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3rd MRO SMARTHUB FORUM
OCTOBER 22, 2024
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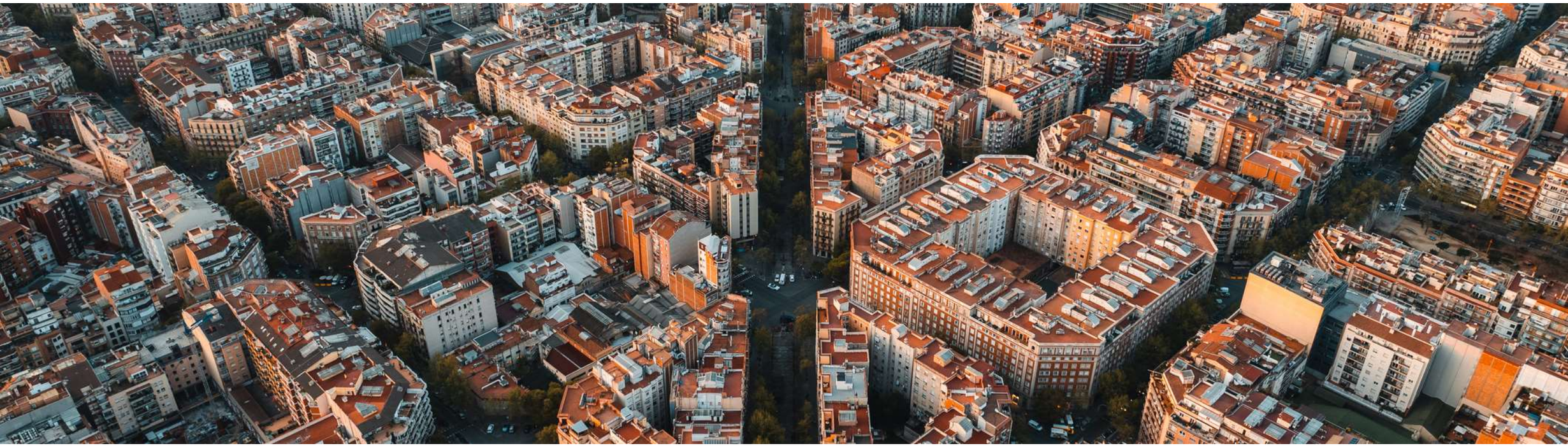

Fleet Evolution and Implications for Airline Technical Operations

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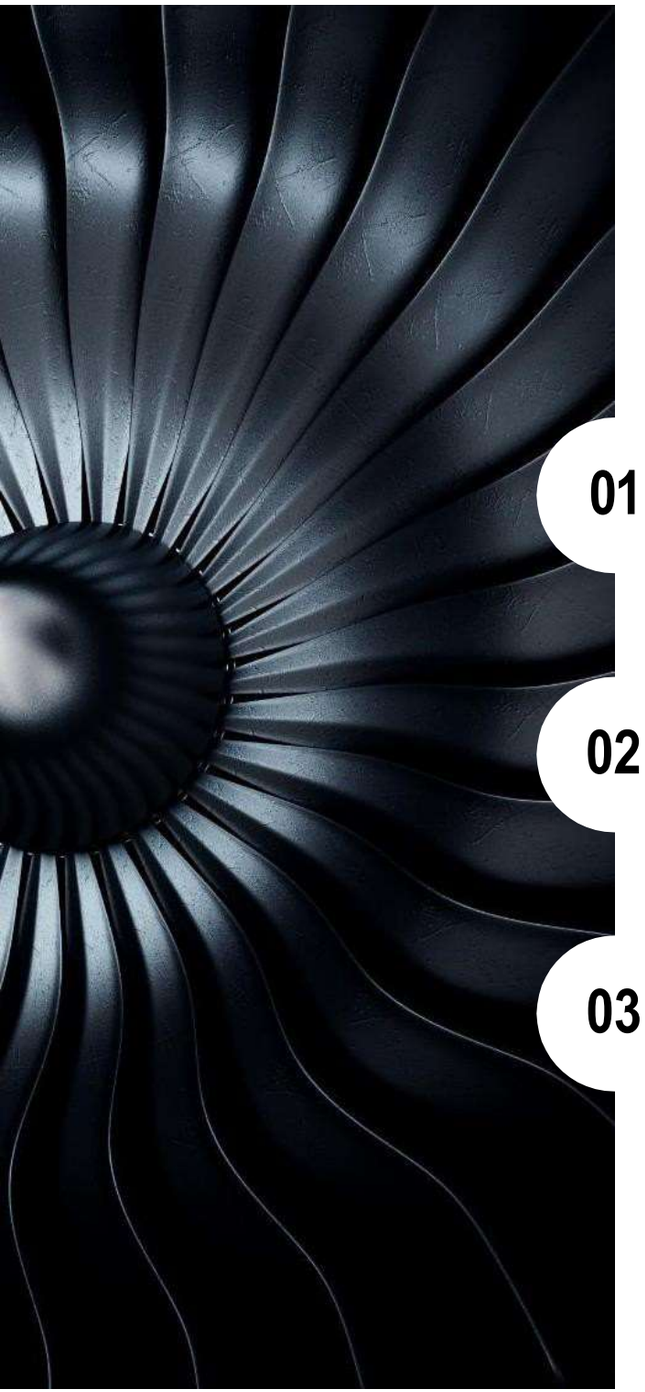
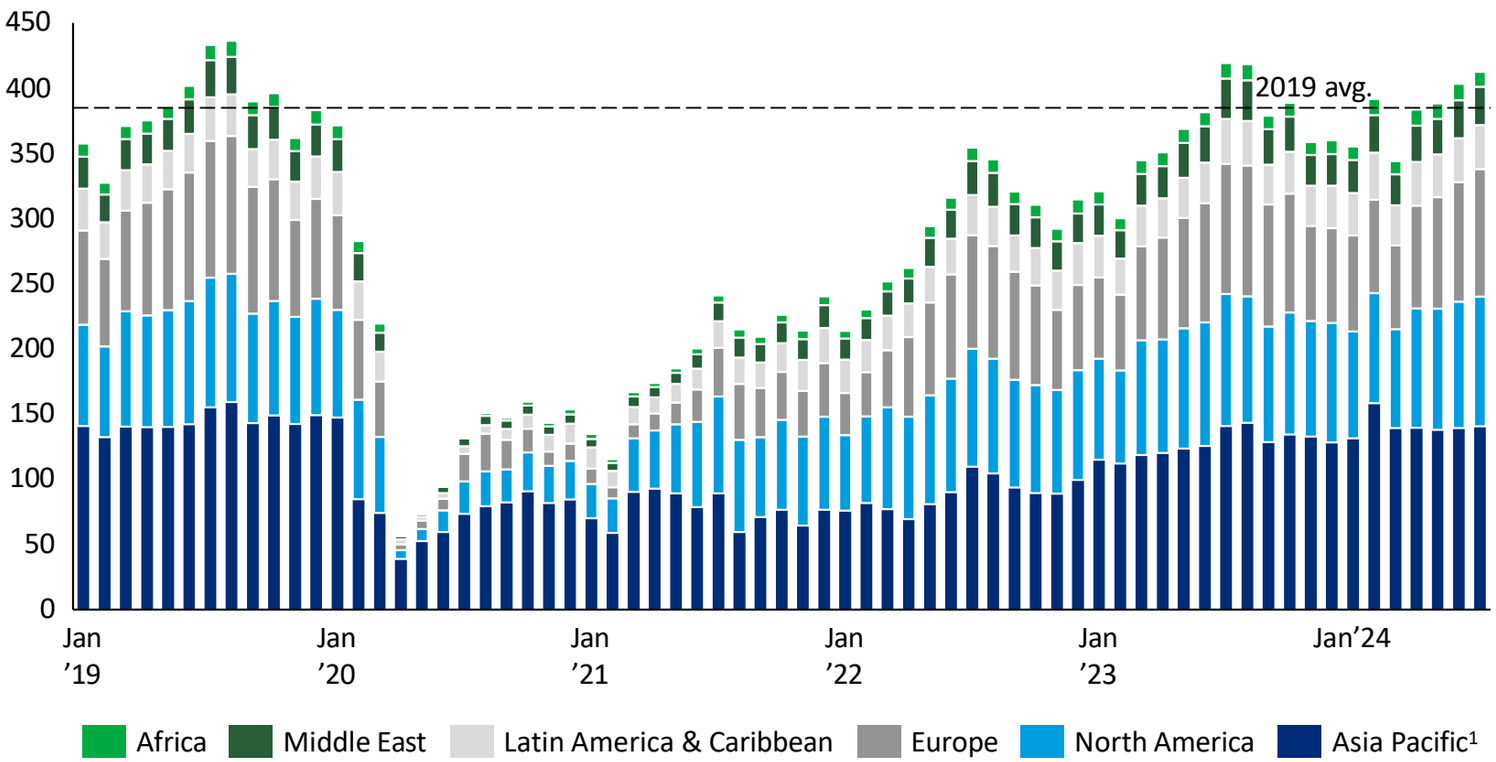


CONTENT

THE AVIATION SECTOR HAS SEEN A STRONG RECOVERY POST COVID, WITH PASSENGER TRAFFIC BACK TO 101% OF 2019 LEVELS AS OF Q2 2024…

Monthly Passenger Traffic by Region
Jan 2019 – Aug 2023, millions of passengers



Total Jan-July 2024 Actual Recovery Rates

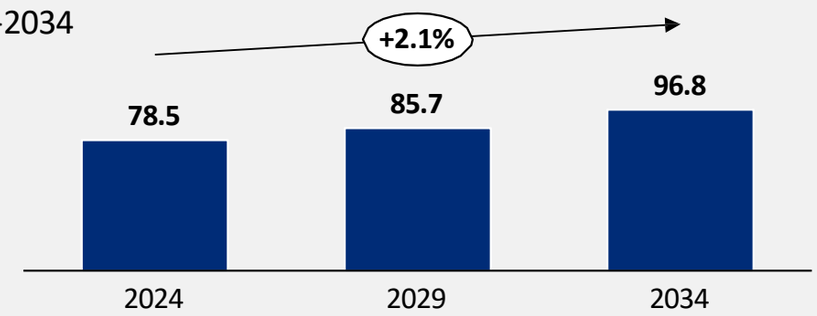
Region	Total Market Recovery
Africa	113%
Asia Pacific	100%
Europe	94%
Latin America	110%
Middle East	111%
North America	103%
Global	**101%**

1. Includes China/India
2. Recovery measured as Aug 2023 compared to Aug 2019

TRAFFIC GROWTH IS EXPECTED TO CONTINUE TO GROW IN LINE WITH HISTORICAL RELATIONSHIP TO GDP, DRIVING FLIGHT HOURS AND FLEET GROWTH

10-year projections for traffic growth and gross domestic product
2024–2034

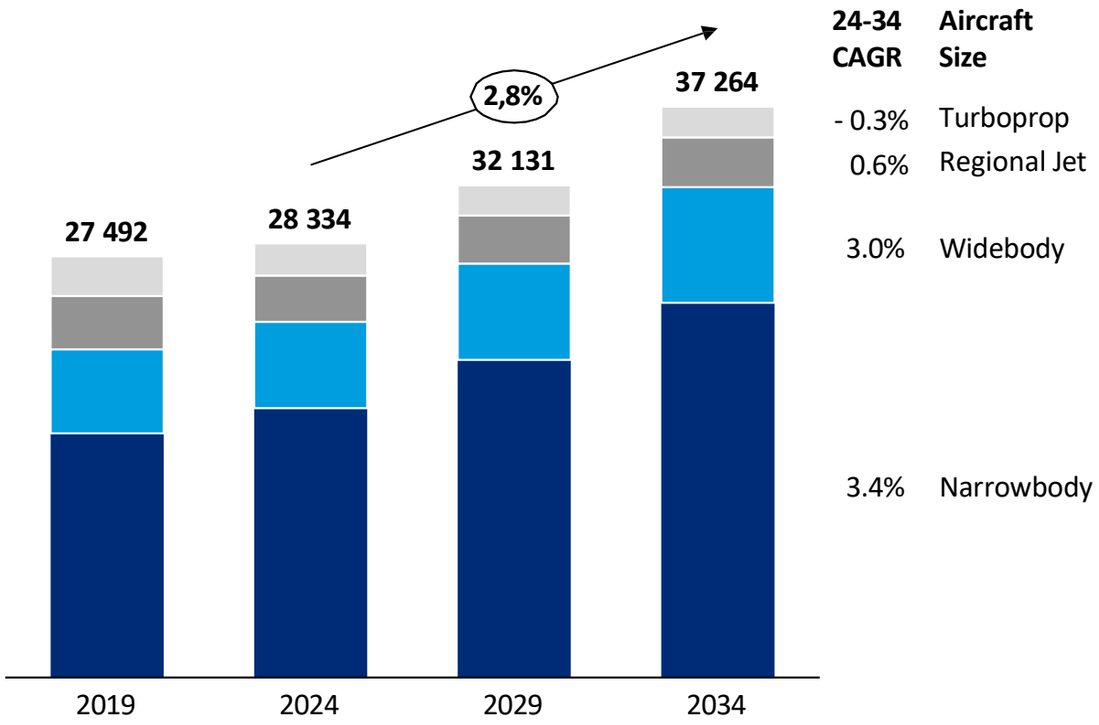
Global flight hours
By MM hours, 2024-2034



Source: Oliver Wyman

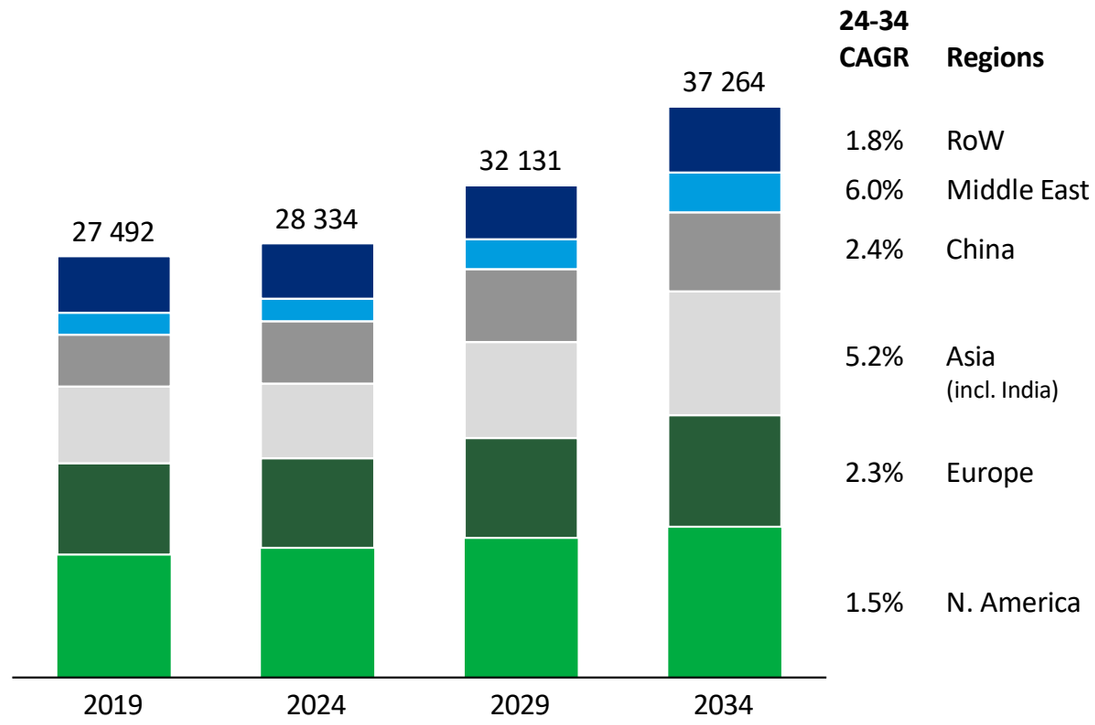
BY 2034, THE GLOBAL IN-SERVICE FLEET WILL REACH 37,250, GROWING 2.8% ANNUALLY, MAINLY DUE TO NARROWBODY DEMAND AND EXPANSION IN ASIA AND THE MIDDLE EAST

Fleet Growth 2019-2024 By Aircraft Size



Fastest Growing (% CAGR 2024-2034)	Biggest Growth (# of aircraft 2024-2034)	Largest in 2034
Narrowbody, 3.4%	**Narrowbody + 6,900 A/c**	**Narrowbody**

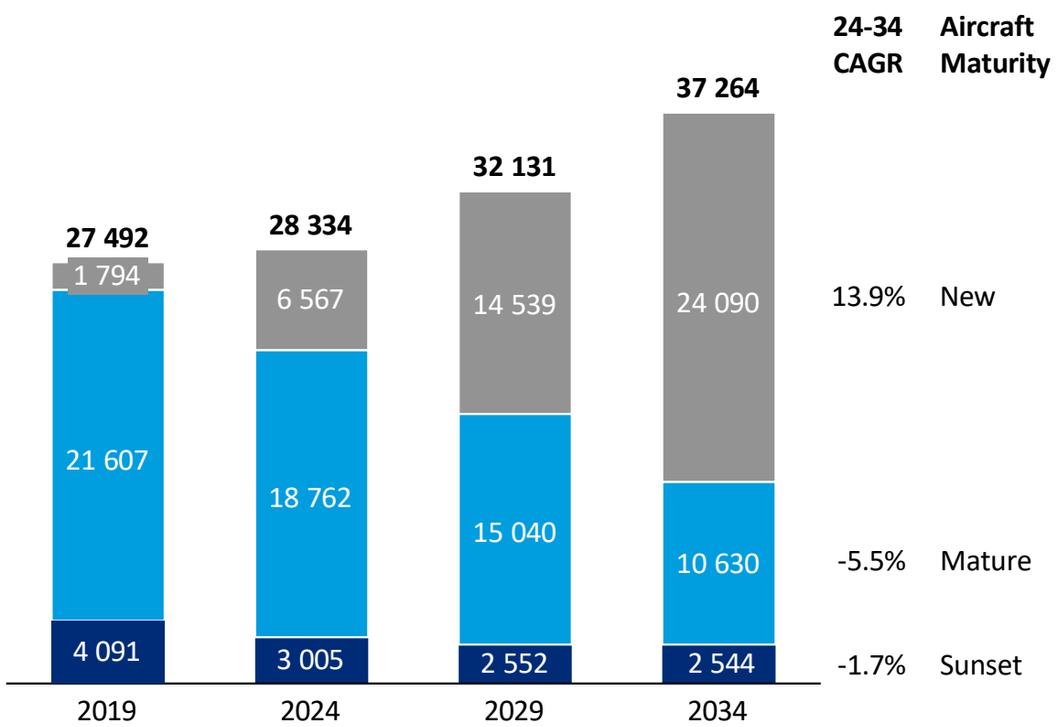
Fleet Growth 2019-2024 By Major Region



Fastest Growing (% CAGR 2024-2034)	Biggest Growth (# of aircraft 2024-2034)	Largest Region in 2034
Middle East, 6.0%	**Asia + 3,200 A/c**	**Asia Pacific (inc. China)**

THE FLEET GROWTH WILL LEAD TO A SIGNIFICANT SHIFT TOWARDS NEWER GENERATION AIRCRAFT

Fleet Growth 2019-2024 By Aircraft Maturity



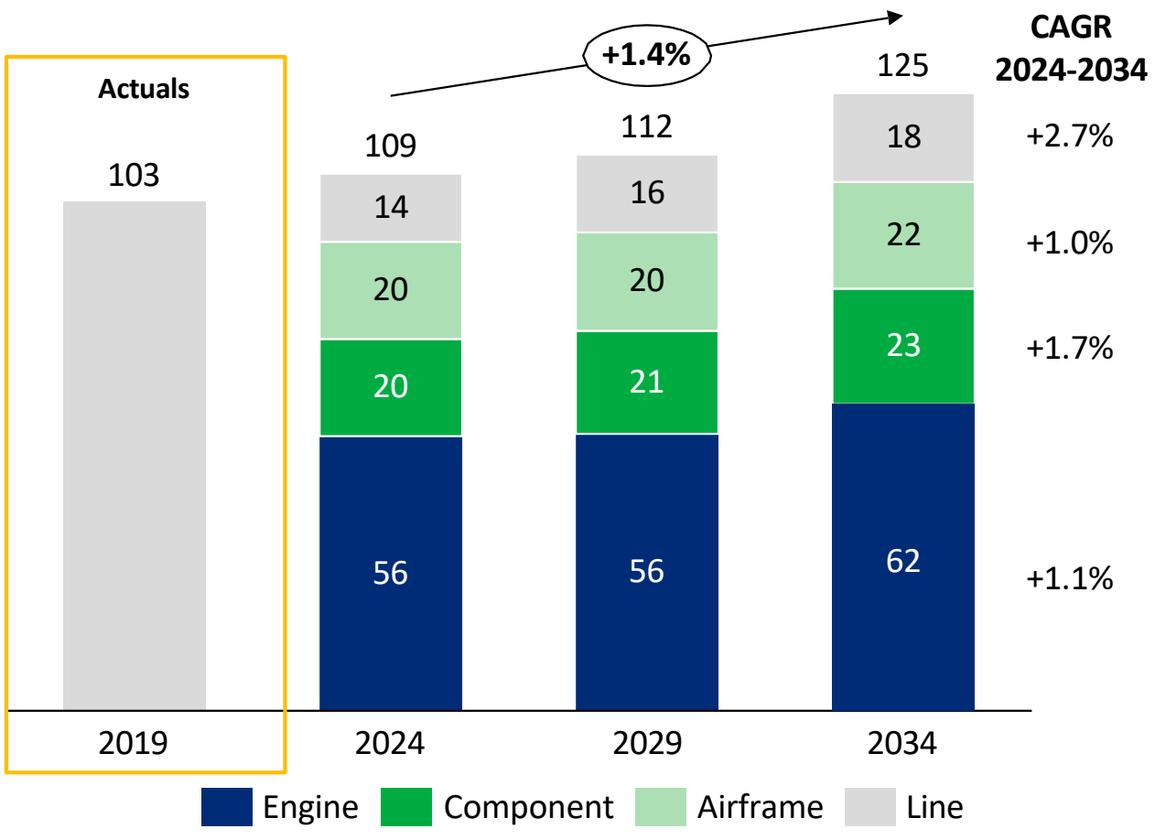
Fastest Growing (% CAGR 2024-2034)	Biggest Growth (# of aircraft 2024-2034)	Largest in 2034
New, 13.9%	**New, + 17,520 A/c**	**New**

Takeaways from Overall Fleet Outlook

- **Fleet grows by 30% over decade**
- **A320 family fleet in 2034 will be almost 12,000**
- **Airbus 320/Boeing 737 active fleet split will be 58% vs. 42%**
- **Critical mass of global fleet will have moved to Asia and China**
- **Massive swing to newer generation aircraft, from ~1,800 to ~24,000**

MRO SPENDING IS EXPECTED TO GROW 1.4% P.A., REACHING $125 BILLION BY 2034, DRIVEN BY THE INCREASED INSTALLED BASE AND OLDER AIRCRAFT FLYING LONGER

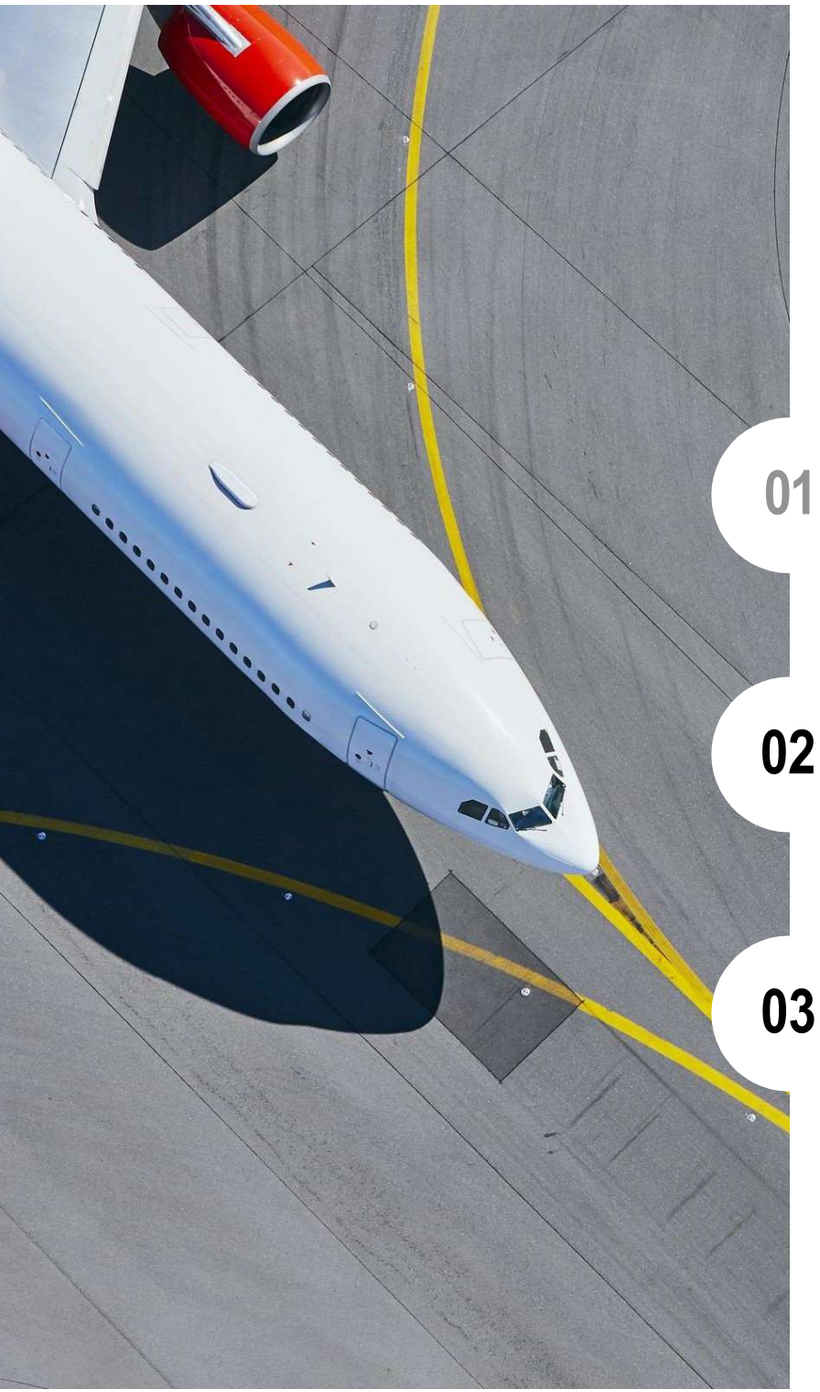
Global MRO market
$B, 2019 - 2034



Takeaways from MRO Forecast

- **In constant $, absolute spend growth (+15%) is relatively flat despite fleet growth of 30%**
- **Engine MRO remains largest driver of spend throughout**
- **Per fleet outlook, highest MRO spend growth is narrow body (by class), Asia/China (by region) and next gen (by maturity)**
- **Average fleet average age grows from 12.5 to 13.1 (2024-2034)**

Source: 2024 Oliver Wyman Fleet & MRO Forecast, 2019 Oliver Wyman Fleet & MRO Forecast, Oliver Wyman analysis



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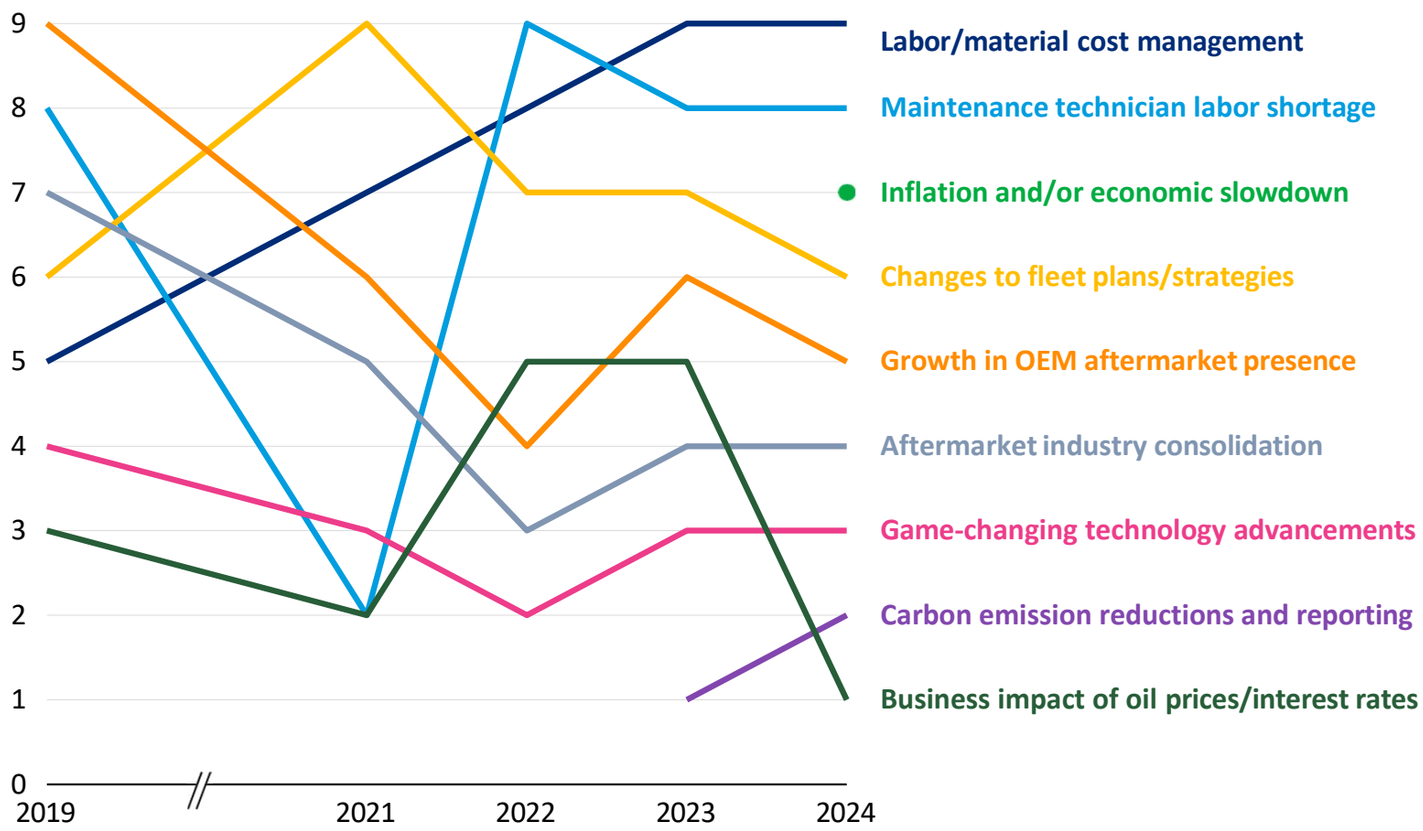
OUR MRO SURVEY FOUND THAT, FOR THE THIRD YEAR IN A ROW, THE 150+ RESPONDENTS CITED COST MANAGEMENT AND LABOR SHORTAGES AS THE TOP TWO DISRUPTORS

Ranking of top industry disruptors
By MRO Survey year



- **Rising factors**
  - Labor shortages
  - Aftermarket consolidation
  - Technology advancements
- **Declining Factors**
  - Fleet plans/strategies
  - OEM presence
  - Oil prices/interest rates

Note: Survey was not published in 2020

THESE DISRUPTORS LEAD TO AIRLINE TECHNICAL OPS FACING FIVE MAJOR CHALLENGES

1

Talent gaps and increased costs

Shortages of workers, skills gaps, and increased costs, heightened by pandemic and underlying structural / demographic challenges

2

Supply chain stability

Shortages, growing inventory costs, increased risks (geopolitical, climate, and other) in key aviation clusters

3

Fleet lifecycle management

Optimizing end-of-life cycle costs – leverage green time and USM; end-of-life asset values; managing obsolescence

4

Next wave of IT innovation

Modernizing obsolete systems, increasing mobility, and taking advantage of modern solutions (computing power, data transparency)

5

ESG scrutiny

Increased scrutiny by investors and other stakeholders and new challenges (disclosure requirements/ carbon accounting, renewed safety focus, etc.)

AS A RESULT, LEADING TECH OPERATIONS ORGANIZATIONS ARE WORKING ACROSS THEIR ORGANIZATION TO PREPARE FOR THE FUTURE

Human capital and front-line productivity

- Comprehensive “Recruit and Retain” strategies
- Value propositions fit for GenZ
- Overhauled training for a changing workforce
- Next evolution of front-line technology
- Reinvest in Lean techniques (supported by tech)

Supply chain

- Upgrade supplier management capability
- Network and footprint: Increased resiliency and optionality
- Sourcing and supplier resilience
- OEM alternatives
- Inventory planning and management

More detail on following pages

Maintenance program/planning

- Predictive maintenance
- Adaptive maintenance programs
- Replacing physical / functional maintenance tasks with electronic tasks
- Shifting from manual to automated / supervised planning
- Greater integration of Operations and Commercial planning

Technology Innovation

- MRO IT modernization
- Mobility
- New skillsets to take advantage of latest tech.
- Robotic process automation capability
- Data excellence

More detail in Section 3

ESG performance and reporting

- Reduced direct emissions as table-stakes
- ESG in supply chain decision making
- Safety culture and technology 2.0
- Increasing embracing of diversity, inclusion, and belonging

THERE IS A PERFECT STORM OF SUPPLY CHAIN CHALLENGES DRIVEN BY VARIOUS FACTORS AND RISING COSTS MAKING BUFFERING EXPENSIVE

Supply chain risk…

Long lead times

- Demand increase post-COVID combined with…
- … slow ramp-up due to material/labour shortages and investment/cash flow uncertainties …
- … leads to long lead times from suppliers

Uncertainty

- Uncertainty about if/when orders will be delivered often tackled by higher inventory levels
- Demand changes then lead to excess or obsolete inventories
- This uncertainty is amplified by often transactional supplier relationships

Poor transparency

- Global events, cash flow challenges and material shortages create risk throughout a wide and deep supply chain
- Limited systemic end-to-end visibility of risk up and down supply chain

…and rising costs

- Era of higher interest rates with increased cost of capital
- Higher inventories are not the best economic answer to shortages
- Cost of labour and raw material prices also rising
- Sustainability is becoming an additional cost factor

> The operation was more stable, but capacity could not yet be fully utilized. The fleet could not be fully deployed. **We […] face long delivery times of spare parts.**"

– KLM CEO, 2024

> **We have to carry more resiliency than ever in terms of our operations, […]. That's one of the costs of uncertainty.** It's great to be making money again but, boy - it is challenging."

– Cebu Pacific airline CEO, 2024

> An aircraft operator needs to be serviced and all of a sudden, we get word that a **first-tier supplier can't provide an essential engine or avionics [component] on time because they can't get parts**, so they may have to […] give them to the aftermarket line to be able to fix it."

– GAMA CEO, 2024

> Lufthansa, […], has already issued two profit warnings this year, **as spiraling wage costs, a squeeze on ticket prices and a tough aviation market make for a difficult recovery**."

– Reuters, 2024

TO TACKLE THE NEW NORMAL, AIRLINE TECHNICAL OPERATIONS ARE FOCUSING ON THREE STRATEGIC SUPPLY CHAIN LEVERS THAT DRIVE SIGNIFICANT VALUE

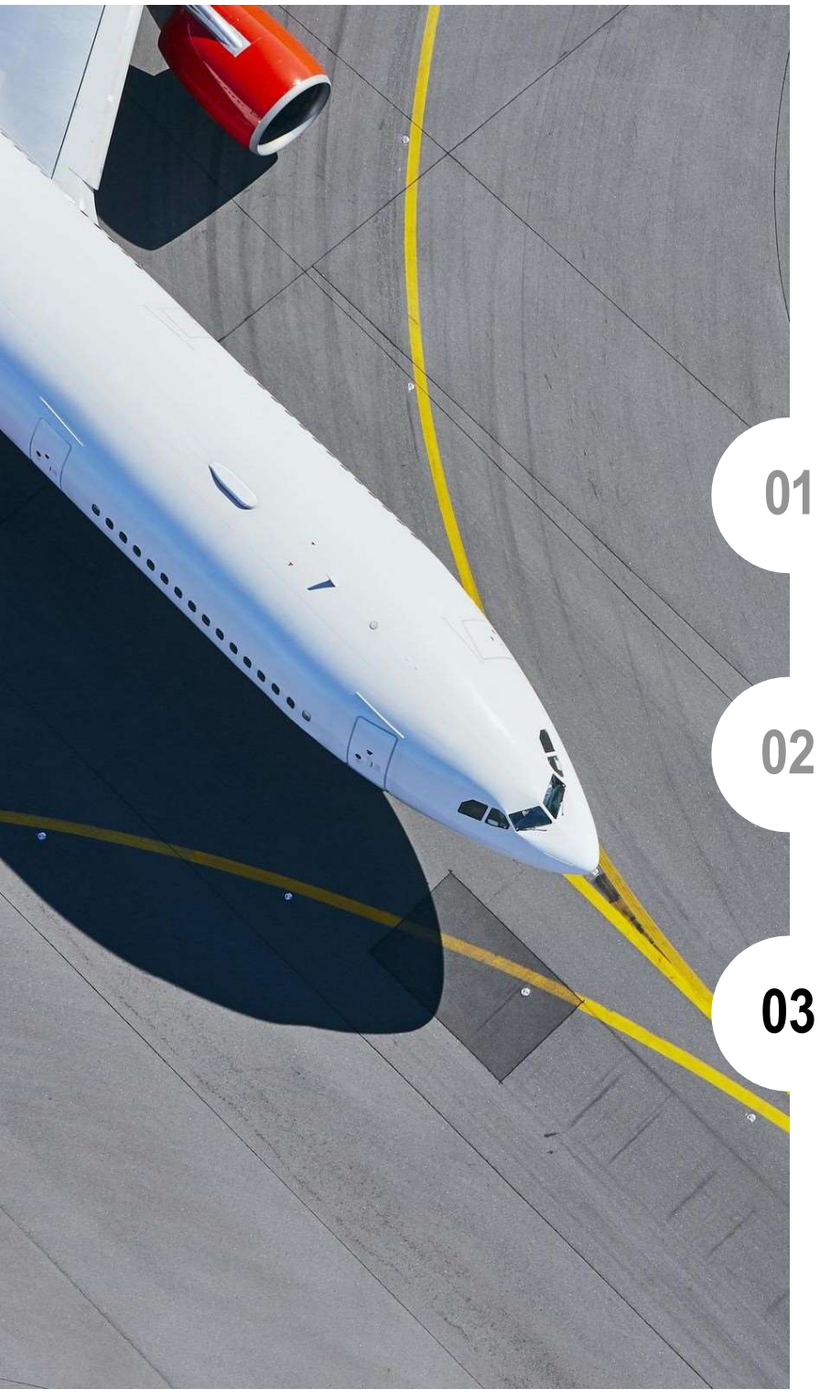
			Typical impacts observed		
1		**Forecasting and Inventory Steering**	**−15-20%** Inventory value	**+5-10%** Supplier OTIF	**−7-13%** CRO costs
2		**Logistics and Warehousing Footprint**	**−8-12%** Warehouse cost	**−10-15%** Logistics costs	**+4-8%** Service OTIF
3		**Integrated supply chain risk and resilience**	**+40%** Parts availability	**>98%** On-time-in-full	

- Leverage AI-based forecasting to forecast C&E demand and component repairs
- Adjust stocking levels/locations to overall reduce inventory and increase availability
- Improve collaboration with suppliers

- Review central warehouse locations and optimise logistic flows
- Renegotiate logistic services to gain more control & transparency

- Map of supplier network beyond tier 1 suppliers (i.e., tier 2, 3, …)
- Risk identification and assessment
- Implement risk mitigation strategies

1. Overall equipment effectiveness = share of production time that is used for production (i.e., excluding down-times for maintenance, equipment changes, etc.)



CONTENT

EMERGING AND INNOVATIVE TECHNOLOGY TRENDS: EARLY ADOPTION

MRO IT Modernization

Replace legacy systems with modern MRO IT solutions that offers improved configuration control, mobility solutions, and allows for future innovation

augmented AMTS

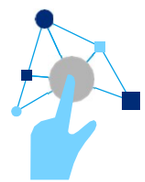
Enable higher AMT time on tools by improving decision making, reducing tedious data entry and research

Next Generation Training

Provide engaging, interactive, and relevant training experiences in augmented and virtual reality

ML/technology enabled inventory availability

Use analytics and ML to support data-driven decisions for material forecasting and inventory management



Data Excellence

Proactively monitor and maintain data integrity using AI-assisted techniques and automated workflows

Sustainability carbon tracking

Track supply chain and operations emissions

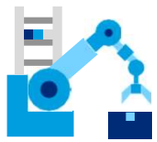
EMERGING AND INNOVATIVE TECHNOLOGY TRENDS: INNOVATION AND RESEARCH

Interconnected Workforce

Provide centralized remote support capabilities and enable peer-to-peer knowledge sharing

Dynamic & supervised (AI) Planning

Iterate & adapt maintenance plans continuously, optimizing for MX. coming due, parts, labor, and flight plan



NEXTGEN Warehouses

Deploy robots to automate and streamline routine warehouse operations

Adaptive MX Programs

Adaptive optimization of maintenance programs, leveraging ML-enabled reliability analysis, IoT sensor data, and optimal packaging

Smart Records

Build core data infrastructure to fully remove manual records validation/and adjustment processes

EVOLVING Workspaces

Rethink workspaces to allow for rapid “retooling” and provide greater support to AMTs

Active MX Mgt. system

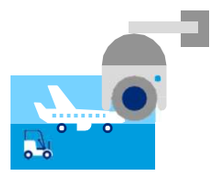
Implement real-time oversight and maintenance tracking solutions to drive work visibility, accountability, and efficiency

Mobility 2.0

Digitize capabilities to fully remove paper-based processes and enable active checks & balances

MX operation digital twin

Digitally replicate the airline’s operation in real-time and allow concurrent scenario analysis and optimization



INHERENT Safety

Utilize supervision technologies to ensure comprehensive protection and create a safer environment

THANK YOU FOR YOUR ATTENTION; NOW FOR Q&A…….AND A SHAMELESS ADVERT

Q&A

In case of interest, annual publications for anyone in aviation and aftermarket…..

At https://www.oliverwyman.com/our-expertise/insights.html

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