

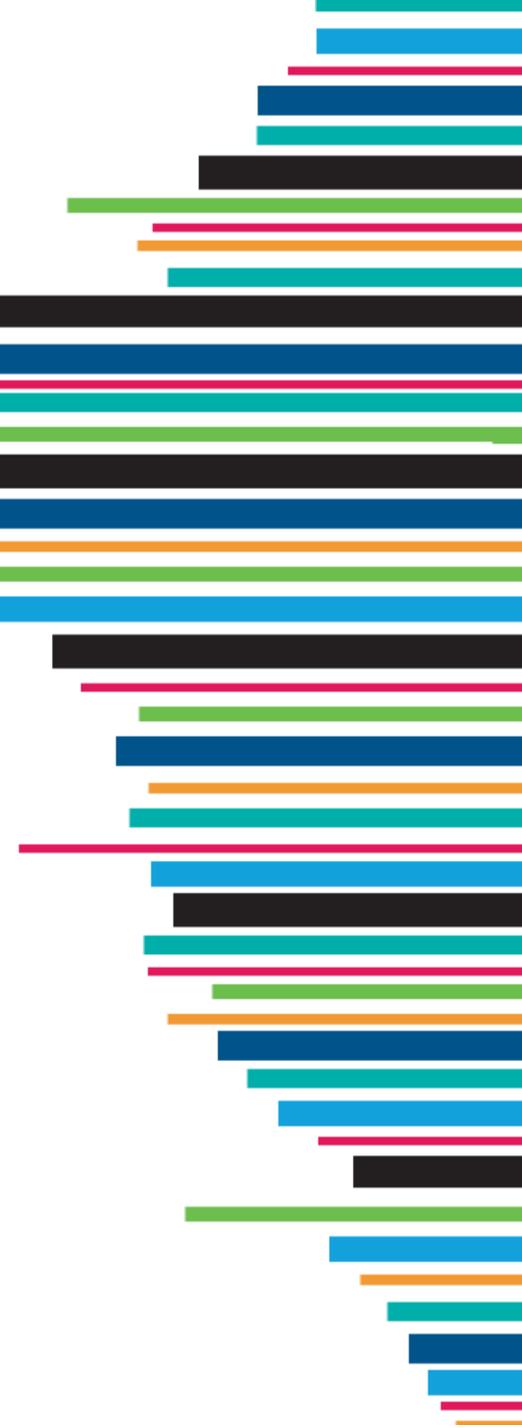
13th MAINTENANCE COST CONFERENCE
SEPTEMBER 13-15
Panama City, Panama **2017**



AIRCRAFT HEALTH MONITORING

The True Value of Aircraft Health Monitoring and
Data Management

14 September 2017



Agenda

Market Trends

MRO Forecast

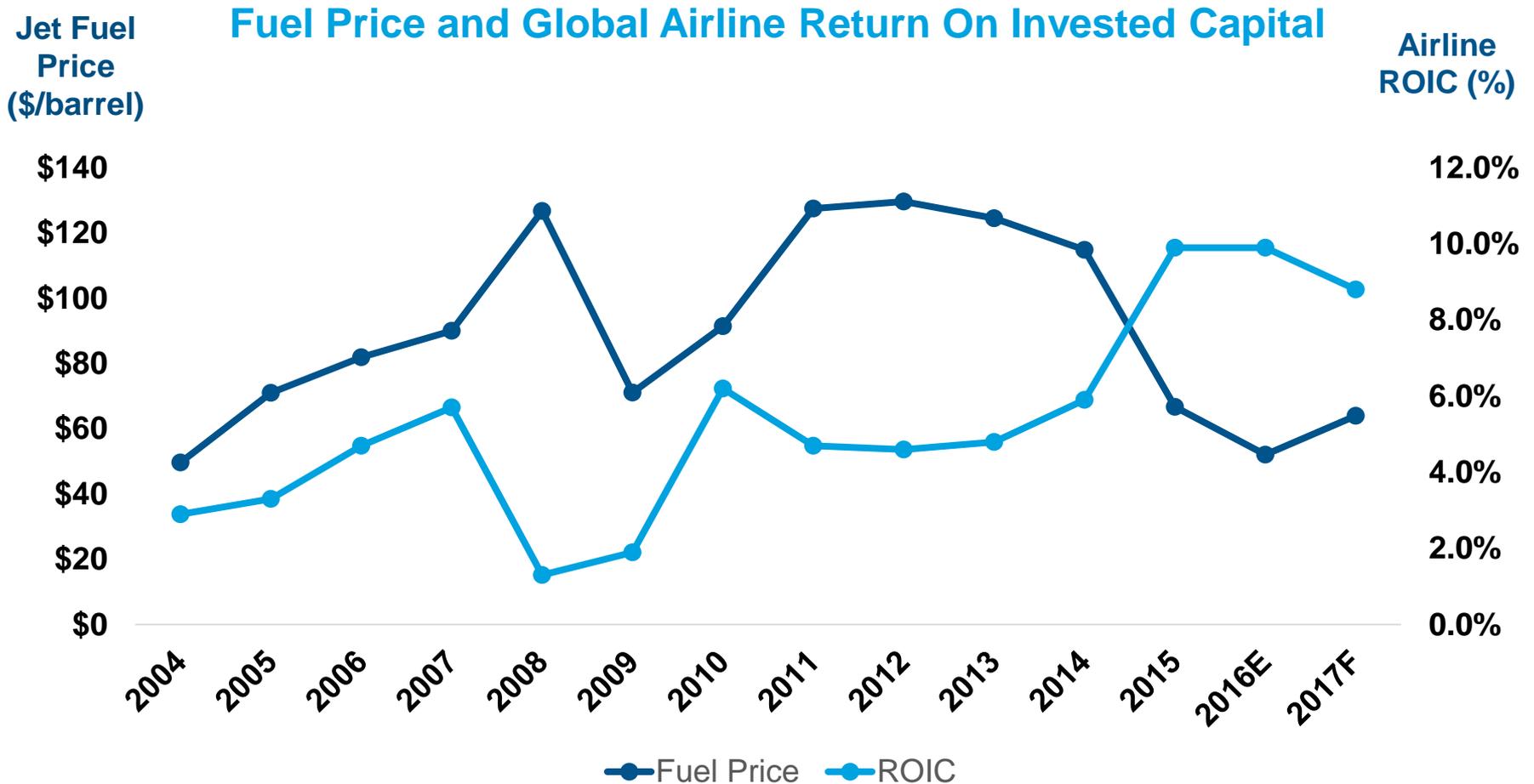
New Technology Aircraft

Benefits for the Airline

Market Trends



Airlines are achieving historically high return on invested capital (ROIC) levels – there’s an evident correlation with changes in fuel costs



Source: IATA, ICF Analysis

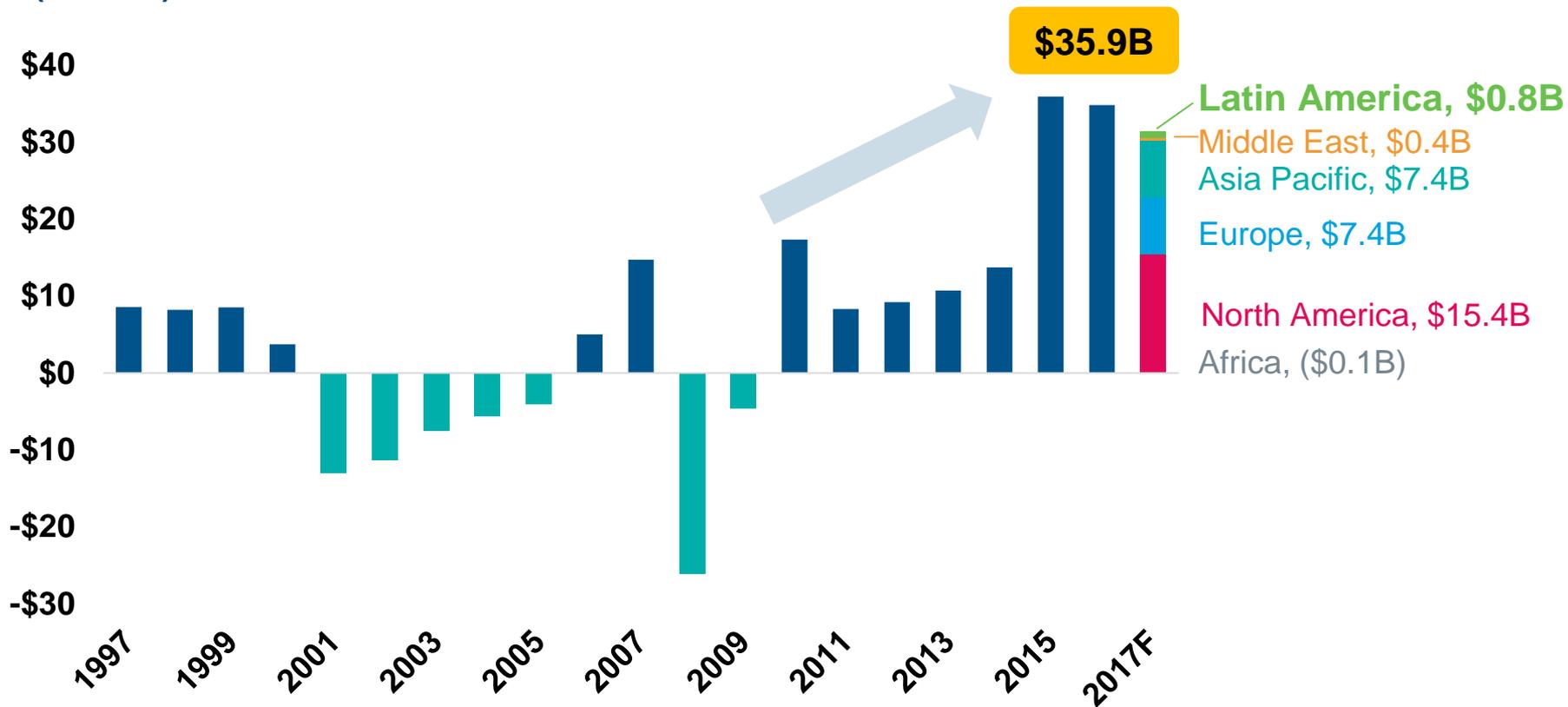


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The global airline industry achieved record profitability over the past years, driven by low fuel prices and greater cost control

Global Airline Profitability, 1997-2017F

\$USD (Billions)



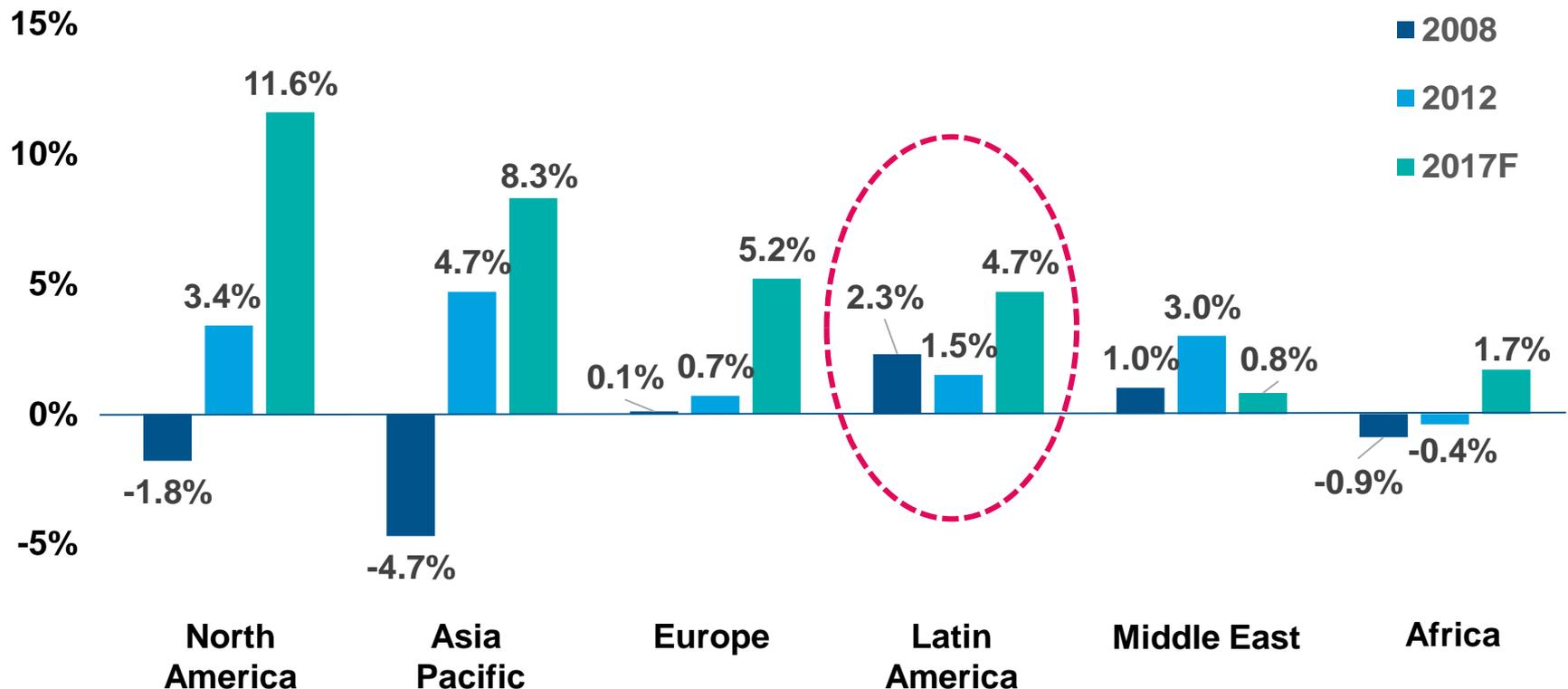
Source: IATA, ICF Analysis



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Latin America has seen modest but stable profit margins over the past decade

Global Airline EBIT Margin by Region



Source: IATA, ICF Analysis

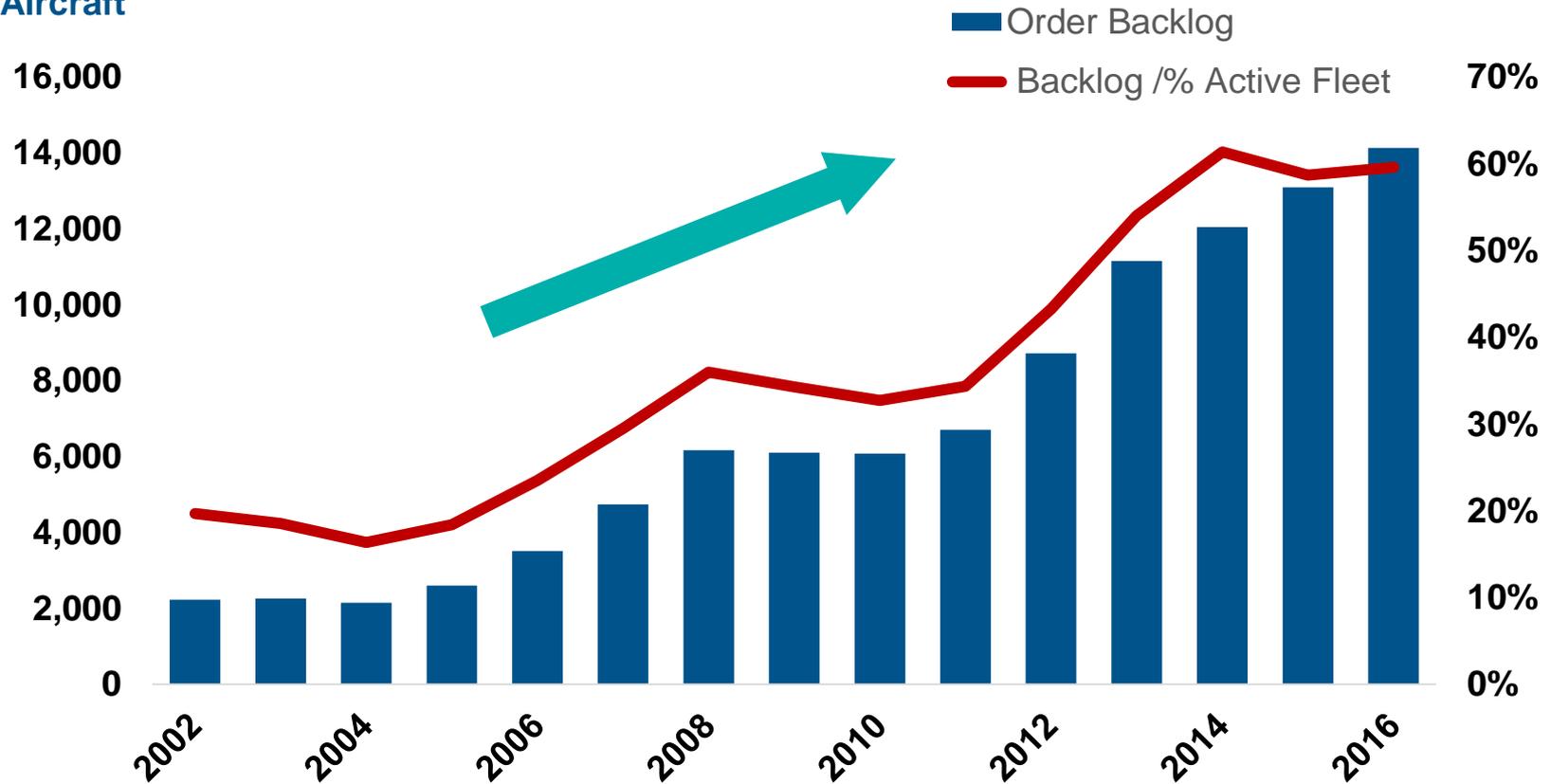


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Commercial aircraft OEM production backlog remains at historical highs...

Commercial Aircraft OEM Production Backlog

Aircraft



Source: CAPA, ICF Analysis



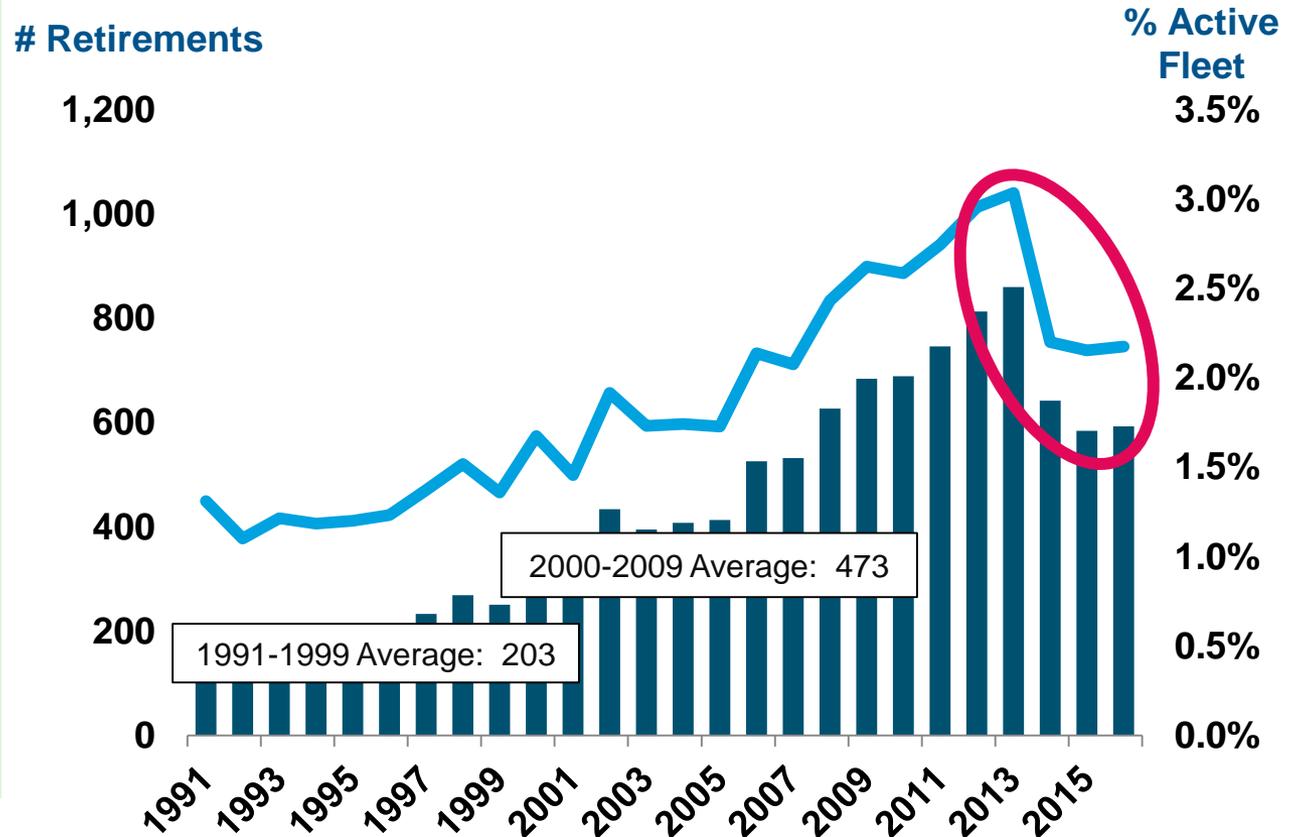
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... and more stable fuel costs have slowed aircraft retirements

Commercial Annual Aircraft Retirements

Potential Impact:

- Reduced part-out feed stock for surplus market
- Mature aircraft being placed with new operators
- Increase in airframe and engine MRO spend on older airframes
- Improved new parts sales
- Higher used part values/pricing



Source: CAPA, Airline Monitor, ICF analysis



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The outlook for Latin America's aviation industry is starting to brighten as economies recover

Aviation Outlook:

- *Economic growth remains weak, driven by uncertainty and geopolitical events*
- *Three LCC carriers have launched this year, bringing total LCCs to over 10*
- *Additional LCCs have been announced*
- *High taxes on air travel and airport duties hinder market growth*
- *Infrastructure constraints*

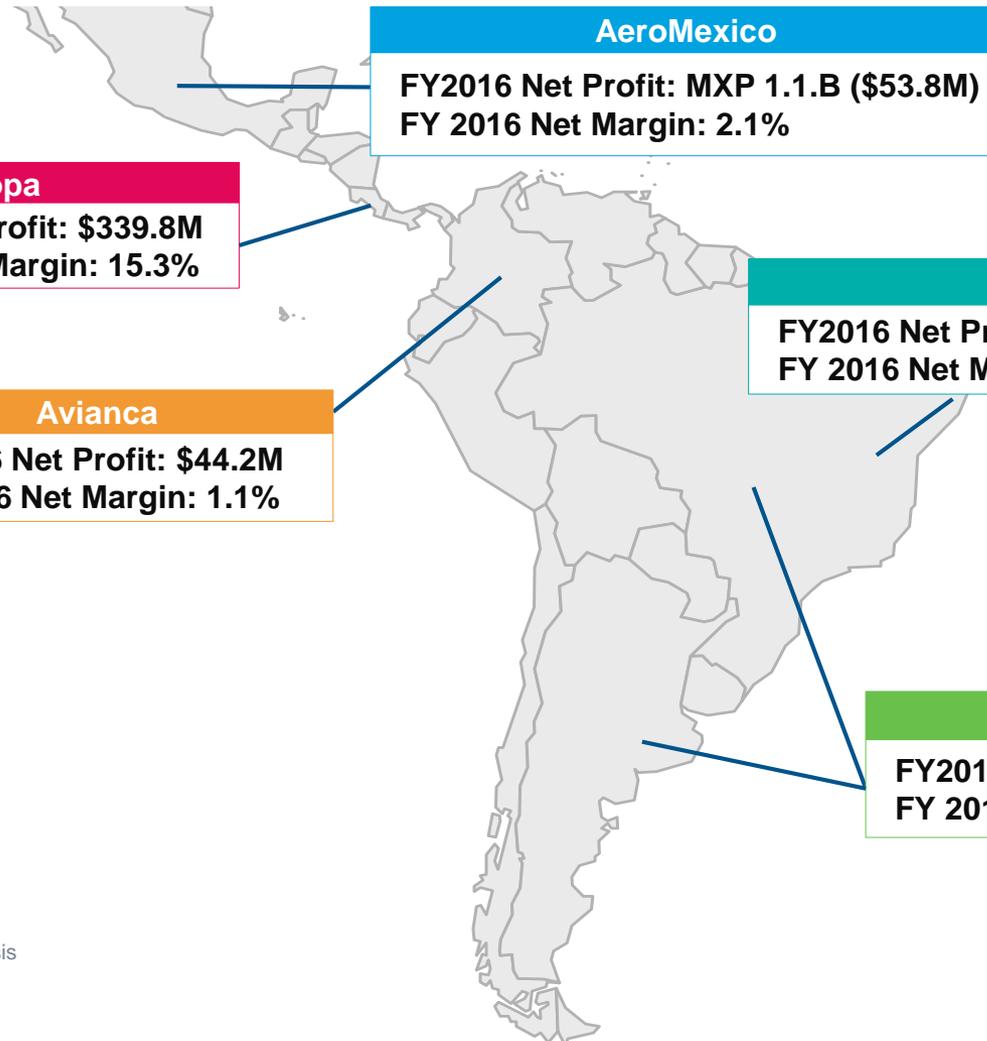


Source: ICF Analysis



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...and carriers are beginning to reverse losses and earn profits



Source: IATA, Company Filings & ICF analysis



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MRO Market

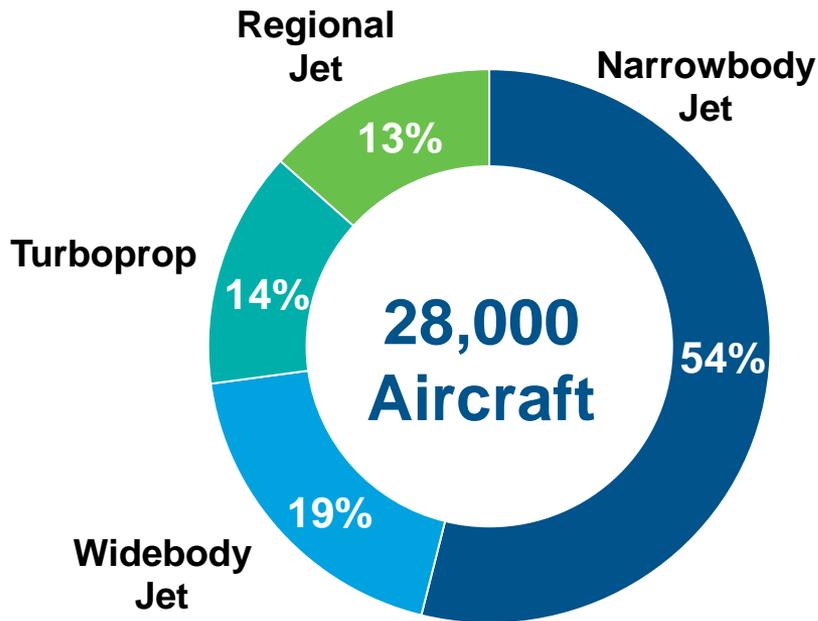
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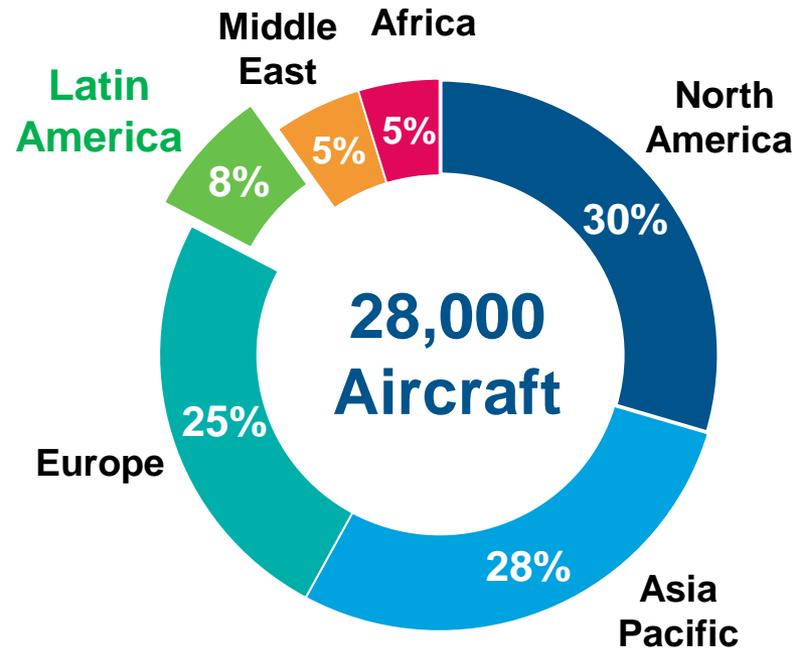
The current commercial air transport fleet consists of ~28,000 aircraft; ~2,000 are located in Latin America

2016 Global Commercial Air Transport Fleet

By Aircraft Type



By Global Region



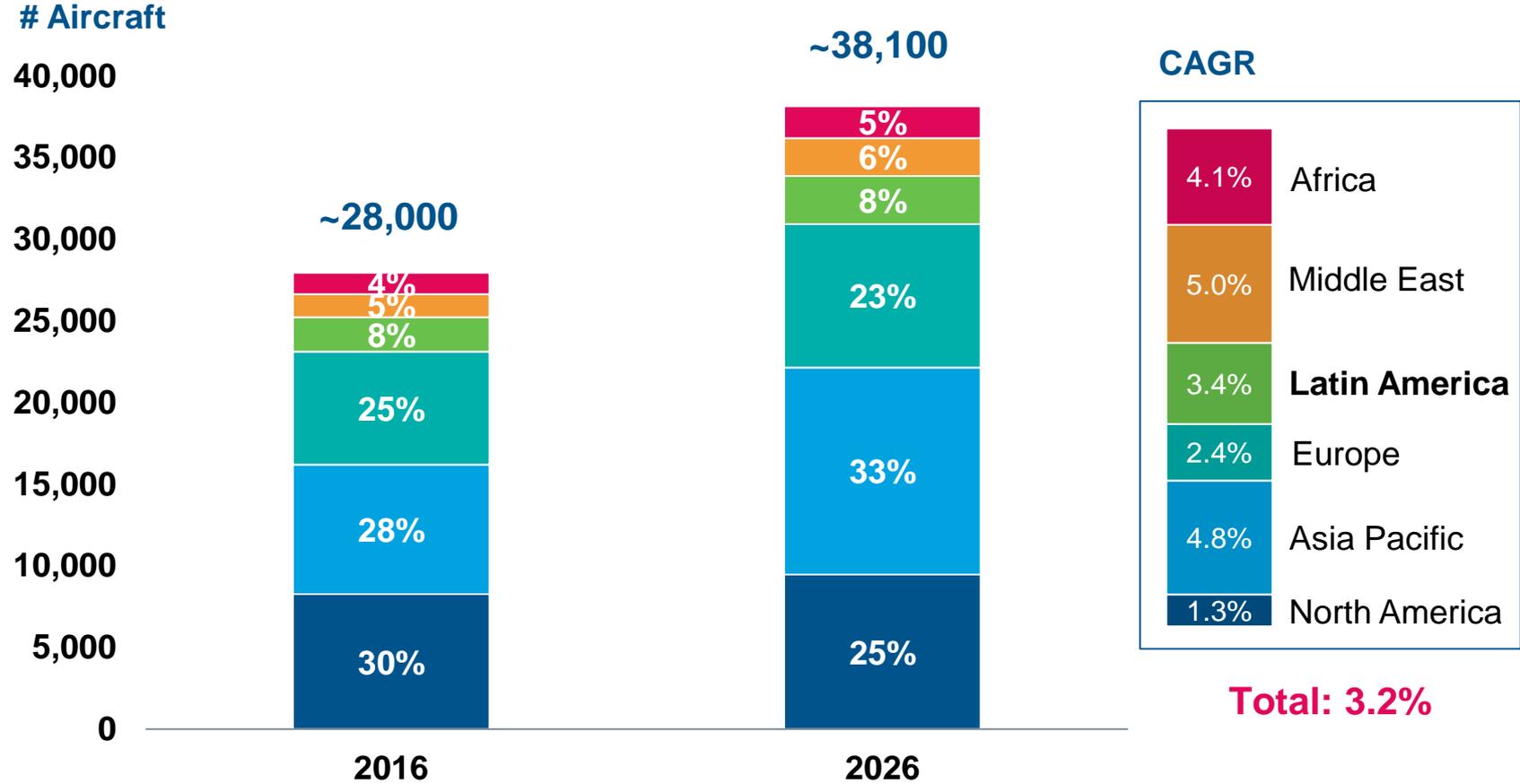
Source: ICF, CAPA 2016



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The combination of strong air travel demand and the need to replace ageing aircraft will drive fleet growth at a healthy 3.2% p.a.

10-Year Global Air Transport Fleet Growth



Source: ICF, CAPA 2016

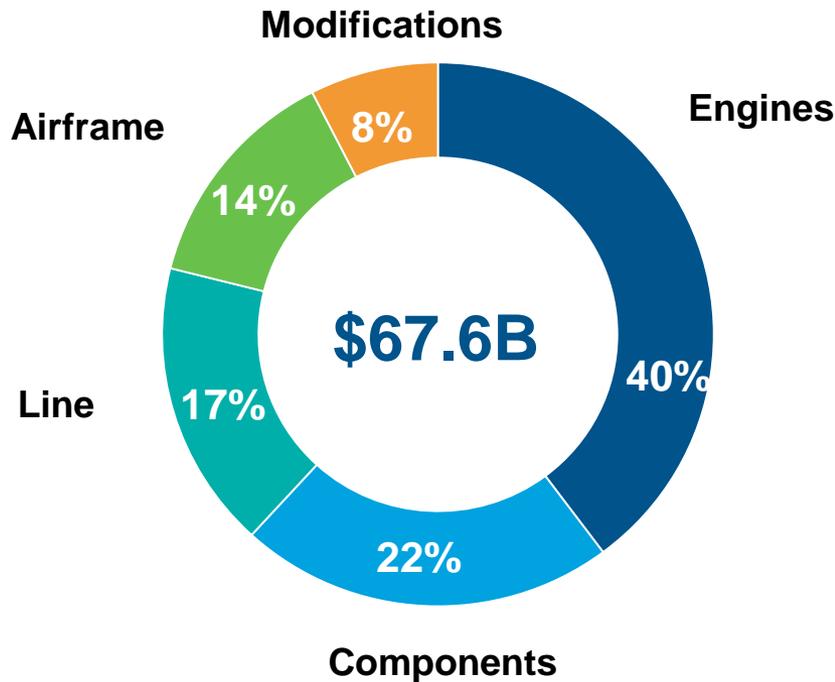


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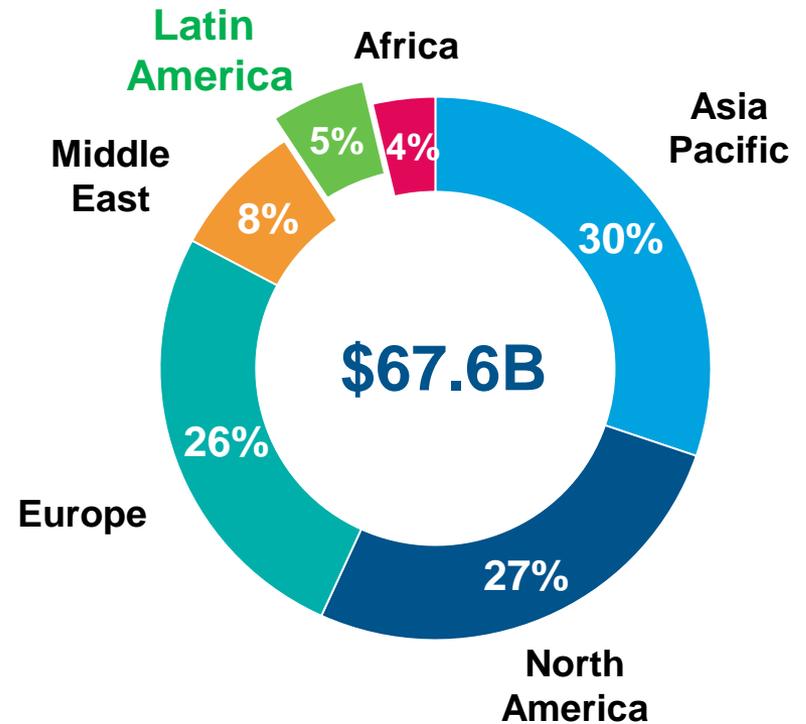
2016 commercial air transport MRO demand is \$67.6B; Latin America has ~5% of the market

2016 Global MRO Demand

By MRO Segment



By Global Region



Source: ICF, CAPA 2016, Constant 2016\$

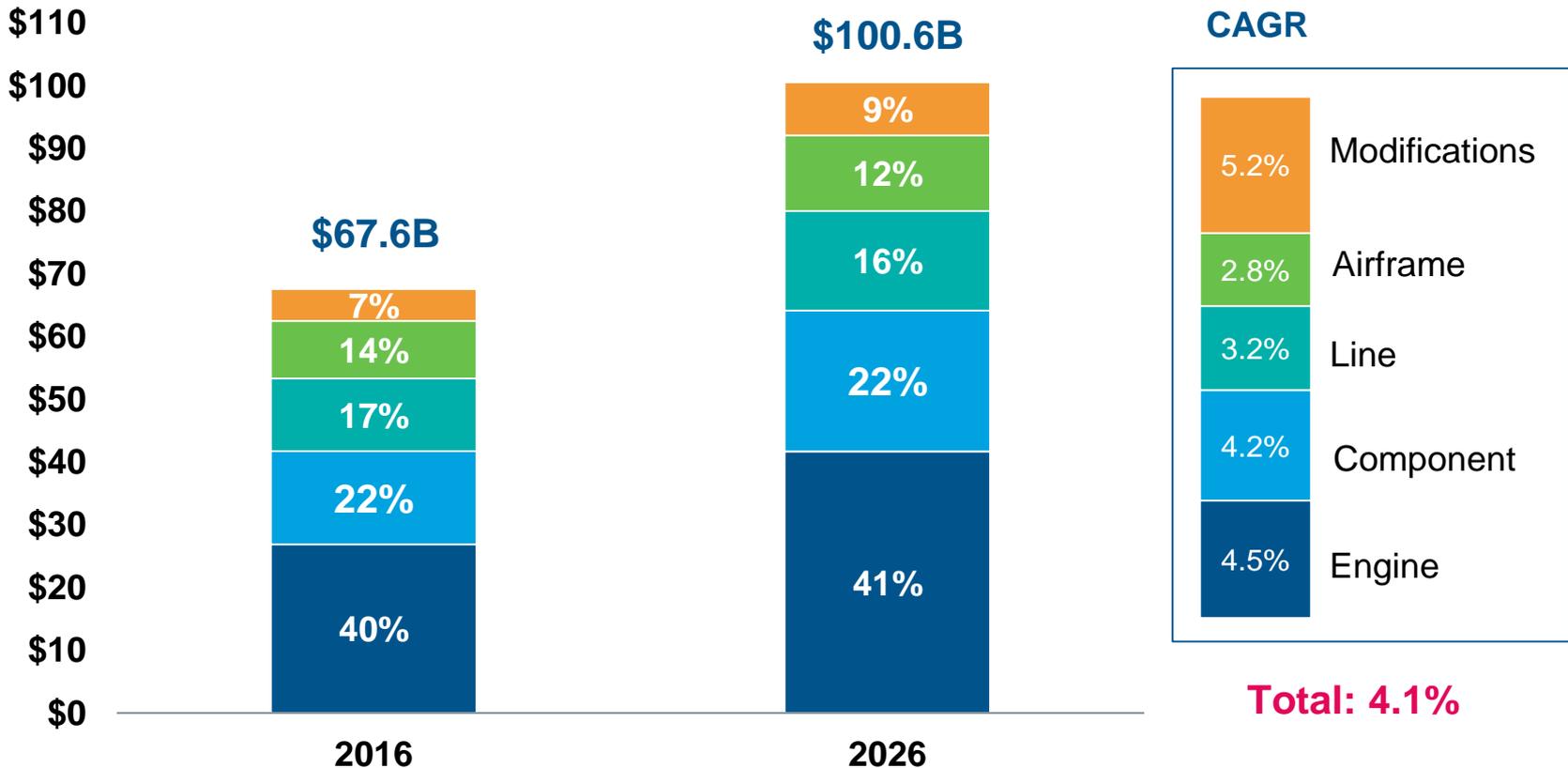


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The global MRO market is expected to grow by 4.1% per annum to over \$100B by 2026

10-Year Global MRO Demand Growth

\$ USD (Billions)



Source: ICF, CAPA 2016
Note: Constant 2016\$

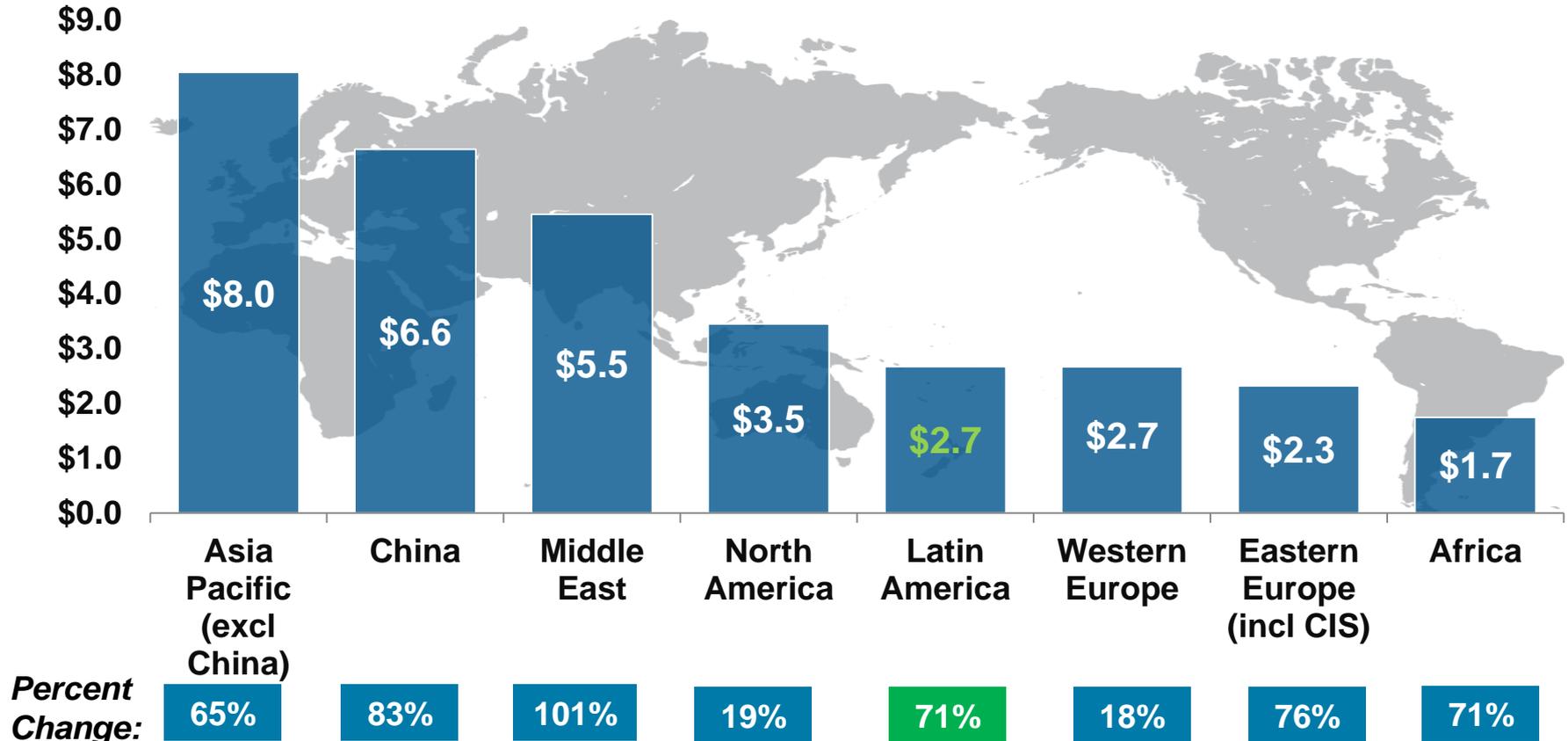


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Over the next decade, Latin America will see ~\$2.7B increase in MRO spend

Difference in MRO Spend, 2026 vs. 2016 –By Global Region

\$ USD (Billions)

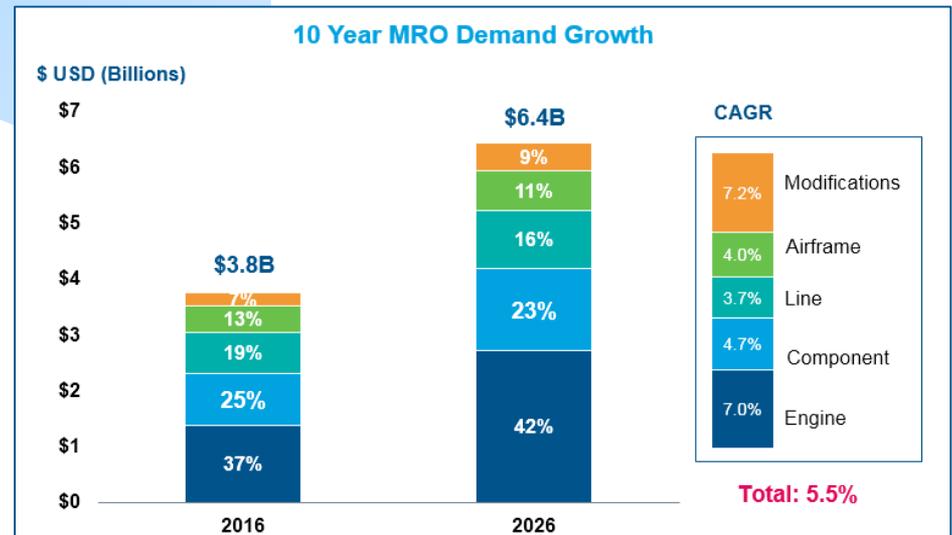
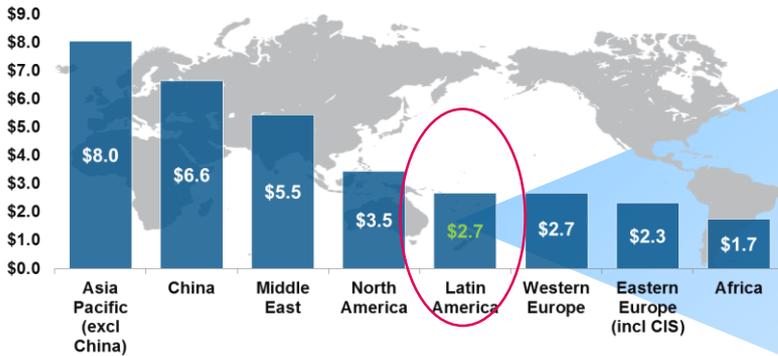


Source: ICF, CAPA 2016, Constant 2016\$



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2016 MRO market in Latin America is ~\$3.8B; Top 5 operator groups contribute over 50% of the MRO spend



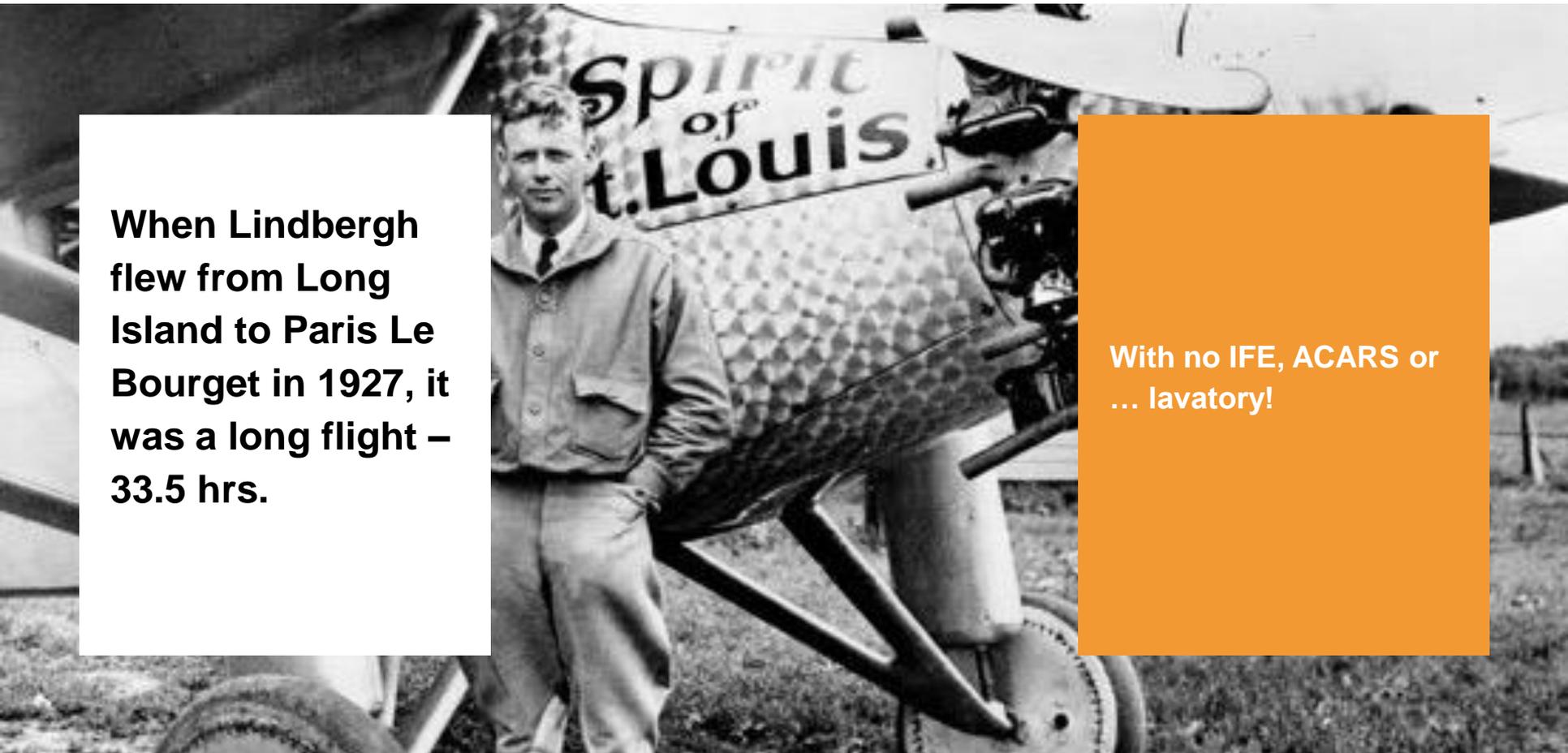
Source: ICF, CAPA 2016, Constant 2016\$



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**New
Technology
Aircraft**



When Lindbergh flew from Long Island to Paris Le Bourget in 1927, it was a long flight – 33.5 hrs.

With no IFE, ACARS or ... lavatory!



The “new technology” fleet is set to grow significantly

10-Year Fleet Forecast by Aircraft Generation

Aircraft

45,000

40,000

35,000

30,000

25,000

20,000

15,000

10,000

5,000

0

~28,000

~38,100

22,097

17,753

4,811

18,252

2,141

2016

2026

CAGR

-7.8%

New

-1.9%

Mature

32.7%

Old

Total: 3.2%

Old: First flight <1990s, e.g. A300/A310 / 747-1/2/3 / BAe146

Mature: First flight >1990s, e.g. 737CL / 737NG / A330/340 / 777 / E-Jet

New: First flight > 2005; e.g. 787 / A350 / A380 / CSeries / E-Jet E2

Source: ICF

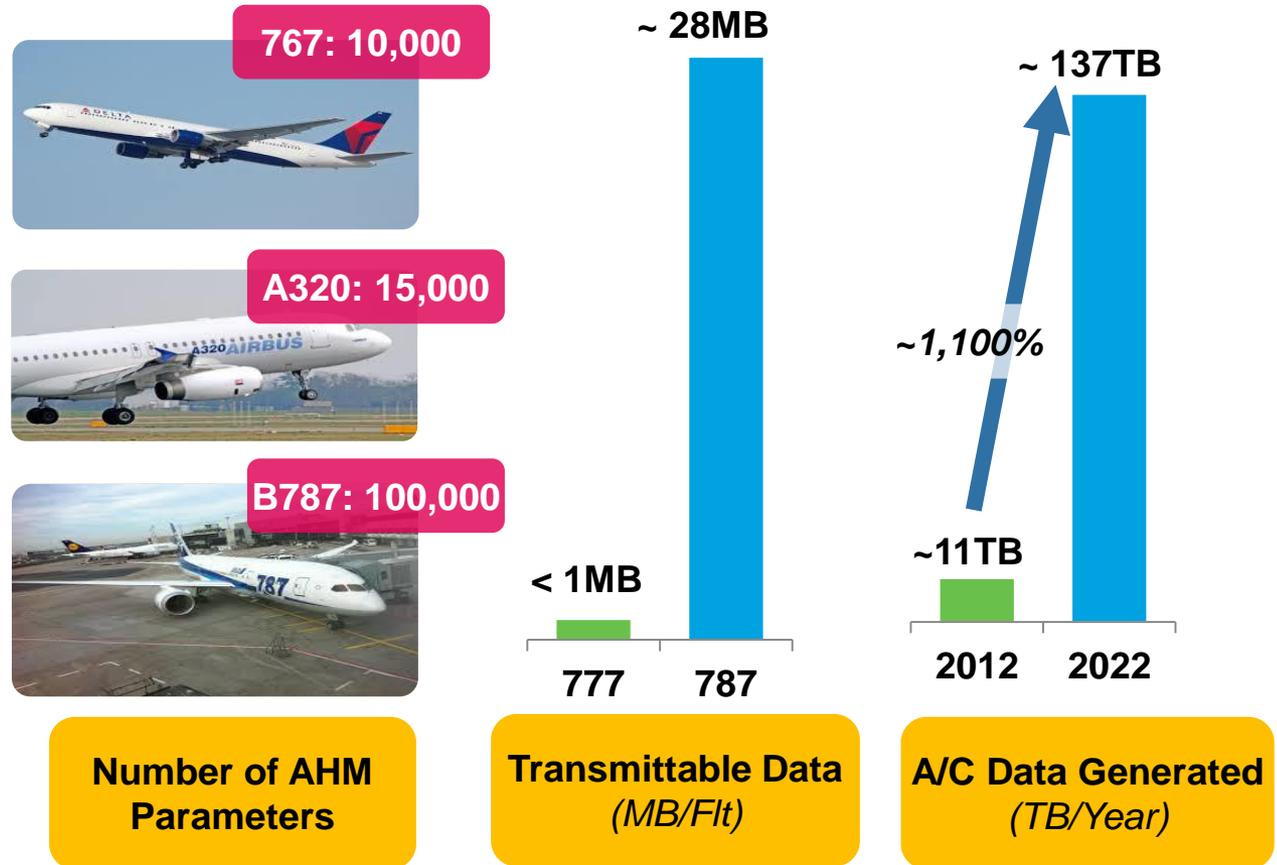


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Airlines need to understand how best to realize value from the terabytes of data generated by new technology aircraft

Stakeholder Battle:
Who will control and gain the most from the operating data IP?

- Operators
- Lessors
- OEMs
- MRO Suppliers



Source: ICF Research



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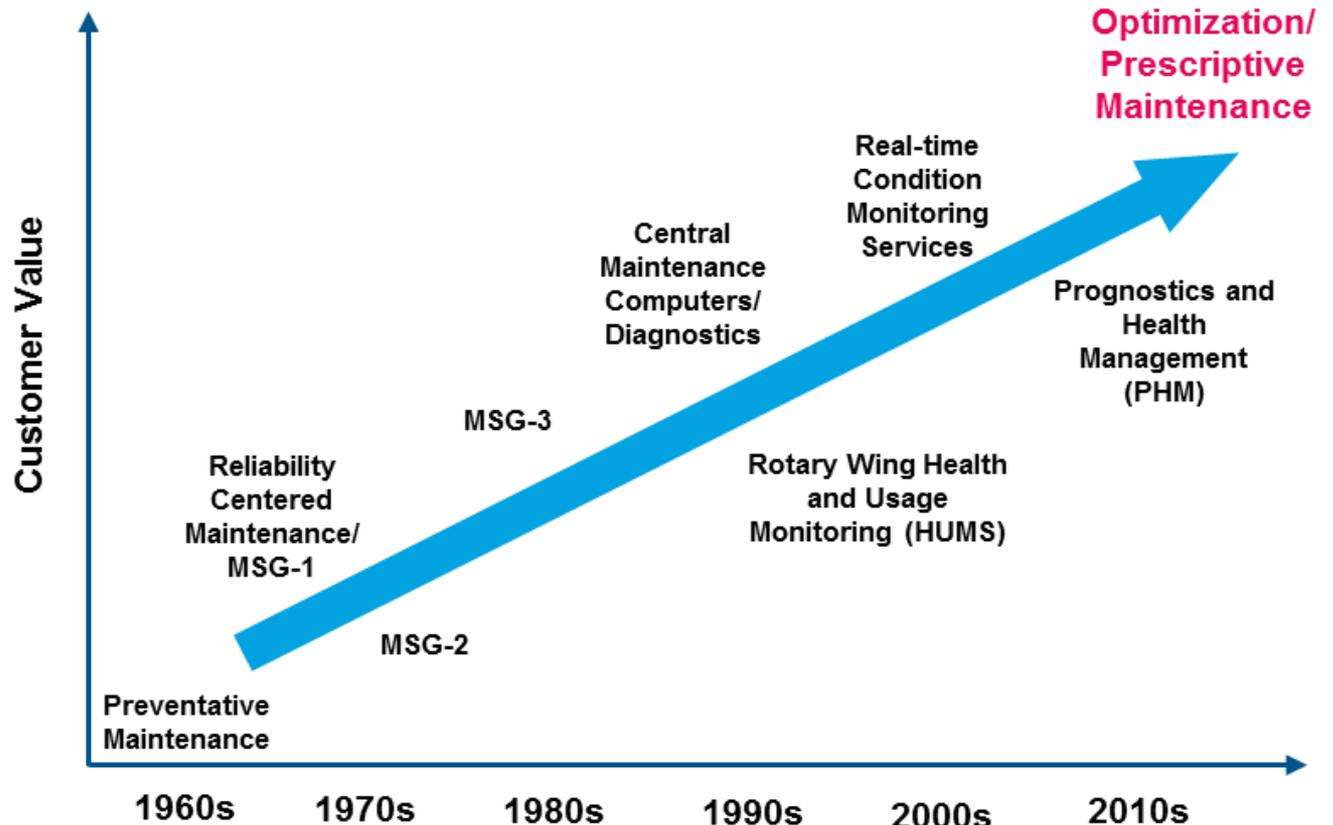
Today, AHM is being used by airlines and OEMs for reliability analysis & updating maintenance programs

Evolution of Aircraft Maintenance Approach

- Aircraft health monitoring
- Predictive maintenance
- Inventory optimization

Leading to...

- Improved aircraft availability
- Cost control



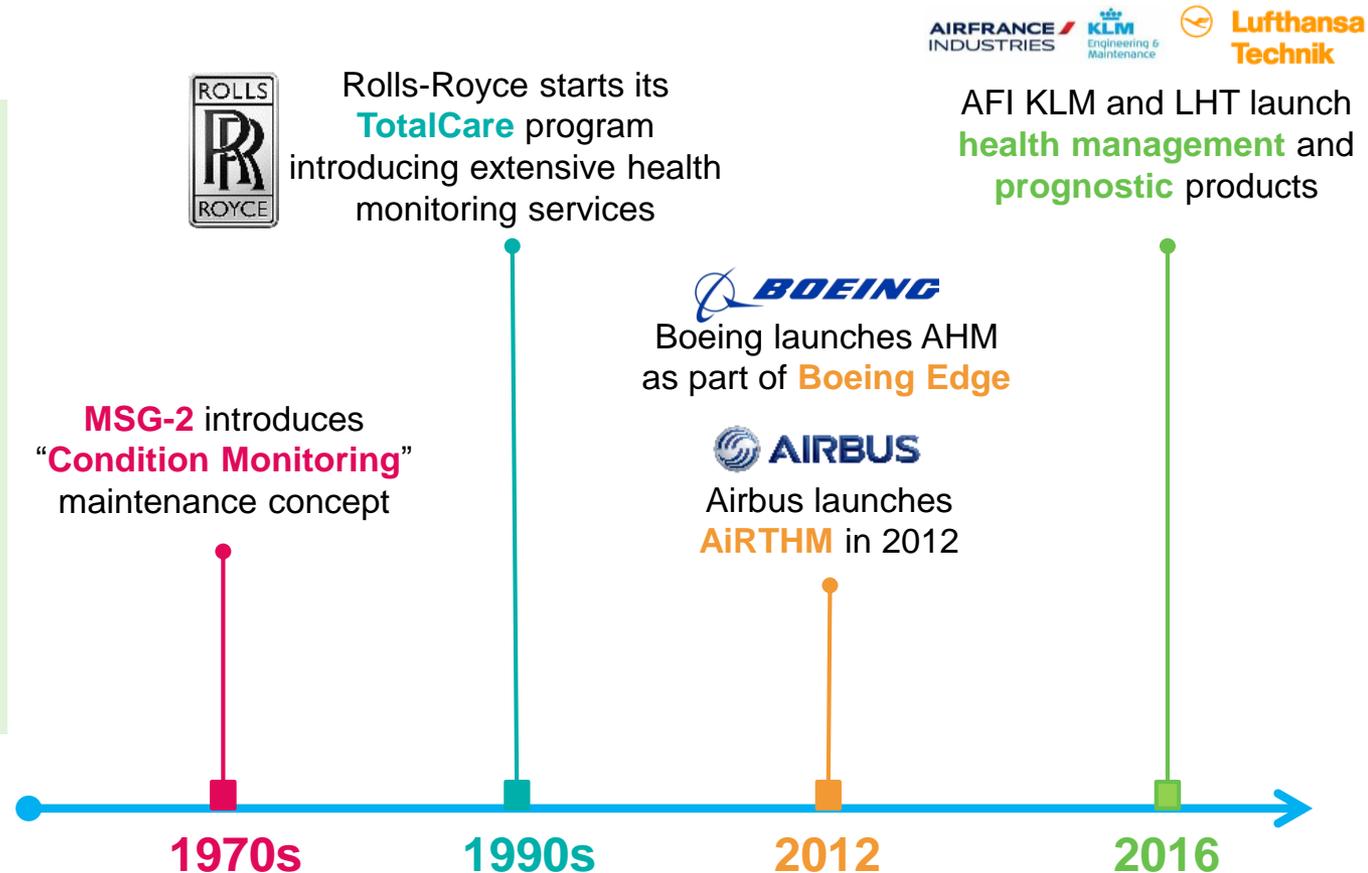
Source: ICF



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As AHM becomes a critical service, non-OEM players need to develop capabilities to retain competitiveness...

- Aircraft Health Monitoring has been around in various forms since 1970
- Rolls-Royce was the first OEM to provide extensive services as part of its TotalCare program
- Large MROs have also started to integrate the product in their services offerings



Source: ICF



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There are a number of structural trends affecting the maintenance data and health management market



Increased OEM
Aftermarket Focus



E-enabled Aircraft



Advancement in
Analytics



Large Volumes of
Data Processing

Source; ICF

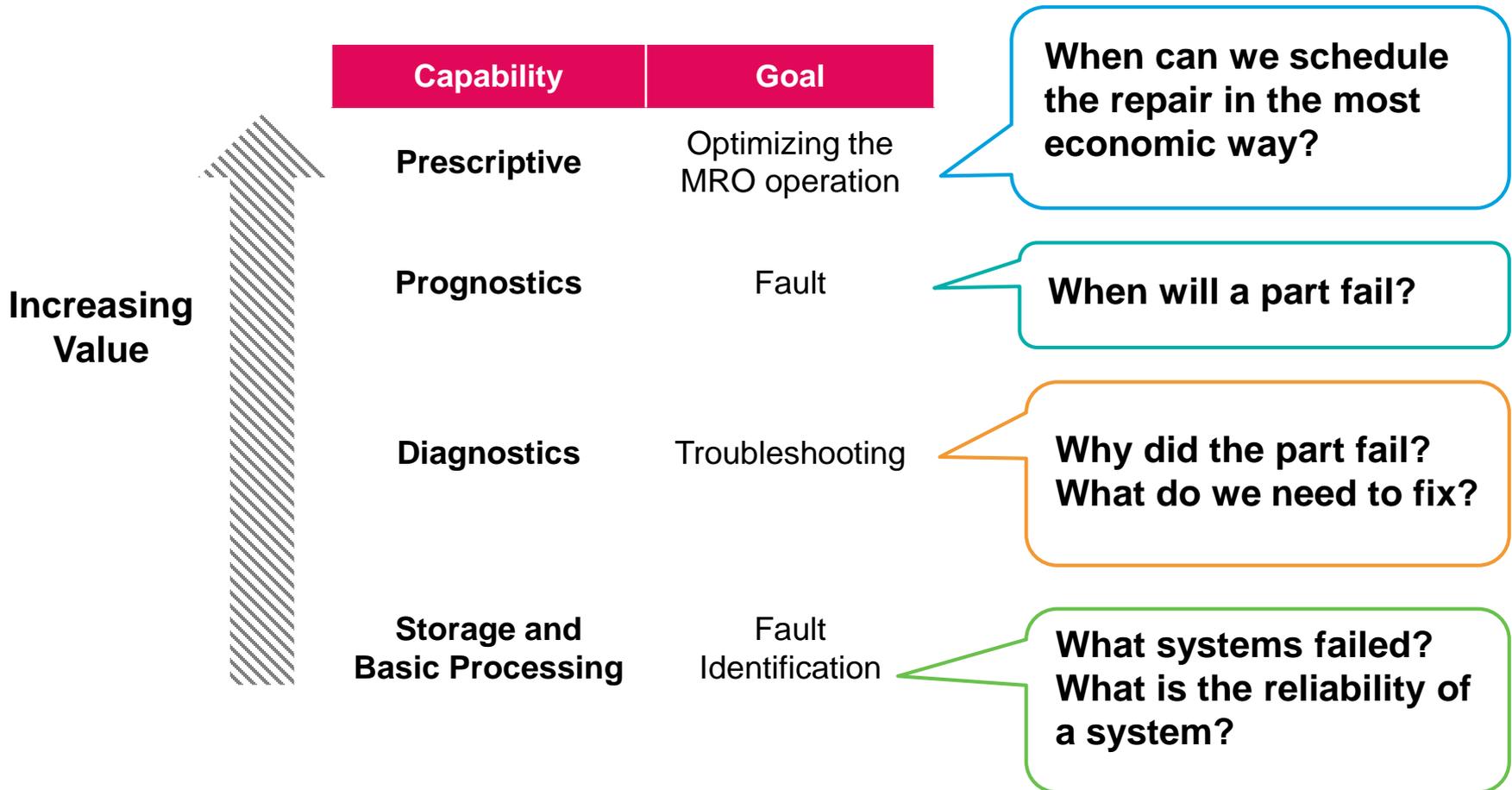


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**True benefits
for the airline**



Airlines can extract the highest value when operator not only predicts the issues but can allocate resources in an optimal way



Source: ICF



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For airlines, improved technical dispatch reliability and fewer NFFs are the key benefits of AHM

ICF sees 4 main categories of benefits for airlines:



Technical Dispatch Reliability: Increased dispatch reliability



No Fault Finds: Reduction in unnecessary removal of functional components



Inventory: Spare parts held by airlines/MROs



Labor Productivity: Increased labor productivity

- *Airlines can optimize inventory by strategically distributing parts among maintenance centers and holding the right number of parts*
- *Improved monitoring can reduce time spent on finding faults*

Source: ICF Analysis



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THANK YOU

For questions regarding this presentation, please contact:

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ICF provides aircraft operators, manufacturers, financiers, lessors, and owners, maintainers, airports, and related businesses with world-class advisory, implementation, and improvement management consulting services.



Aerospace and MRO



ICF guides manufacturers, airlines, independent MROs, suppliers, and the financial community through every step of the aerospace and MRO supply chain to realize value and deliver strategies that drive growth. We understand and focus on the key aspects of the industry, and have the proprietary tools necessary for successful operations. Below, we briefly describe our core aerospace & MRO services and proprietary supporting products.

AEROSPACE AND MRO PRODUCTS

ICF's suite of proprietary aerospace & MRO tools, models, and databases helps stakeholders navigate key business challenges to their advantage.

Fleet & MRO Forecasts

Proprietary, independent forecasts for commercial and business aviation, industrial gas turbine, and military markets.

Value Database

Production value breakdown by component category and raw material content across the aerospace supply chain.

MRO Best Practices and Benchmarks

Comprehensive, proprietary databases on processes, costs, and organization.

ICF focuses on key aspects of the industry that drive value in both revenue growth and cost control.

Strategy Development

Leveraging years of aerospace and MRO advisory experience as well as proprietary market intelligence, ICF delivers data-driven, objective insight to underpin sustainable strategies.

Transaction Support

For clients' investment decisions, ICF combines global thought leadership in aerospace and MRO supply chain with accurate market intelligence, operations expertise, and unparalleled industry contacts.

Operations and Supply Chain

ICF's proven tools and methodologies offer improved performance and cost reduction across manufacturing, operations, and all phases of make-buy supply chain planning and execution.

MRO Business Improvement

For airlines, OEMs, and independent MROs, ICF has deep experience in comprehensive operational and financial diagnostics based on extensive proprietary benchmarks, followed by results-oriented improvement programs.

