics would fall closer to our best-case scenario.

EXHIBIT 40: FLEET FORECAST WITH ALTERNATIVE SCENARIOS, 2019–2029

NUMBER OF AIRCRAFT



Source: Oliver Wyman

Two alternative scenarios to the baseline forecast will be reviewed in the following sections:

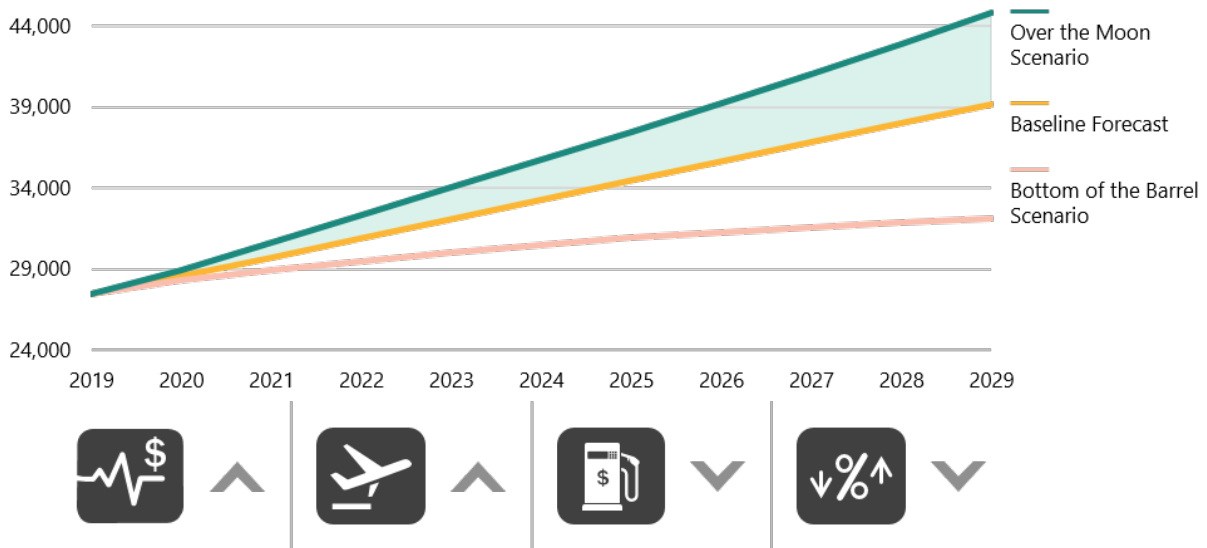
- **Over the Moon:** This is the scenario that depicts the global economy as a well-oiled machine, running in perfect harmony year after year. This is the extreme best-case scenario.
- **Bottom of the Barrel:** This is an extreme negative scenario illustrating the effects of an event or series of events that have devastated the world economy.

OVER THE MOON

This scenario represents an extreme coalescing of positive forces and therefore is unlikely. For this best-case turn of events to come about, economic health would need to soar across all supporting metrics. In this environment, operators would be quite profitable and have a low cost for borrowing, enabling them to meet the demand for additional seat miles through new aircraft orders. Because fuel prices would be low, older, less fuel-efficient aircraft would likely remain in the fleet to meet demand as there is no longer a high variable-cost disadvantage to operate them.

EXHIBIT 41: OVER THE MOON FLEET FORECAST, 2019–2029

NUMBER OF AIRCRAFT



Source: Oliver Wyman

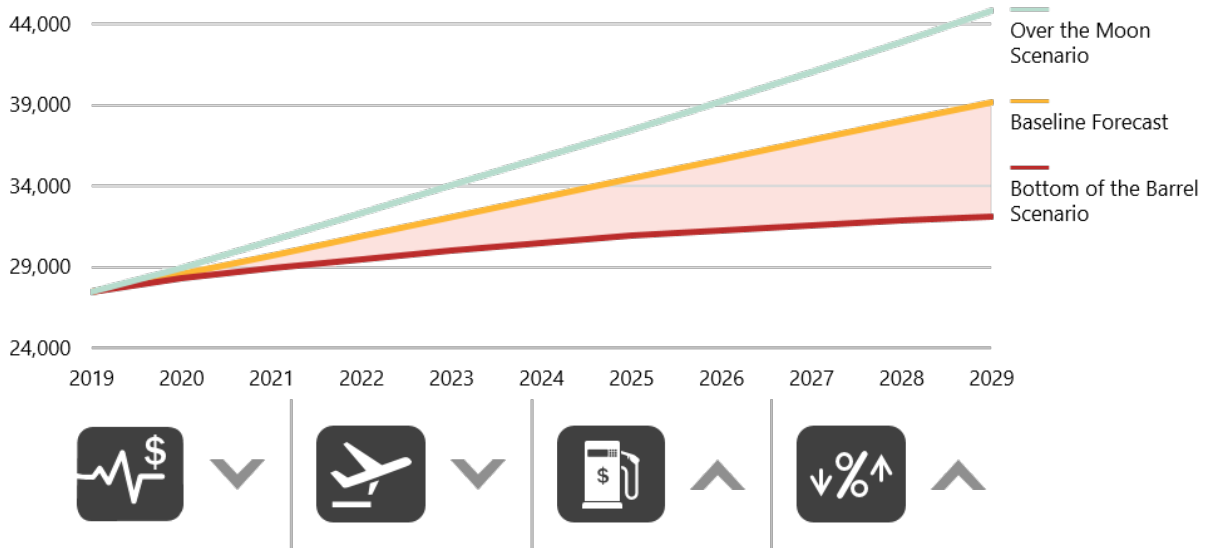
In this scenario, the commercial fleet would grow to 44,803 by 2029, a more than 5,600-aircraft increase from our baseline forecast, due to over 3,000 additional deliveries and almost 2,500 fewer retirements. This fleet growth would fuel an expansion of the MRO market to \$131.7 billion in 10 years' time, nearly \$16 billion more than our current baseline forecast. In this high demand environment, additional carriers would have entry points into the market to serve various passenger groups around the world. Manufacturers would accelerate production rates even further, and MROs would see an explosion in maintenance work required for older aircraft remaining in service.

BOTTOM OF THE BARREL

This is the worst-case scenario. This outcome would involve a devastating event that severely impacts the world economy in general and the airline industry in particular. The Great Recession of 2007–2009, because of its unanticipated severity, is a prime example of such an event. In a scenario like this, world GDP growth would be much slower than anticipated, traffic growth would be exceptionally low, fuel prices would increase over the short term because of economic uncertainty or supply problems, and interest rates would increase. In this environment, operators would likely increase aircraft retirements because of high fuel prices and low passenger traffic growth. New aircraft orders would be deferred or cancelled altogether.

EXHIBIT 42: BOTTOM OF THE BARREL FLEET FORECAST, 2019–2029

NUMBER OF AIRCRAFT



Source: Oliver Wyman

In a Bottom of the Barrel environment, the fleet would grow to only 32,361 by 2029, nearly 7,000 aircraft fewer than the base forecast, driven by 3,540 fewer deliveries and almost 3,300 more retirements. The lack of new aircraft and the removal of older, more MRO-intensive aircraft would limit the MRO market to \$99.5 billion by 2029. Such an environment, with a slow-growing world fleet hobbled by a lack of demand, would create financial hardships and could bankrupt carriers with low yields and insufficient scale. Consolidation for certain mainline carriers could occur, and independent MROs would be affected as operators may only perform crucial maintenance tasks.

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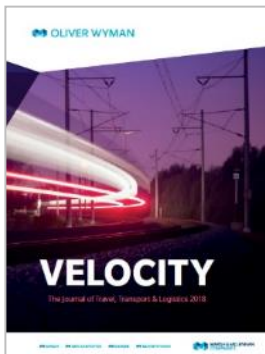
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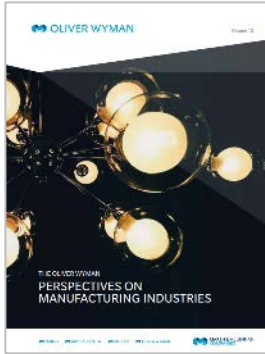
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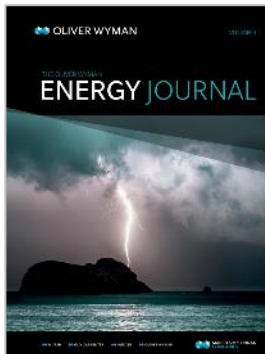
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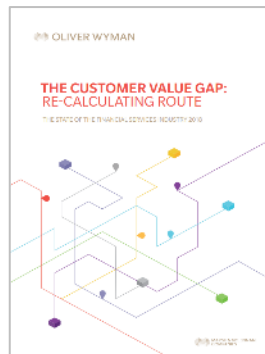
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For more information about this study, please contact Tom Cooper at tom.cooper@oliverwyman.com.

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