



Big data; the race is on, but what is the end goal?

Joost Groenenboom

Principal

19 September 2018

14th MAINTENANCE COST CONFERENCE
SEPTEMBER 19-21
Atlanta - USA 2018





Agenda

- MRO trends
- Digital landscape
- Latest developments
- Summary





MRO trends

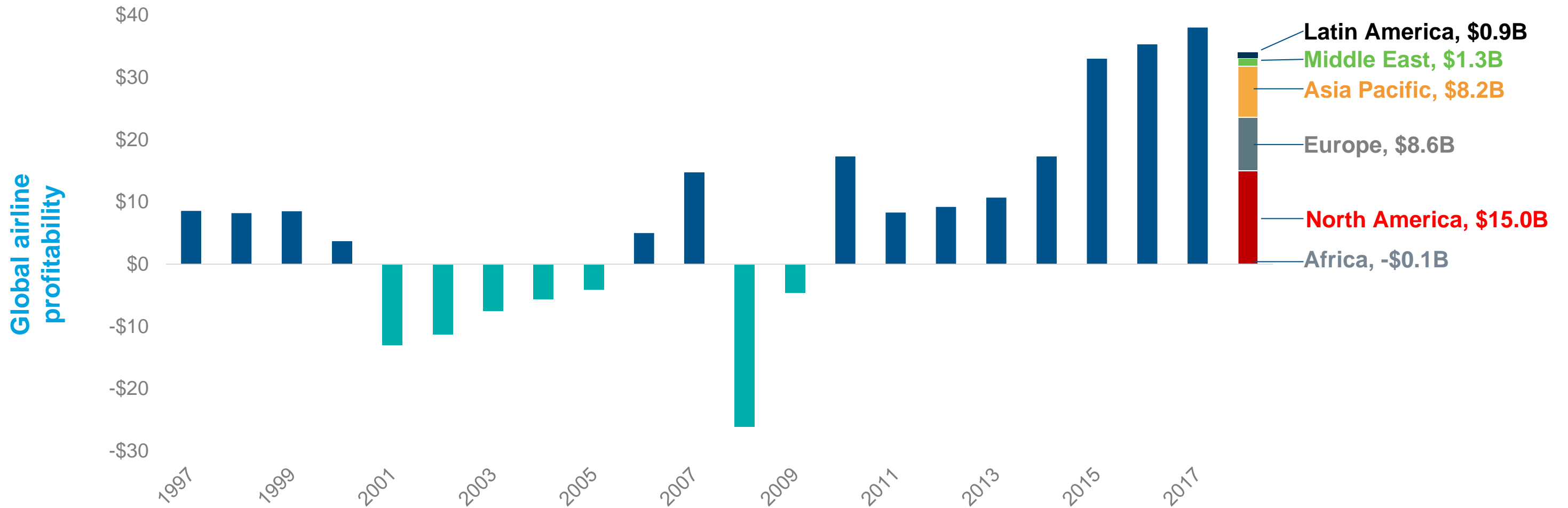


ICF proprietary and confidential. Do not copy, distribute, or disclose.

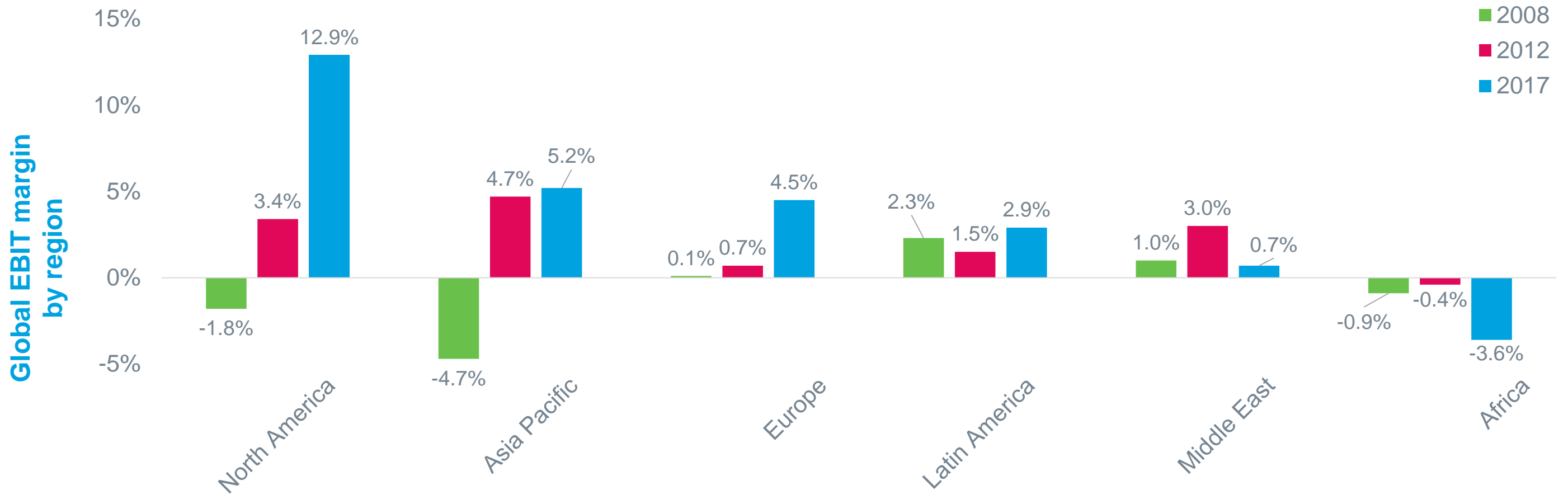
14th MAINTENANCE COST CONFERENCE
SEPTEMBER 19-21
Atlanta - USA 2018



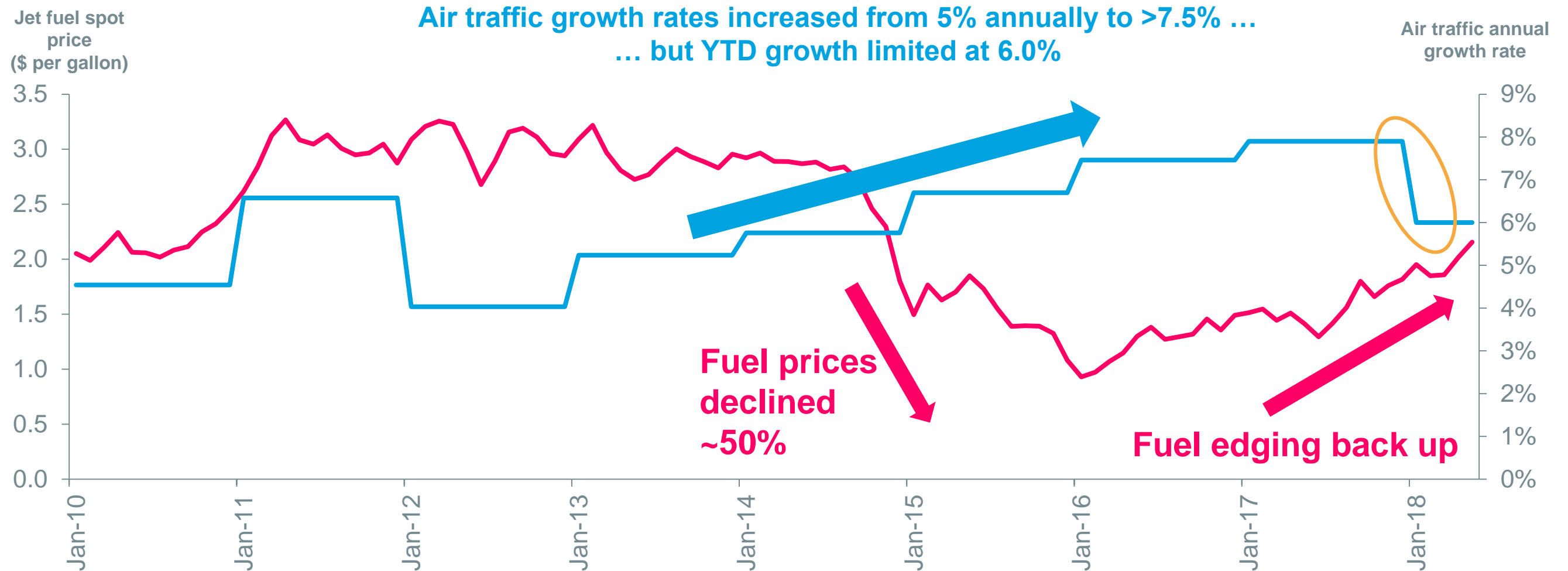
Global airline industry achieved a record profitability of \$38B USD in 2017, but this is forecast to decrease to \$33.8B in 2018



...but many areas continue to struggle although North America has been a bright spot and was leading the way in 2017

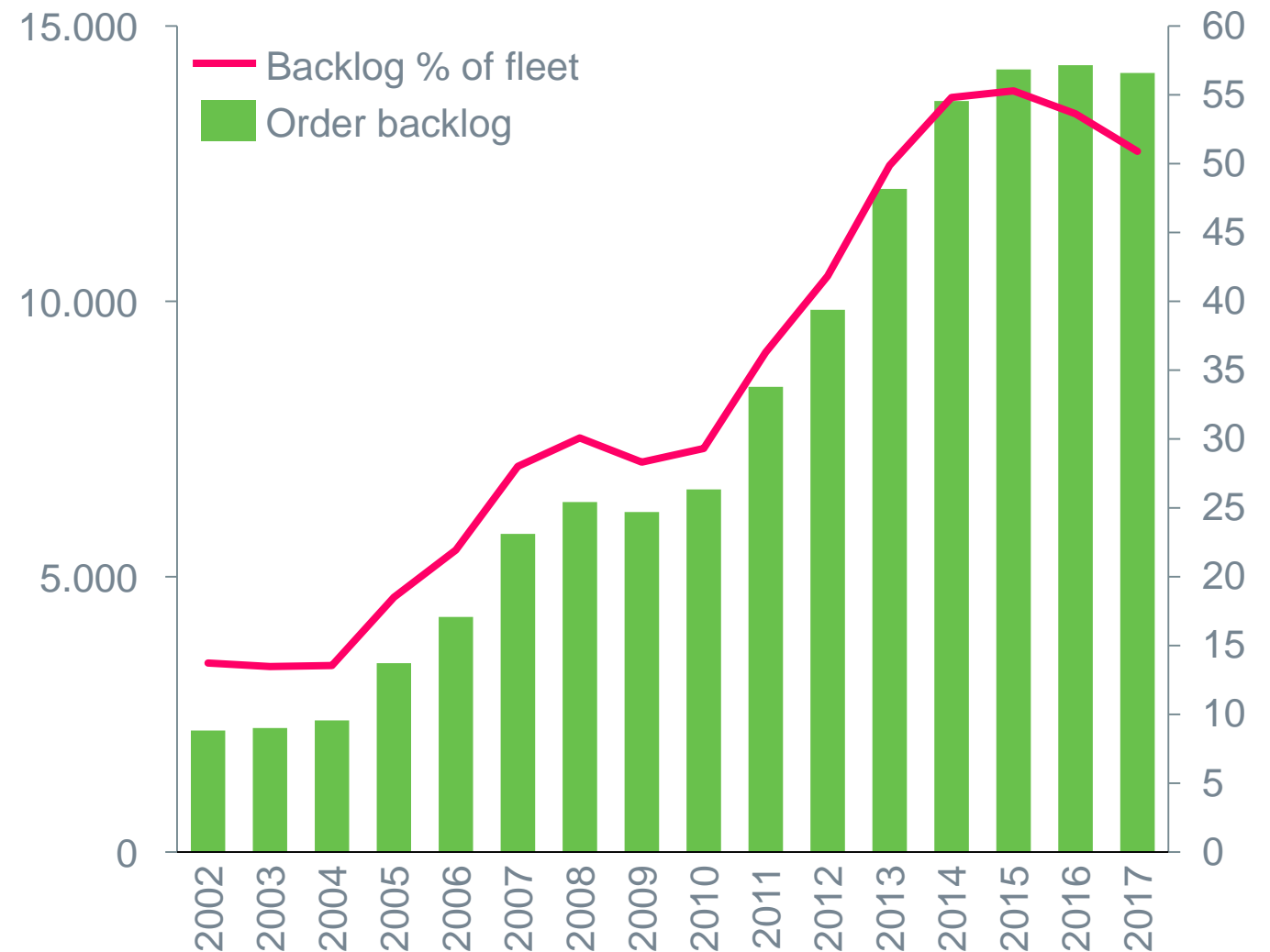


Traffic growth, driven by low fuel prices, is slowly reversing as 2018 has shown YTD growth of ~6.0%



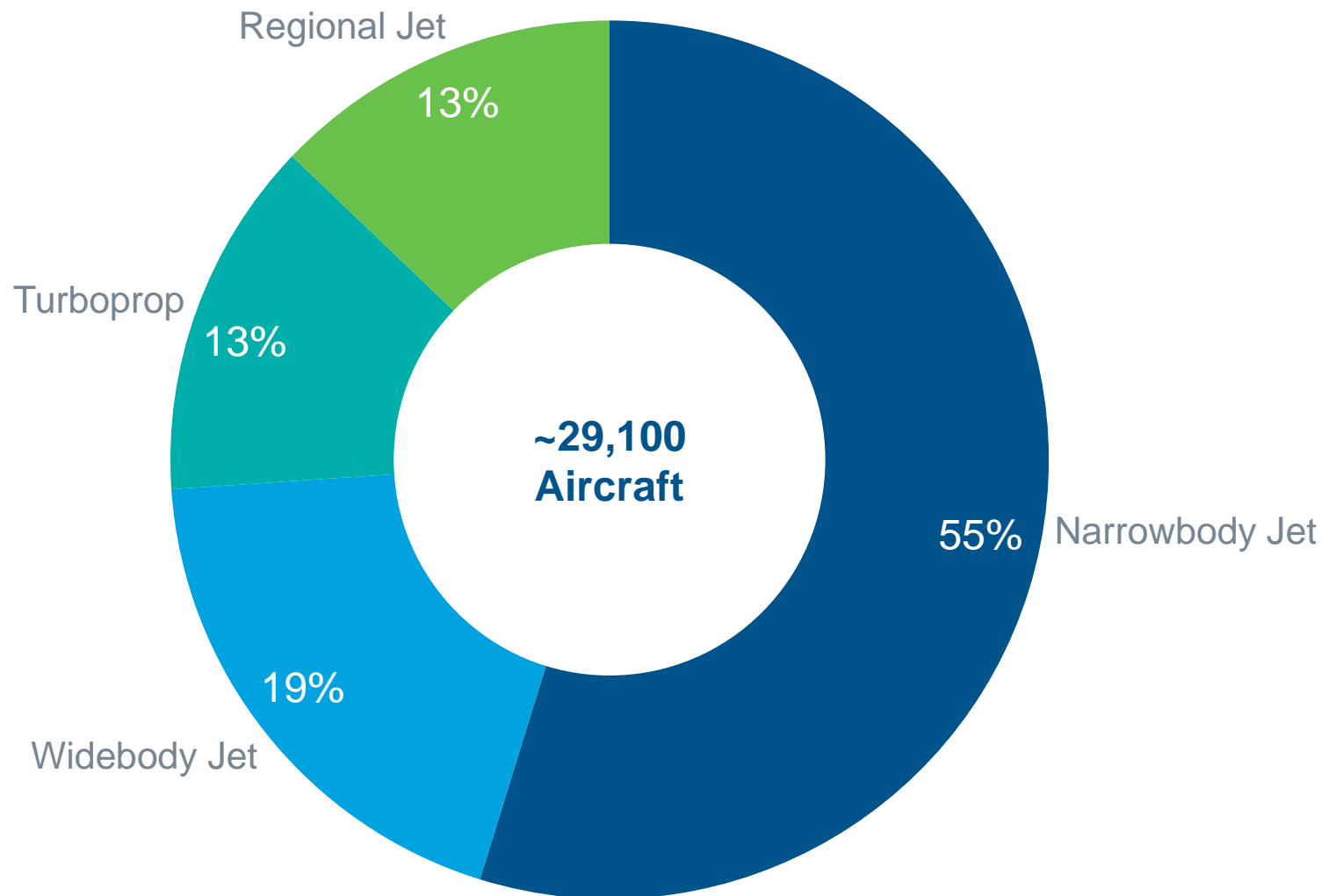
Commercial aircraft OEM production backlog remains at historical highs

- **Backlog more than doubled between 2010 and 2014, driven by:**
 - Emerging market growth
 - Very low interest rates and plentiful capital
 - High oil and commodity prices
 - Introduction of new technology aircraft/engines
- **In 2017, total backlog decreased for the first time since 2009 as deliveries ramp-up and orders slowdown**

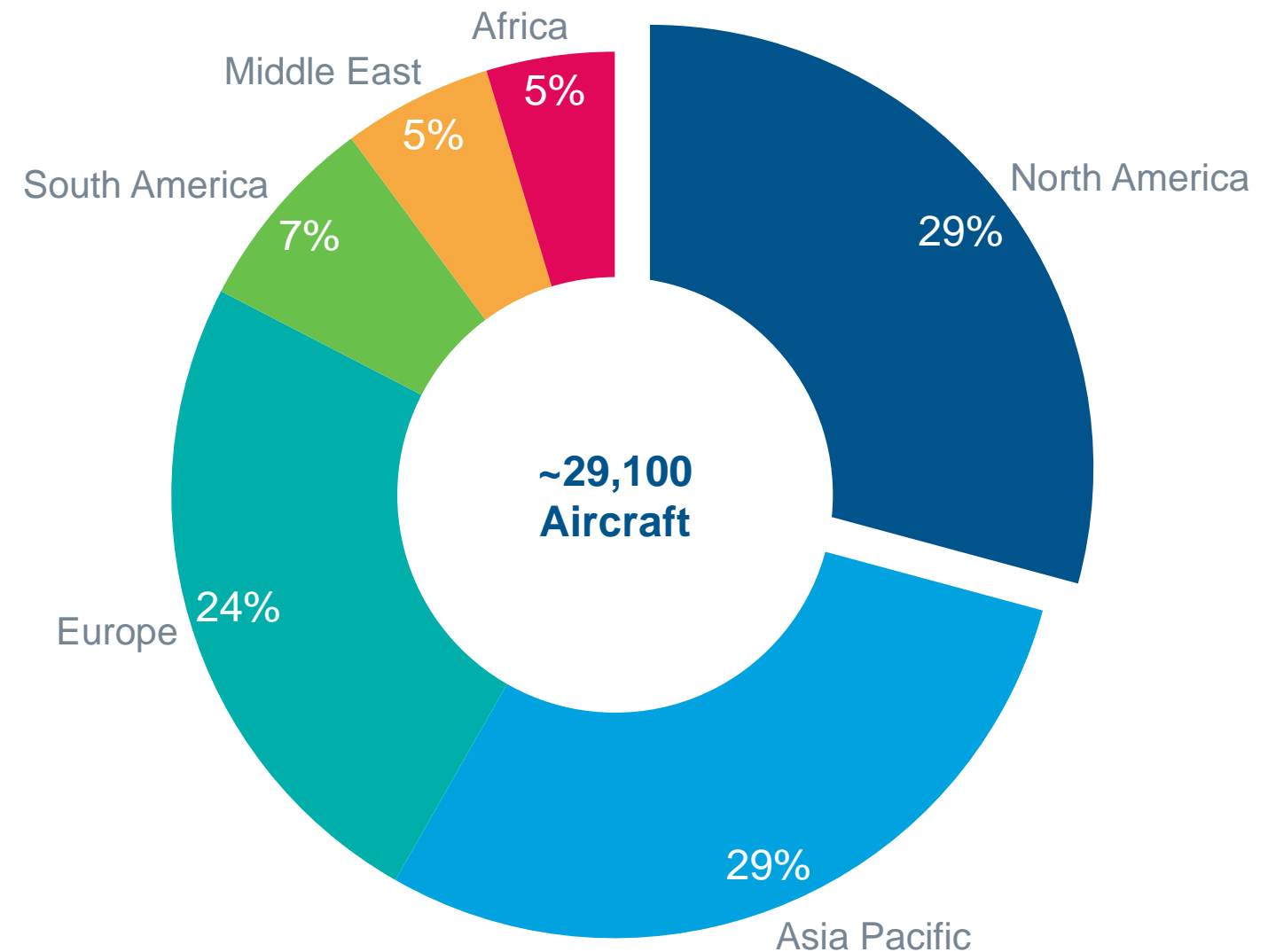


The current commercial air transport fleet consists of ~29,100 aircraft; ~8,500 are located in North America

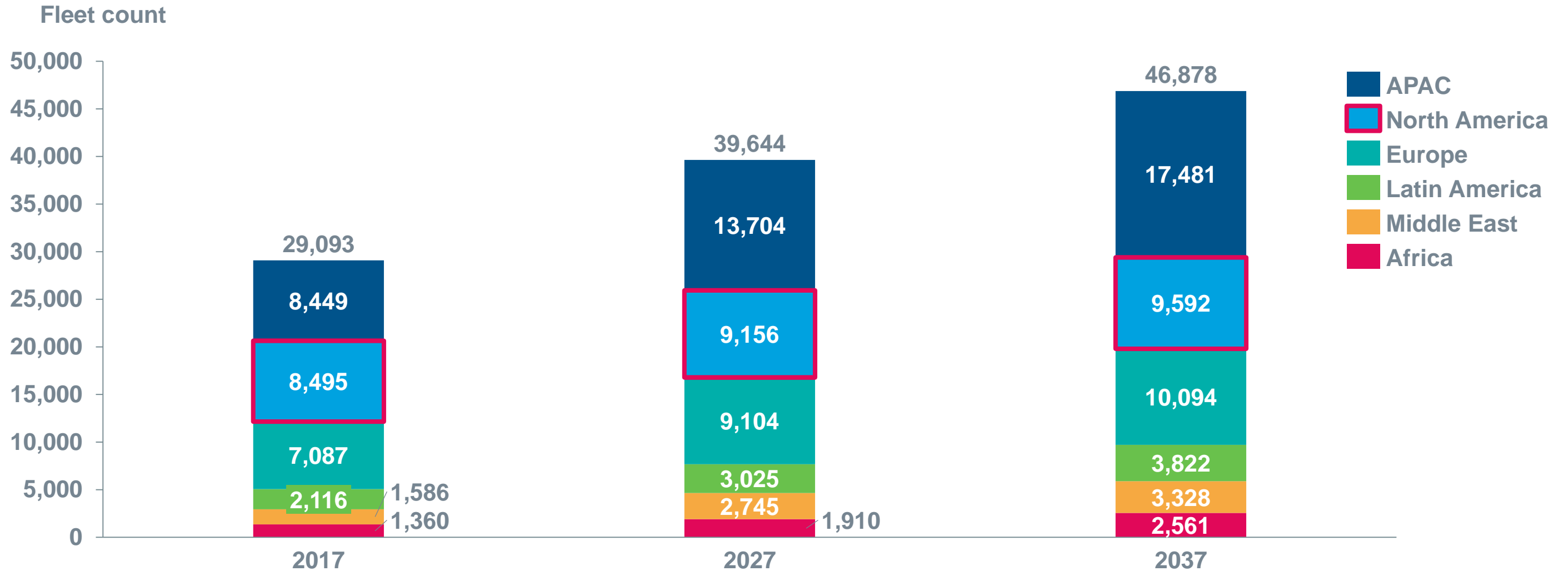
By Aircraft Type



By Region

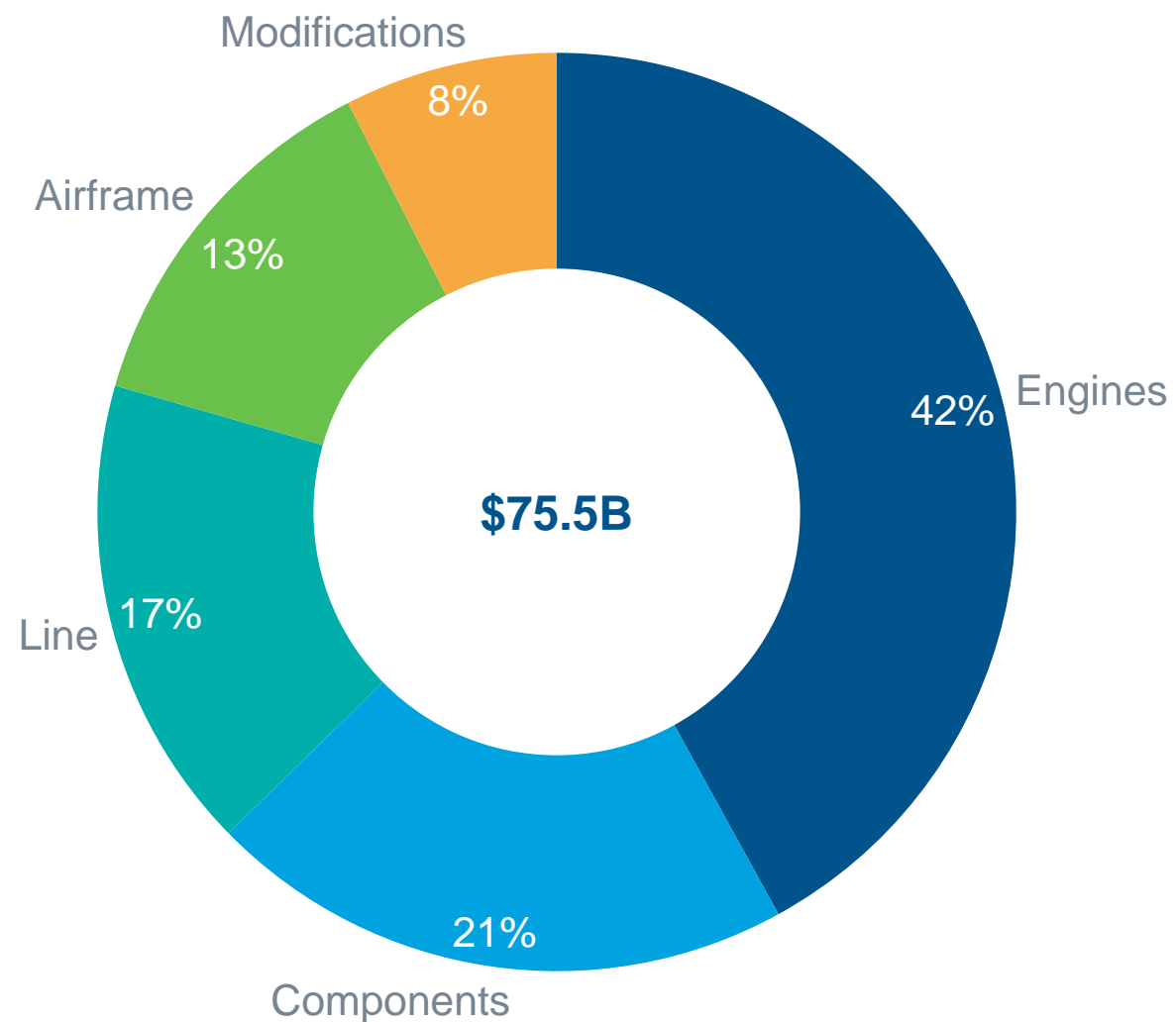


The combination of strong air travel demand and the need to replace ageing aircraft will drive fleet growth at a healthy 3.1% p.a.

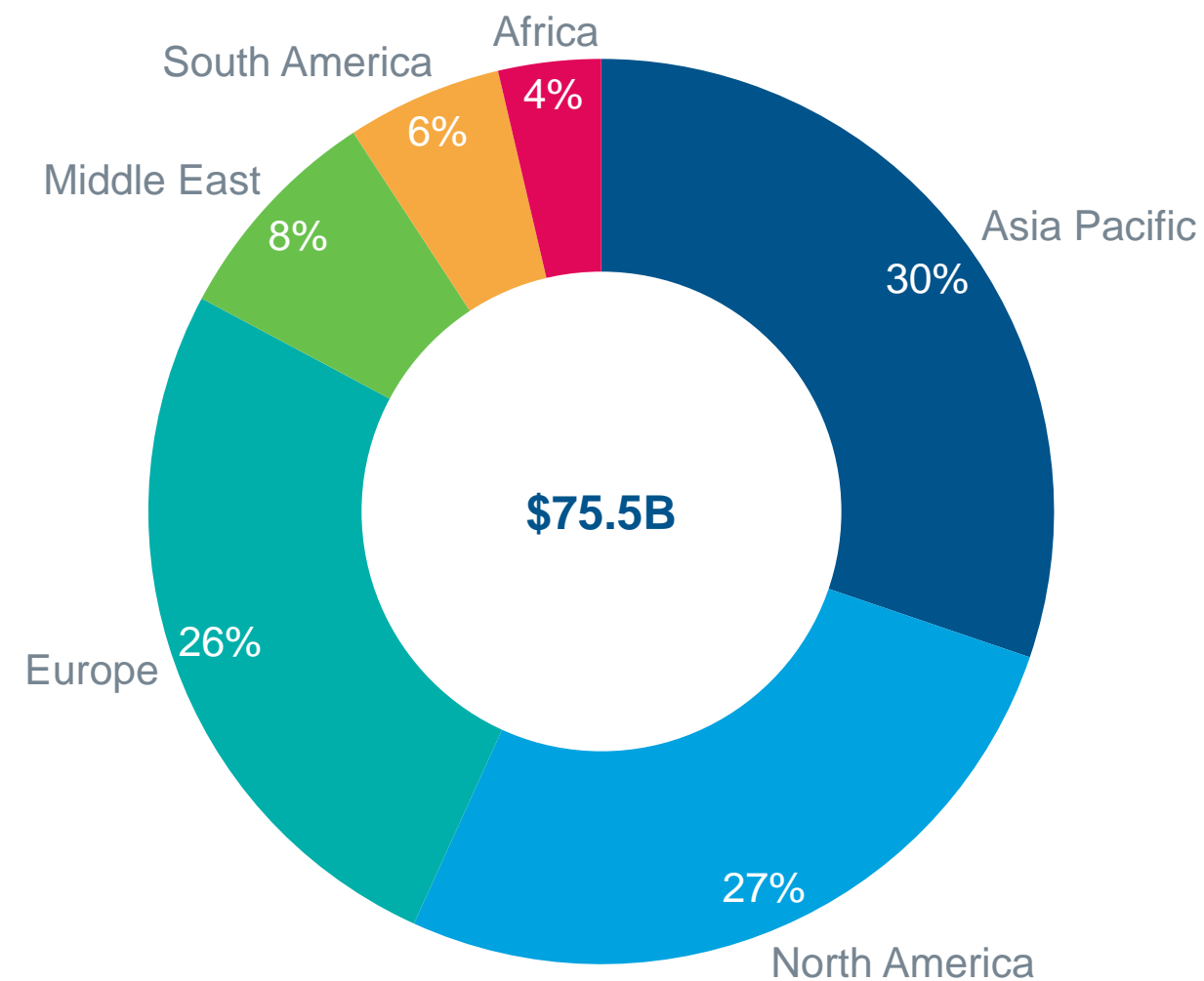


2017 commercial air transport MRO demand is \$75.5B; Asia is now larger than North America and Europe in market size

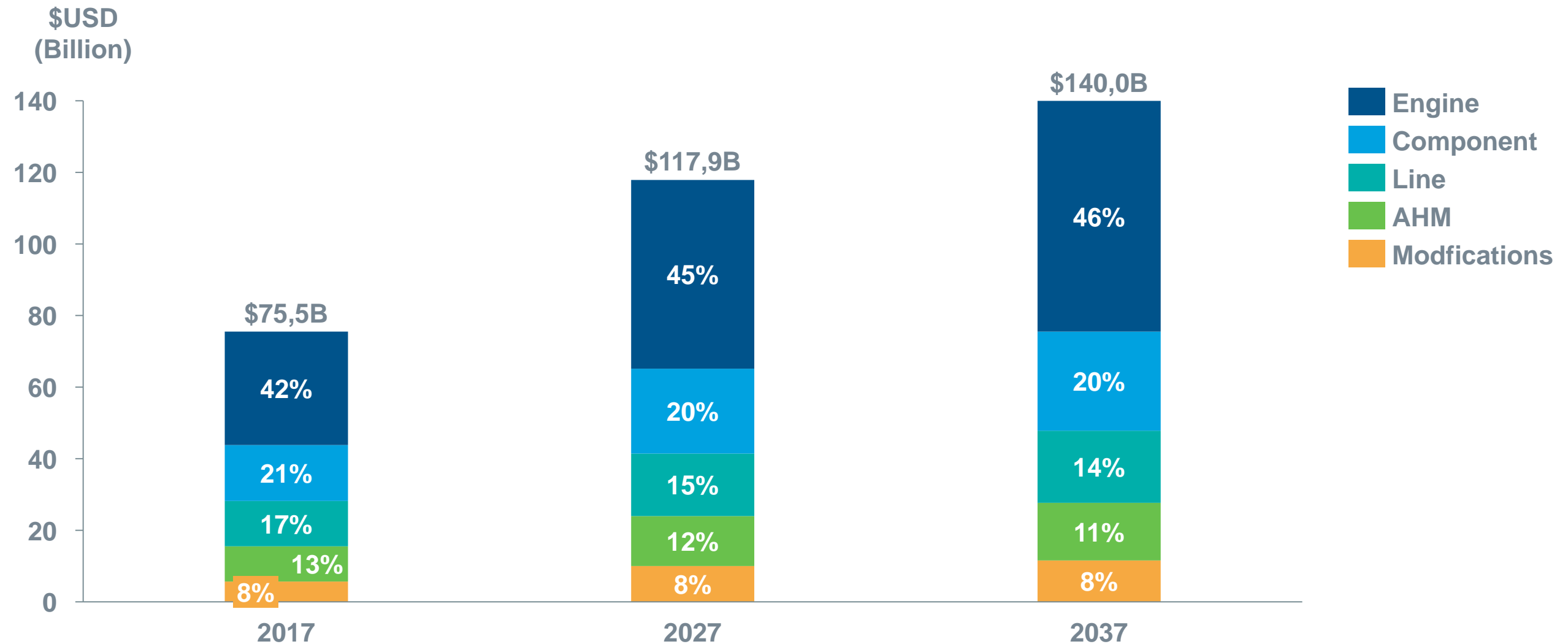
By MRO Segment



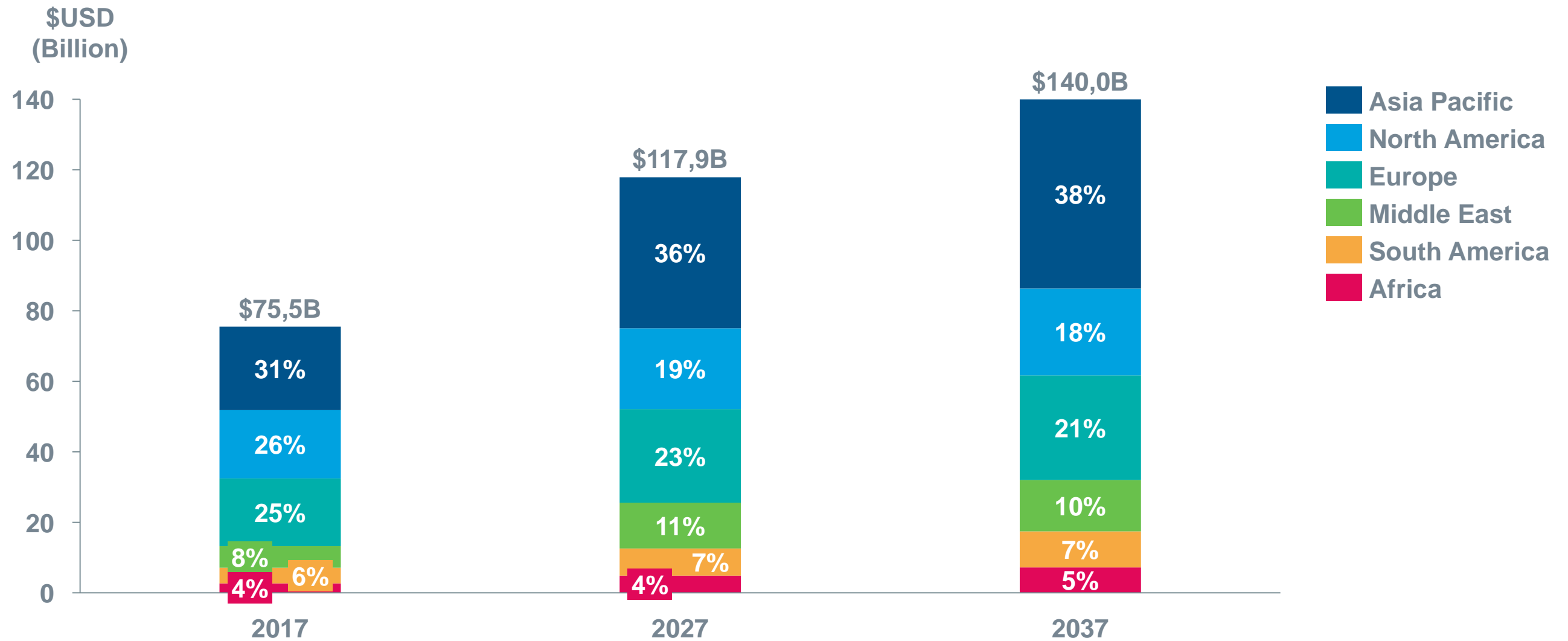
By Region



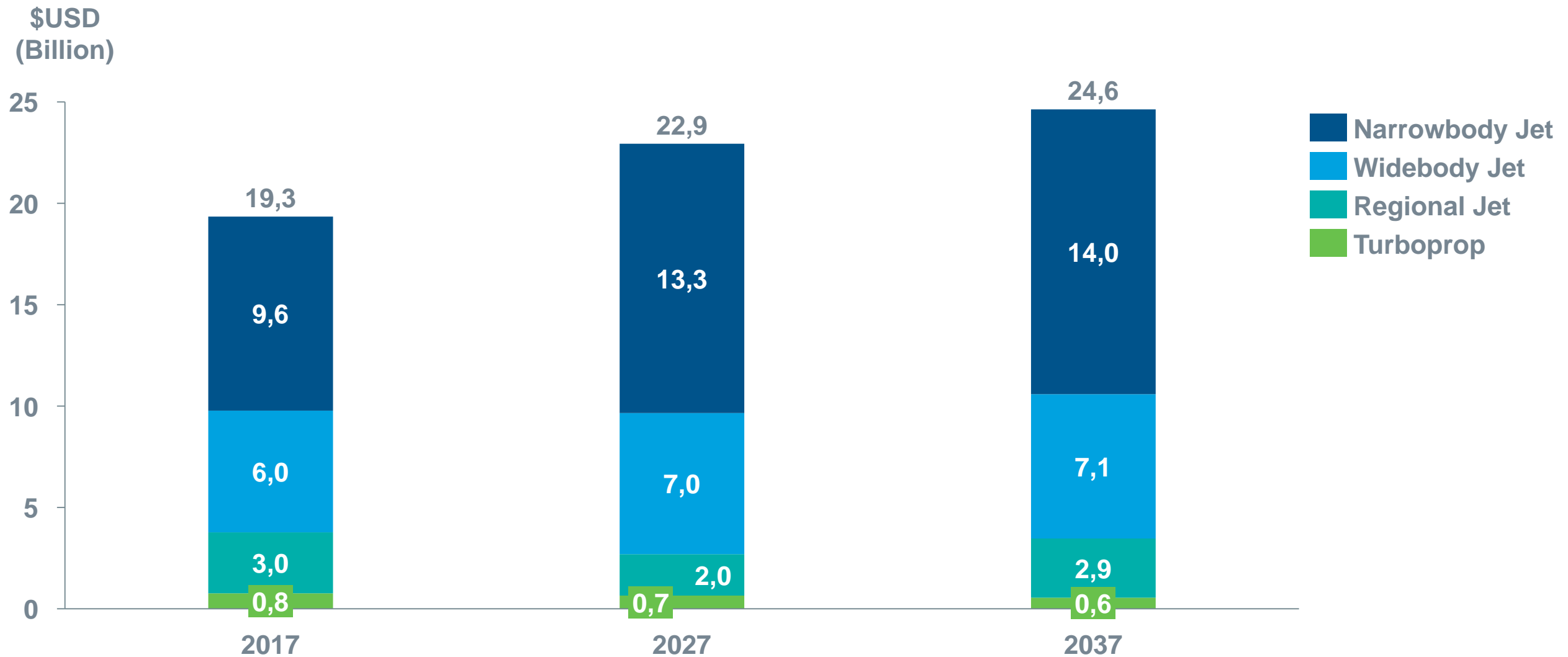
The global MRO market is expected to grow by 4.6% per annum to ~\$118B by 2027



Asia continues to grow strongly and will generate 38% of MRO demand by 2037



North American MRO spend exhibits marginal growth, increasing by 1.7% per annum to \$22.9B by 2027





Digital landscape

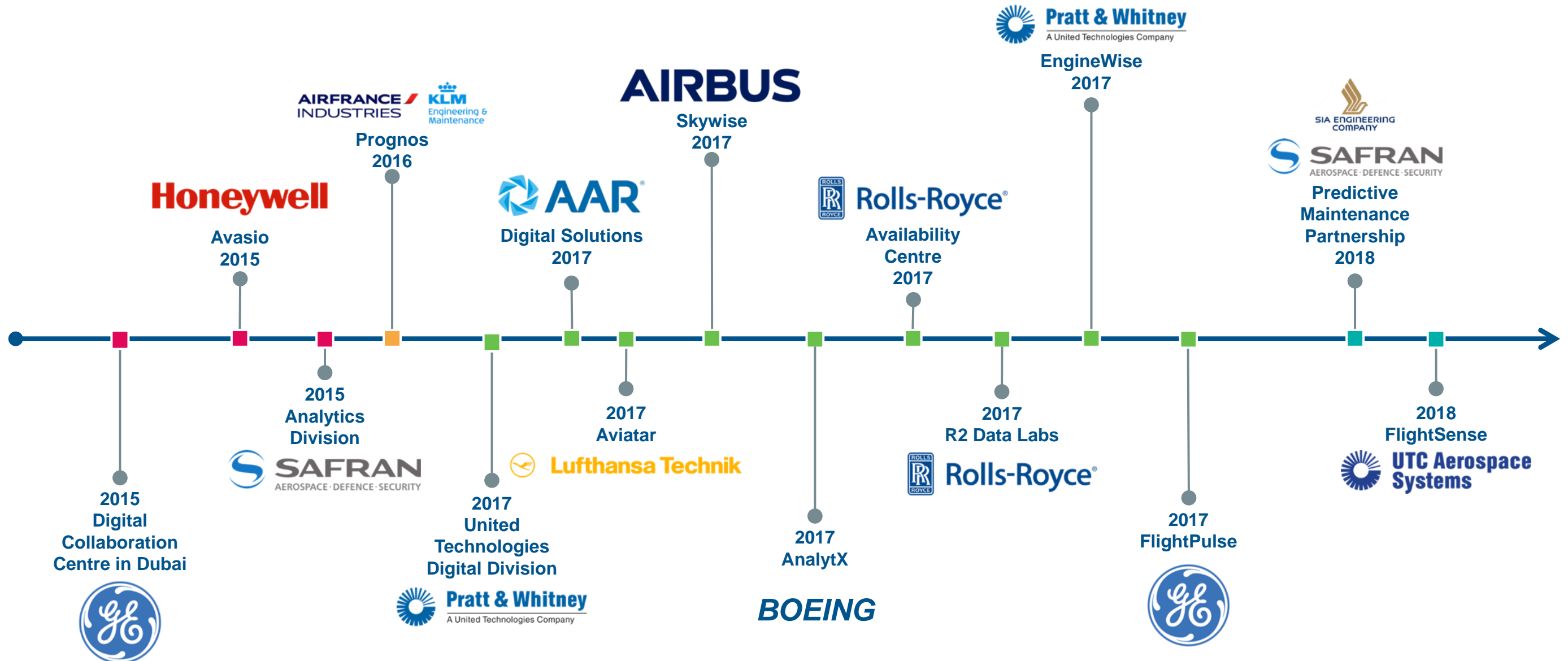


ICF proprietary and confidential. Do not copy, distribute, or disclose.

14th MAINTENANCE COST CONFERENCE
SEPTEMBER 19-21
Atlanta - USA 2018



For the past three years, the digital race has accelerated in the MRO world across all type of players



Several airlines are seeing the first tangible benefits of their aircraft health monitoring trials

Results of Delta's Predictive Maintenance approach

Avoided Engine Events

1,000

(over 1-year timespan)

Delta achieved a 100% completion factor for 241 days in 2017, with a 98% reduction in maintenance-related cancellations

Cancellation reduction

98%

(over 2010 – 2016)

easyJet

31 Events

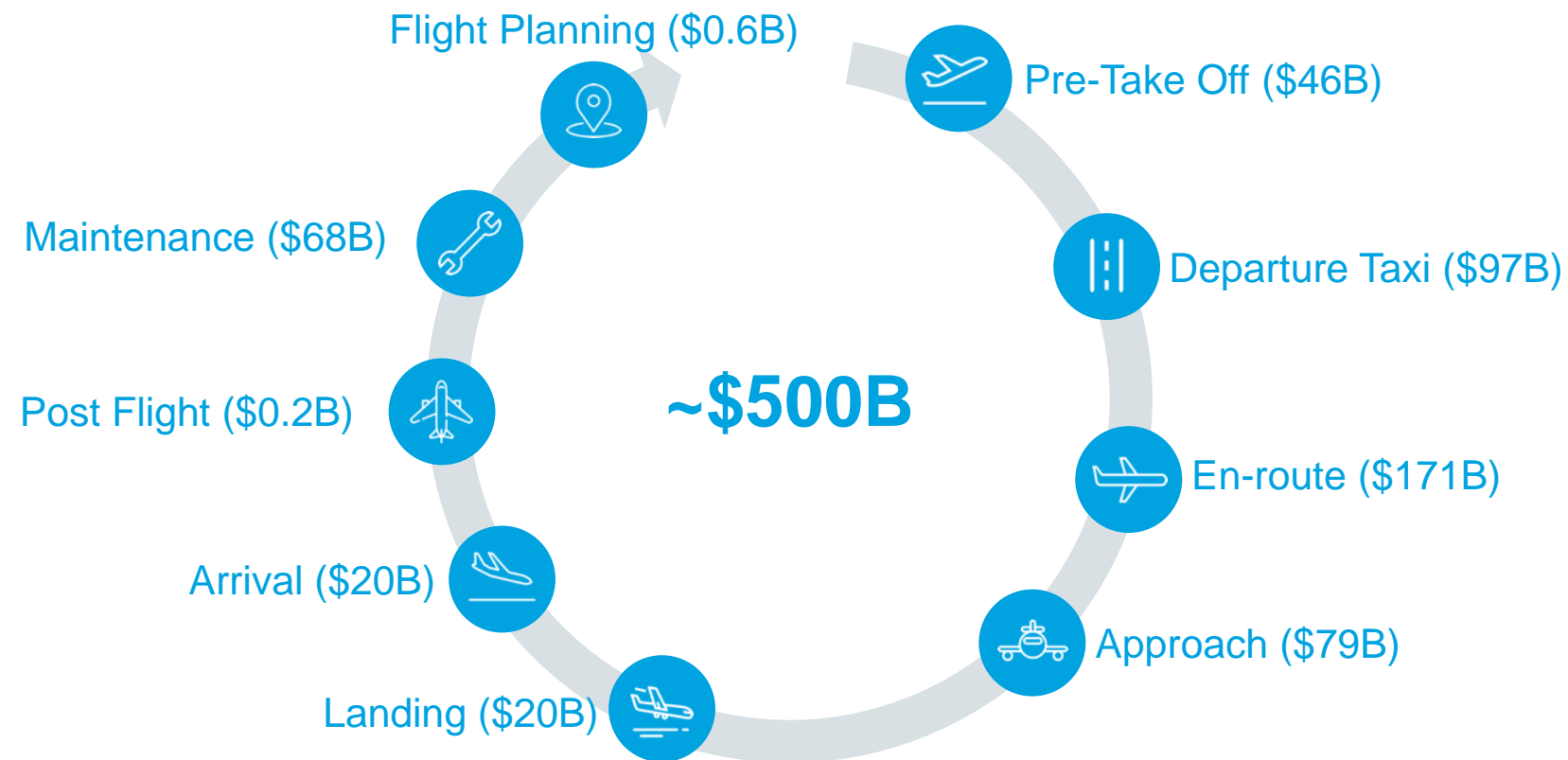
31 instances of Skywise correctly predicting faults before they occurred in service, allowing the carrier to intervene and remove components before they failed

Cathay Pacific

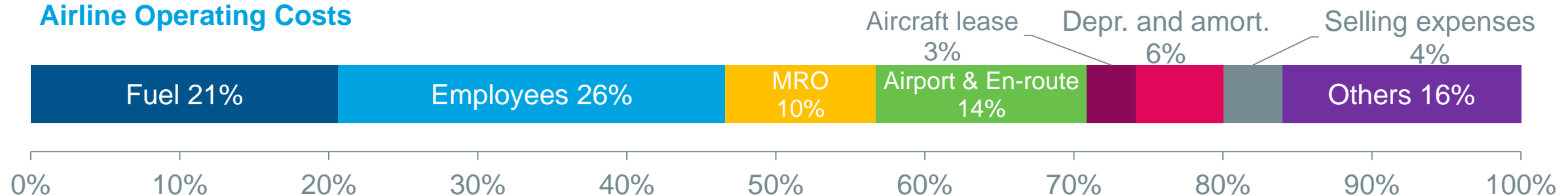
51% reduction

Cathay Pacific reduced APU-related delay minutes by 51% using Honeywell's predictive maintenance trial program

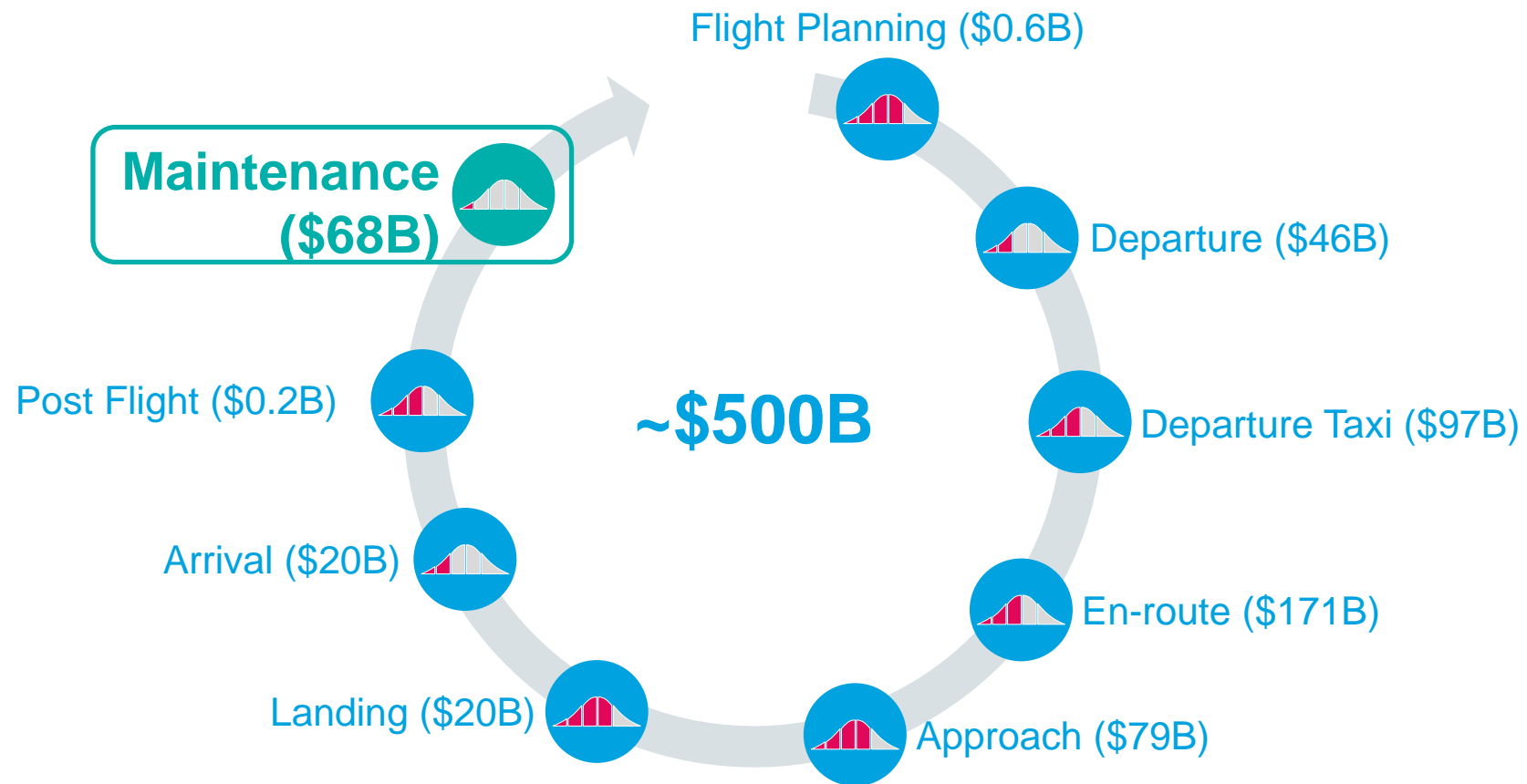
There are nine primary phases within aircraft operations



Airline Operating Costs



...the level of digitization across the nine categories varies



Key

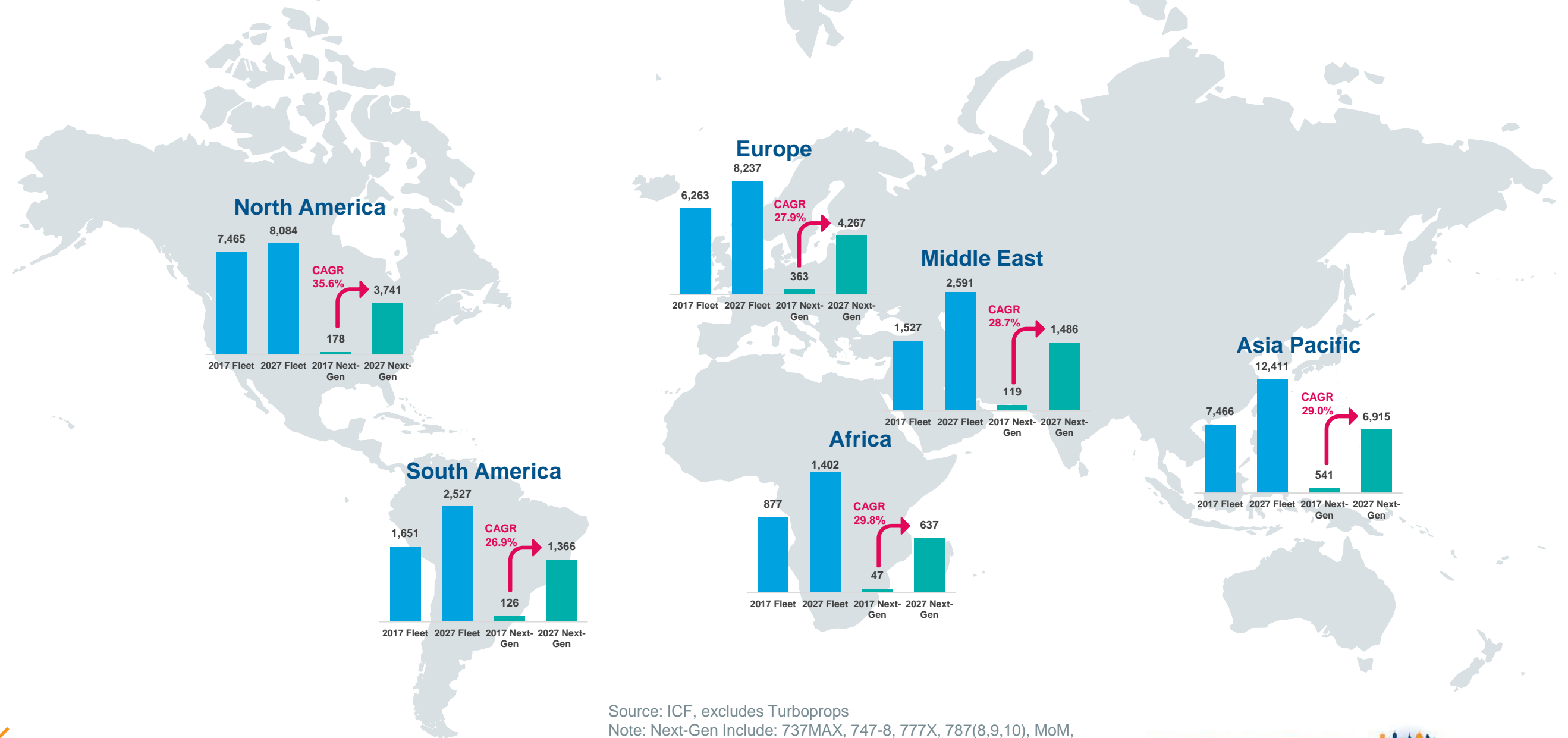
More digitised



Less digitised



In 2027 the air transport fleet will have approximately 17,000 “new technology” aircraft



Source: ICF, excludes Turboprops
 Note: Next-Gen Include: 737MAX, 747-8, 777X, 787(8,9,10), MoM, A319neo, A320neo, A321 neo, A330neo, A350, C919, CSeries, Embraer E2s, SSJ100, MRJ90

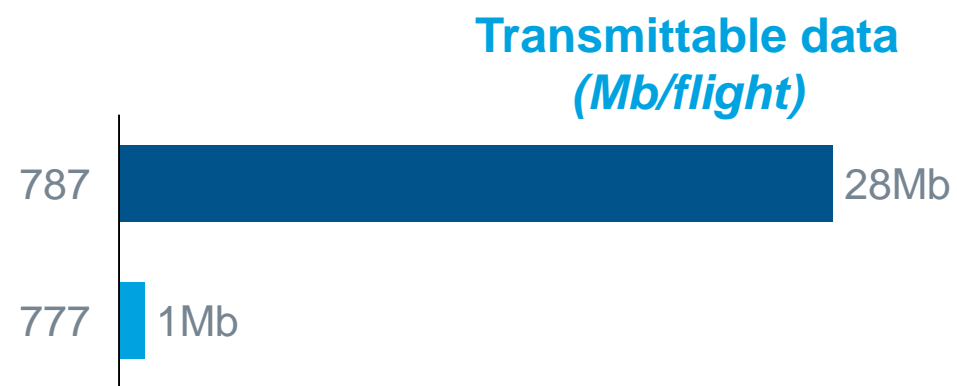
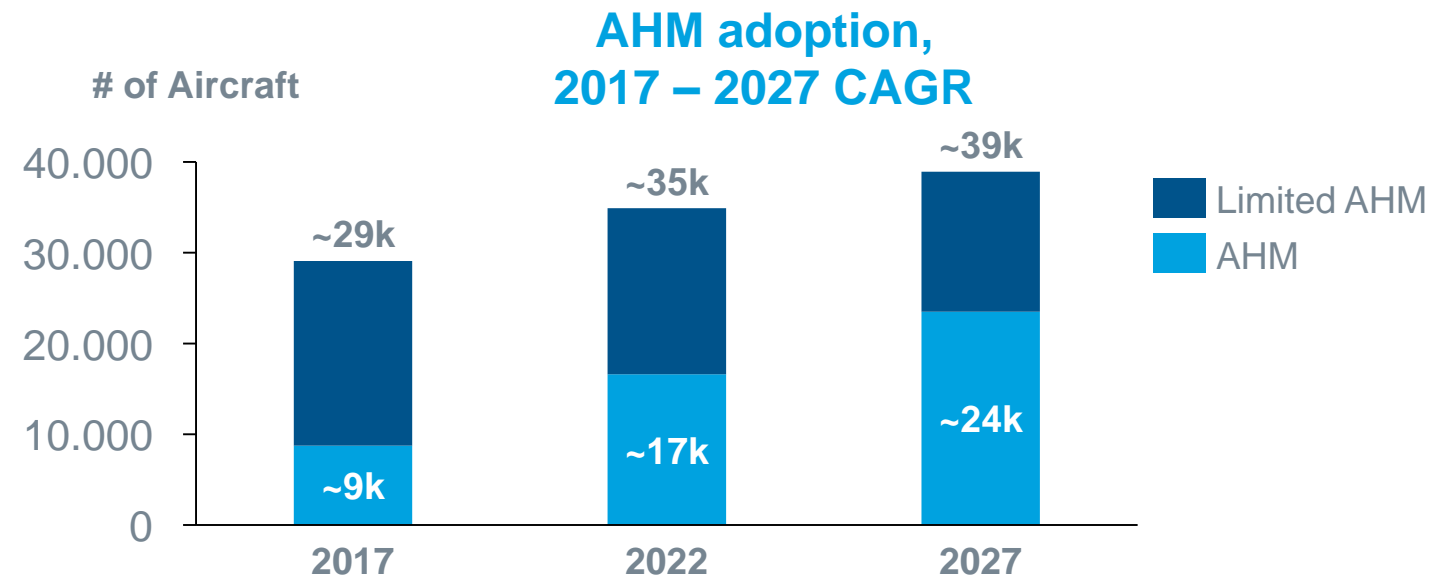


ICF proprietary and confidential. Do not copy, distribute, or disclose.

14th MAINTENANCE COST CONFERENCE
 SEPTEMBER 19-21
 Atlanta - USA 2018



Approximately 24,000 aircraft will be equipped with AHM by 2027

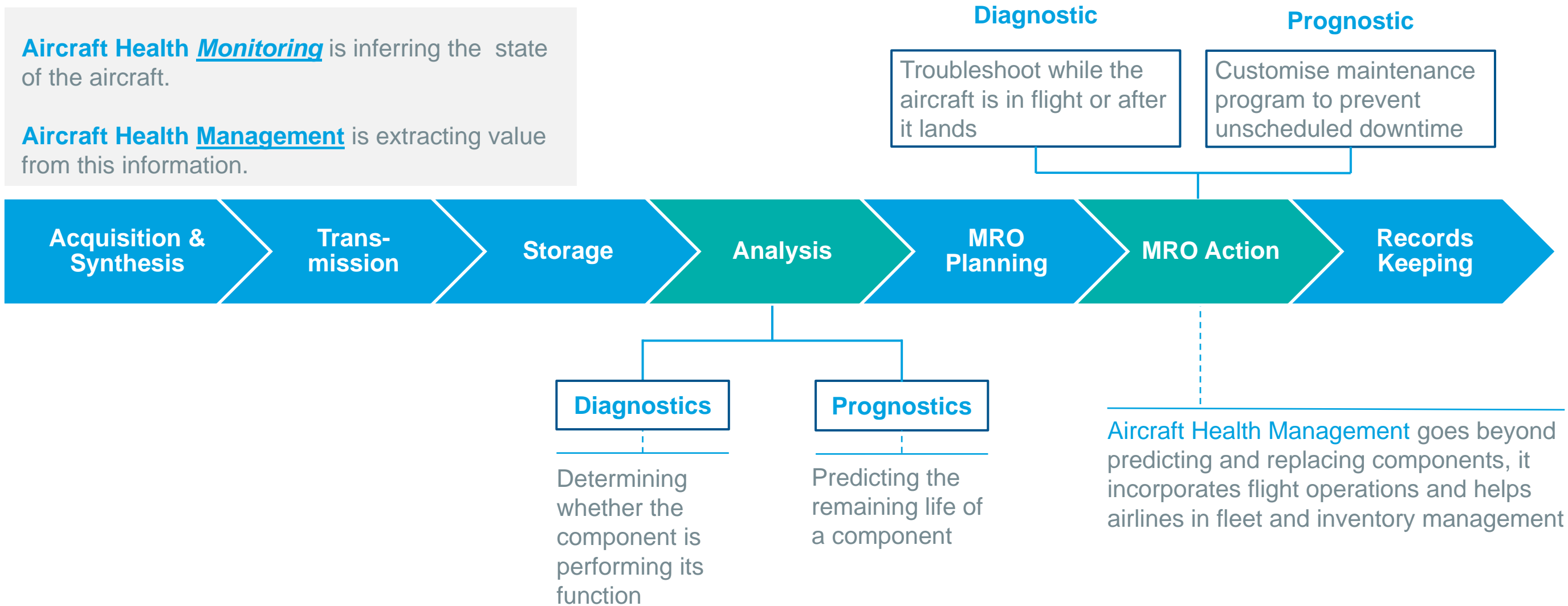


- New generation aircraft generate much more data compared to older types
- As data becomes increasingly useful to improve maintenance, the adoption of Aircraft Health Monitoring is expected to grow
- ICF expects ~24,000 aircraft will be equipped with Aircraft Health Monitoring by 2027 of which 17,000 are new technology aircraft
- This is driving a digitisation of aircraft operations, which will see high growth in the adoption of e-enabled services and further advances in health management

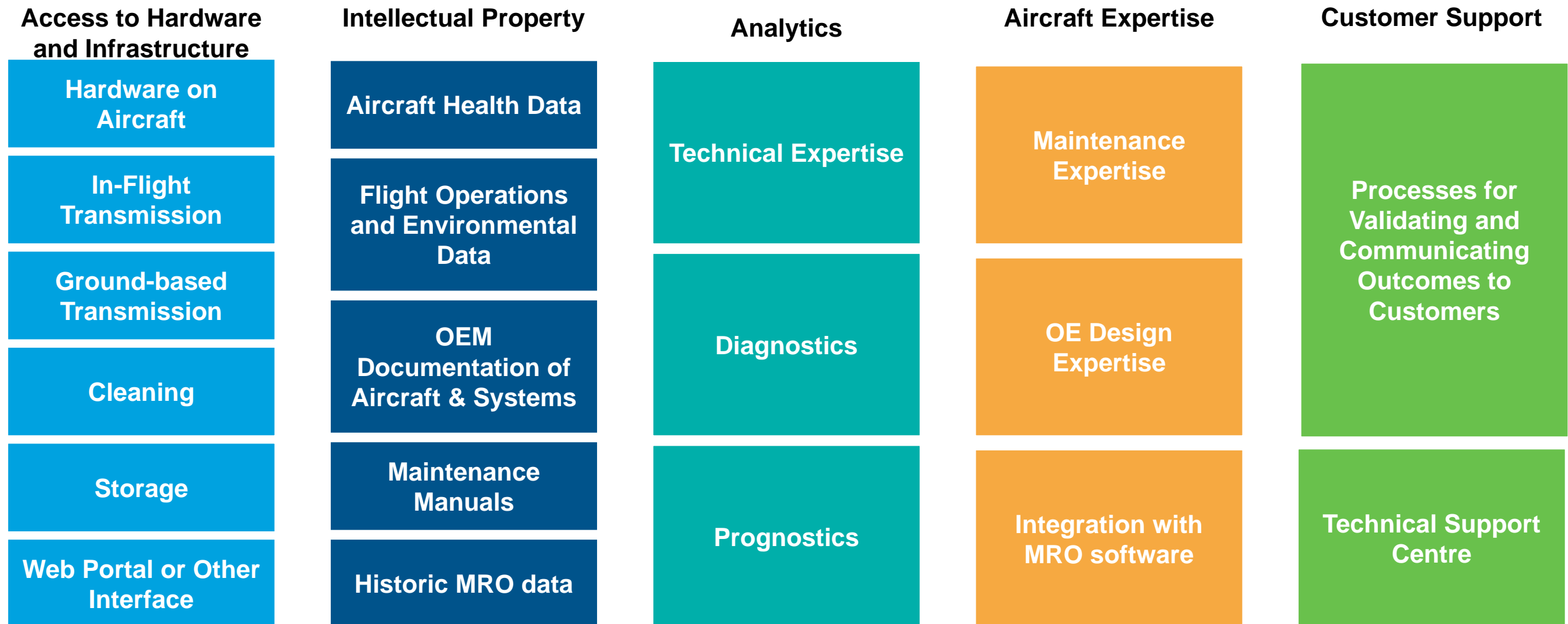
AHM can be viewed as a subset of data management value chain....

Aircraft Health Monitoring is inferring the state of the aircraft.

Aircraft Health Management is extracting value from this information.

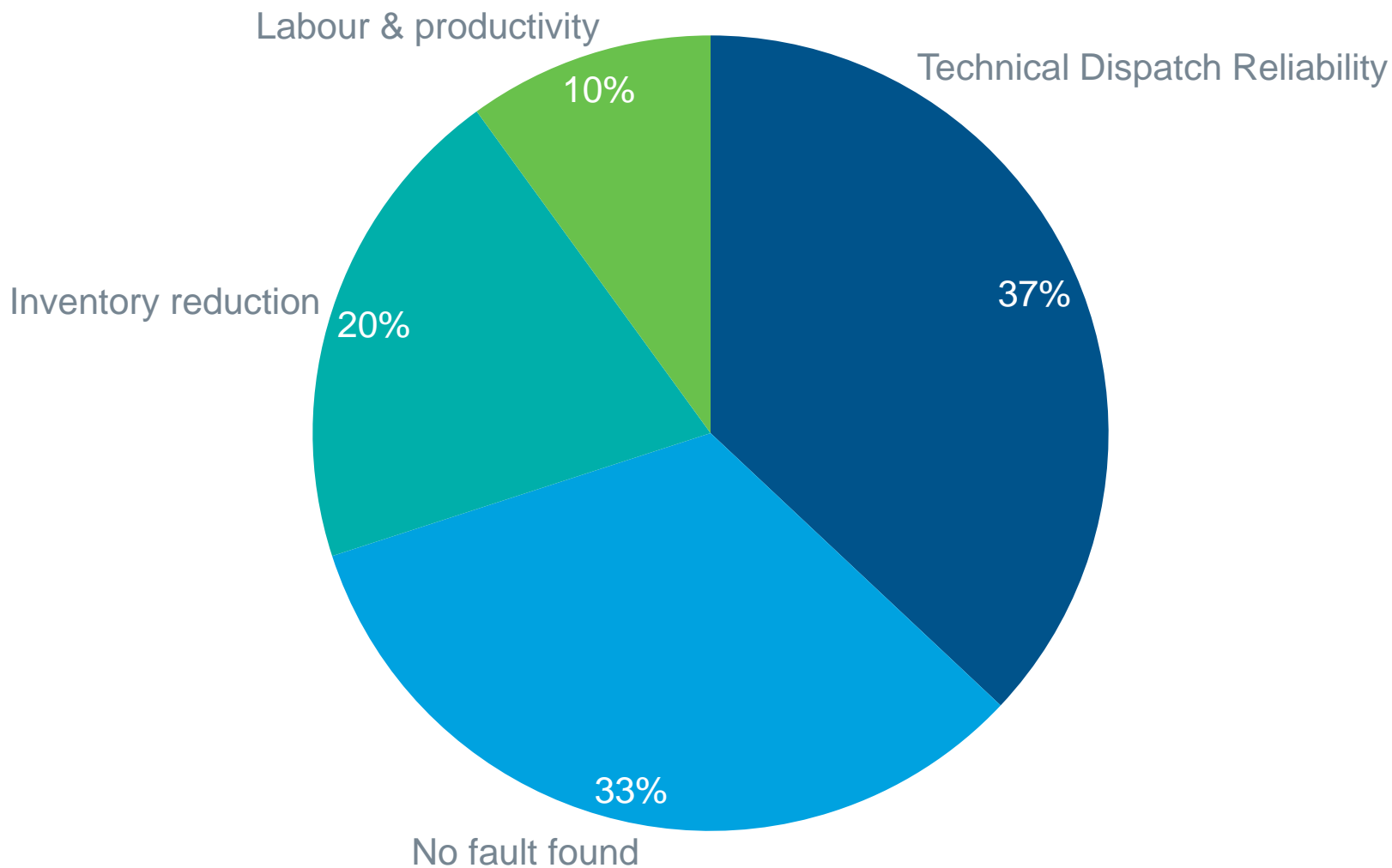


.....consisting of building blocks essential to its implementation



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

Estimated breakdown of AHM benefits



- ICF has quantified the savings into 4 categories:
 - **Technical Dispatch Reliability:** Maintenance related delays of over 15 minutes
 - **No Fault Found:** Unnecessary removal of functional components
 - **Inventory:** Spare parts held by airlines/MROs
 - **Labor Productivity:** Labor costs during maintenance activities
- Through research and analysis, ICF found that improvements in NFFs and technical dispatch reliability bring the most savings from AHM

Latest developments

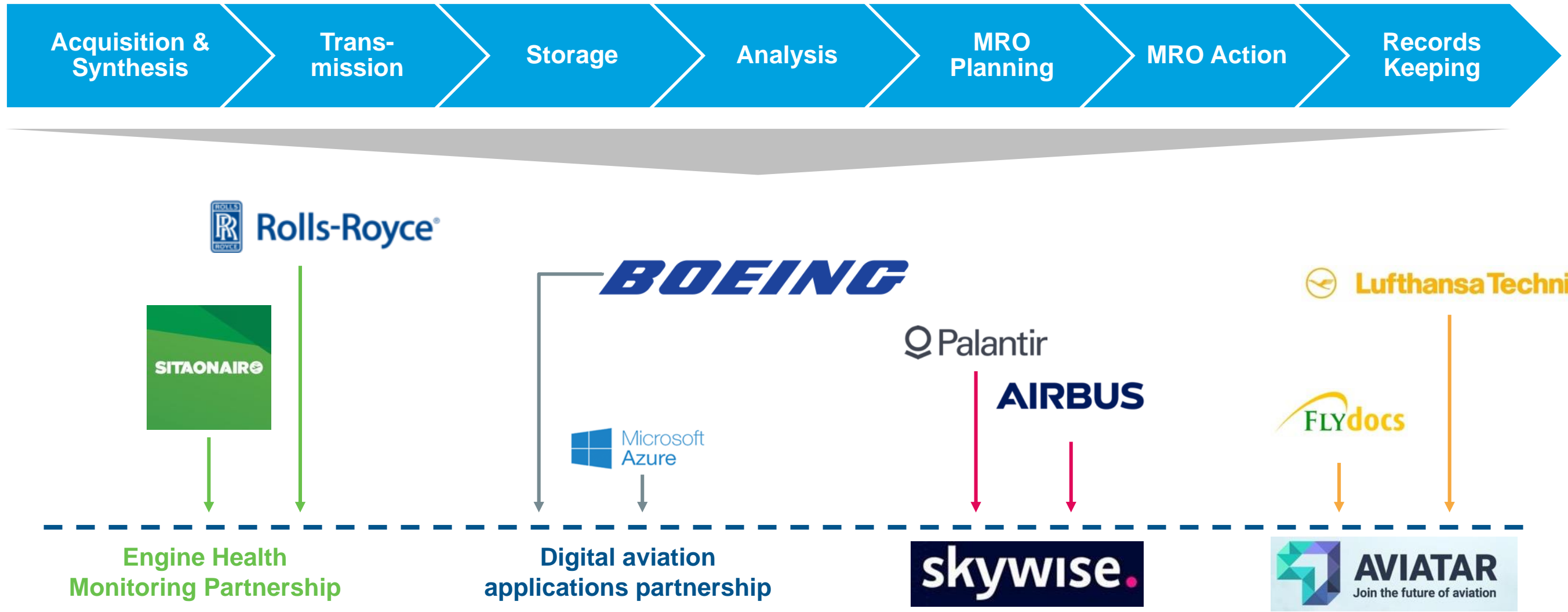


ICF proprietary and confidential. Do not copy, distribute, or disclose.

14th MAINTENANCE COST CONFERENCE
SEPTEMBER 19-21
Atlanta - USA 2018



OEMs & MROs are embracing partnerships to cover the MRO data value chain

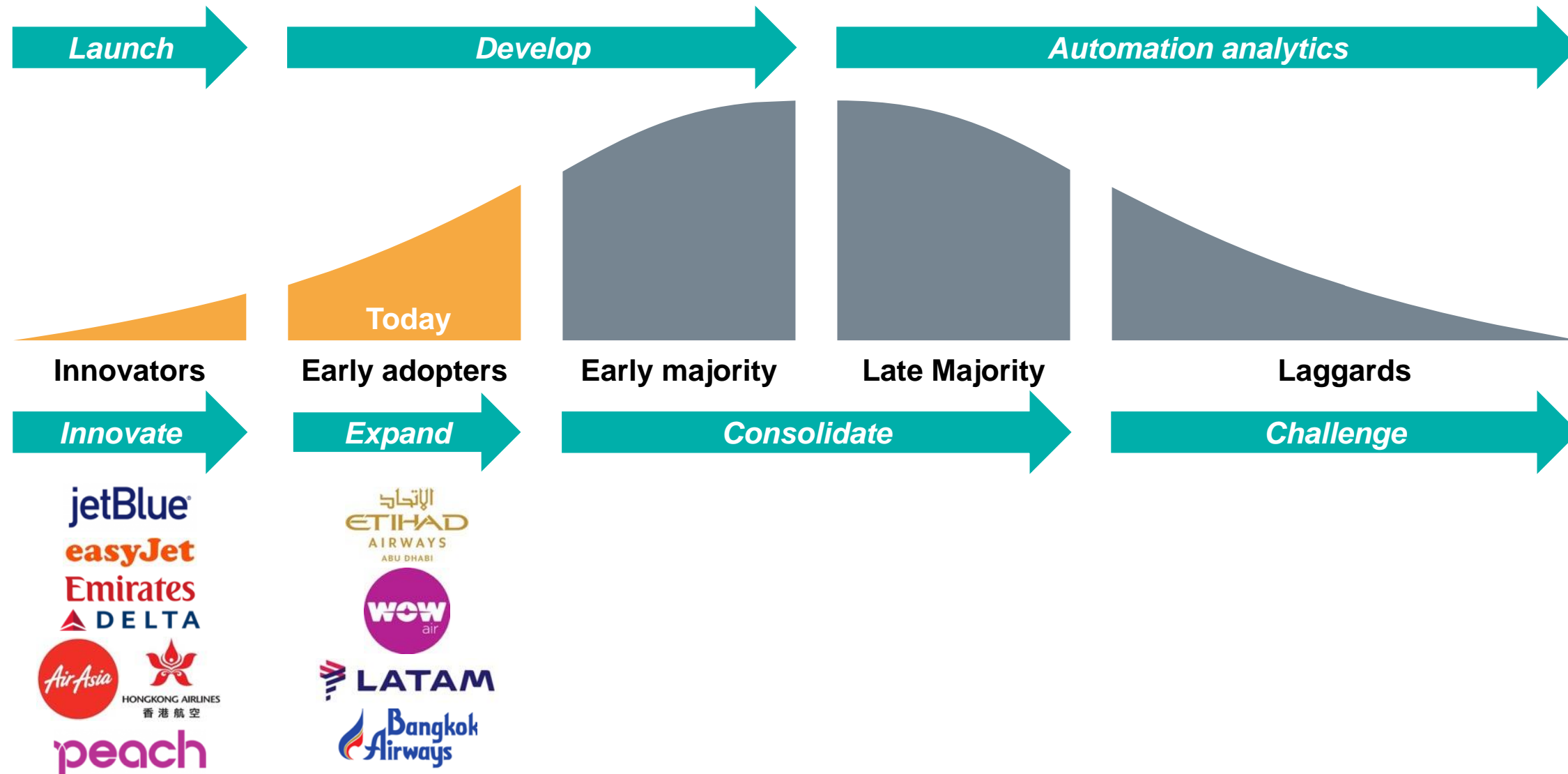


OEMs & MROs are embracing partnerships to cover the MRO data value chain

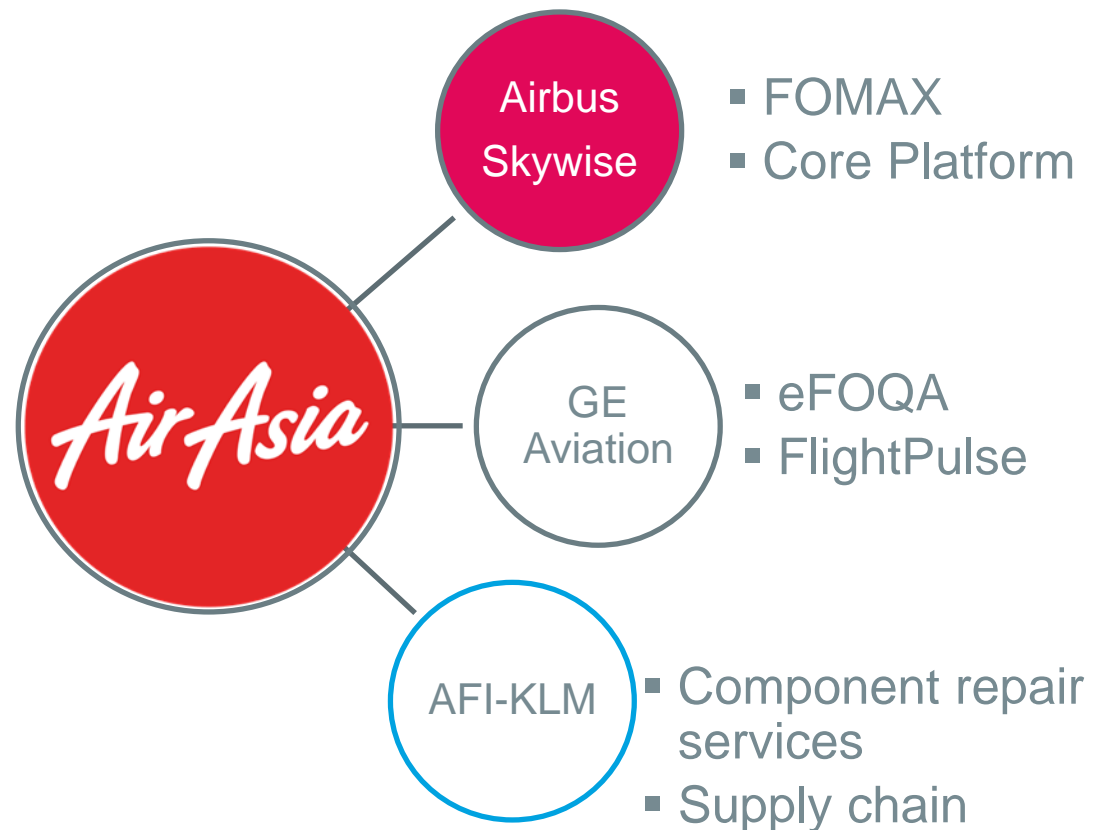


AIRBUS	<i>Rockwell Collins</i>				AIRBUS	AIRBUS MRO Alliance	-
BOEING	Honeywell 	ACARS / Gate Wi-Fi		BOEING <i>AnalytX</i>	BOEING	BOEING	 A Boeing Company
	-	ACARS / Gate Wi-Fi					
	-	ACARS / Gate Wi-Fi	-				-
	-	ACARS / Gate Wi-Fi					-

The MRO industry has entered the *'expand'* phase of the digital maturity lifecycle; numerous suppliers are developing digital tools that provide a solution for a single issue



OEM's are seeking new ways to expand their market share



- Air Asia signed up for Skywise while under a component repair contract with AFI-KLM
- Airbus is likely to target other large (single) fleet operators next
 - Economies of scale
 - Maximum return for the airline
 - Airbus gets closer to reaching critical mass for their platform

MARKET NEWS MARCH 5, 2018 / 4:36 PM / 5 DAYS AGO

Airbus seeks \$10 bln annual commercial services revenue by 2025

Reuters Staff 1 MIN READ  





Summary



ICF proprietary and confidential. Do not copy, distribute, or disclose.

14th MAINTENANCE COST CONFERENCE
SEPTEMBER 19-21
Atlanta - USA 2018



Digitisation could enable airlines to save in excess of \$5B/year

Maintenance cost

~ \$3B

From AHM and predictive maintenance

- Driven by improved dispatch reliability, No Fault Found reduction, Inventory reduction and Improved labour productivity

Fuel saving

~ \$1.7B

From flight optimisation

- Continuous flight optimisation through live weather updates, speed and altitude optimisation...

Delay reduction

~ \$0.8B

From improved operational processes

- Improved turnaround process, in-flight routing optimisation

But there are a number of key questions Airlines, OEMs and MROs need to evaluate



- **Are the basics in place to exploit data? Are your shop findings in a database format?**



- **Will digitisation break the borders between the different players in the aviation market?**



- **Will digitisation allow the outsourcing of currently “core” airline activities?**

Digitisation offers airlines the potential for efficiency that is only just being understood.

Suppliers need to create the right partnerships & value propositions.

Where OEMs have previously focused their Services M&A efforts on R&O investments, focus is now on acquiring IT expertise.

Non aviation incumbents are disrupting the markets (e.g. Amazon in the cargo market)





ICF is one of the world's largest and most experienced aviation and aerospace consulting firms

joost.groenenboom@icf.com



ICF proprietary and confidential. Do not copy, distribute, or disclose.

14th MAINTENANCE COST CONFERENCE
SEPTEMBER 19-21
Atlanta - USA 2018





Let's Make Big Things Possible

Consulting for the
Global Aviation Industry

Airlines | Airports | Aircraft | Aerospace and Maintenance

Helping you manage assets and
operations, mitigate risk, and maximize
return on investment.

we are  **ICF**

Serving the Aviation Community Since 1963

ICF Aviation Comprehensive Services:

Airlines - Fleet and network planning, pricing and revenue management, OTP and operational efficiency

Airports - Strategic planning, policy, route development, concessions planning

Aircraft - Valuations, cash flow forecasts, portfolio due diligence, market analysis, technical services

Aerospace & MRO - Operations assessment, M&A support, marketing analysis

BROAD PERSPECTIVE. COMPELLING RESULTS.

ICF offers our team of nearly 100 aviation experts dedicated to strategic and operations consulting for the aviation industry. Our aviation practice was founded as SH&E in 1963 and, after being acquired by ICF in 2007, we further expanded with the acquisition of AeroStrategy in 2011. Today we are one of the world's largest aviation consulting organizations. We provide objective, independent commercial, financial, technical, and regulatory guidance to aviation clients, including airlines, airports, lessors, financial institutions, manufacturers, governments, and VIPs. From our offices around the globe, ICF helps aviation clients manage assets and operations, mitigate risk, and maximize return on investment. **Visit us online at icf.com/aviation.**



ICF is a proud member of both ISTAT and the IATA Strategic Partnerships Program.



ICF proprietary and confidential. Do not copy, distribute, or disclose.

14th MAINTENANCE COST CONFERENCE
SEPTEMBER 19-21
Atlanta - USA 2018



Airlines

ICF supports airline management and stakeholders in solving complex strategy issues to improve performance.

ICF provides strategic and operational advice to airline management and related stakeholders throughout the world. We help our clients navigate key business challenges by leveraging decades of global industry experience and a suite of proprietary models and databases. Below, we briefly describe our core airline advisory services and proprietary supporting products.

Airline Products

ICF's suite of proprietary airline tools, models, and databases offers a data-driven approach to help management and stakeholders navigate key business challenges to their advantage.

NetWorks® Planning Software

ICF provides its network and schedule analysis/systems to longstanding clients and for use in consulting assignments.

RM100/500/750 Revenue Management Software

Partnering with SITA, ICF has been the developer and technical support for SITA's multi-product RMS suite.

Airline Fleet Planning Model

Developed to give airlines a strong decision support product, ICF's model offers speed and clarity.

Planning

Whether in network, fleet, revenue management, alliances, loyalty, distribution, catering, maintenance, or expense planning, ICF has experience with carriers globally, large and small, legacy and low cost.

Strategy

As airlines assess long-term success criteria, alliance pros and cons, the changing competitive landscape, and areas of defensible advantage, ICF can help with strategic studies.

Operations

ICF supports airlines in turn-time reduction, OTP improvement, cost reduction, operations control, crew productivity, and MRO programs.

Finance

From bankruptcy and turn-around situations to cash-flow forecasting, transaction modeling, and financial planning, ICF has worked with airline CFOs, investors, and creditors.

Airports

ICF supports airports and industry participants across a range of expertise-based engagements.

ICF advises airport management, governments, civil aviation authorities, and buyers & sellers of airport assets throughout the world. Our long-term relationships with these entities make us a trusted guide through today's complex, competitive landscape. Below, we briefly describe our core airport advisory services and proprietary supporting products.

Airport Products

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

NetWorks® Planning Software

ICF provides its network and schedule analysis/systems to longstanding clients and for use in consulting assignments.

Commercial Revenue Database

This premier assembly of expected revenue-generation values guides commercial planning.

Airline Fleet Planning Model

ICF's own, independent traffic demand forecast gives planners an unbiased point of view.

Strategic Planning

ICF brings airport planners with decades of expertise from hundreds of assignments to deliver the insight, attention to detail, and multi-faceted thinking needed for success.

Transaction Advisory

ICF has participated in almost every major airport asset transaction around the world in the past 20 years—and continues to be a trusted, objective, impartial advisor in every engagement.

Policy and Regulation

Some of the best-known consultants in policy and regulation are with ICF, helping airport directors, governing boards, and agencies determine the right framework for each distinct need.

Operations Improvement

Recognizing the power of integrated IT systems, the complexities of hub turn-times, and the environmental cost of non-sustainable operations, ICF can help improve both costs and efficiency.



Aircraft

ICF supports investors in aviation hard assets and provides asset management and remarketing to aircraft owners, lenders, and operators.

Lessors, operators, and investors count on ICF for integrity, flawless analysis, and expert technical support with aviation deals—from a single aircraft to the world’s largest lease portfolio. Our certified ISTAT appraisers value aircraft and aviation assets worth billions of dollars each year, provide due diligence to buyers and sellers, and offer a full range of financial services. Below, we briefly describe our aircraft services and proprietary supporting products.

Aircraft Products

ICF’s suite of proprietary asset advisory tools, models, and databases helps stakeholders navigate key business challenges to their advantage.

Maintenance Cash Flow Forecast

Our proprietary model builds portfolio cash flows from each discrete maintenance event.

TrueBook Valuations

Aircraft and engine bluebooks forecast residual values built up from component value over time.

Spare Parts Inventory Appraisals

Millions of transactions for spare parts support valuation and benchmarks.

Aircraft Transactions

Across the lifecycle—acquisition, inspection, transition, default management, and remarketing—ICF’s experienced aircraft advisors deliver the specialized expertise where and when needed.

Financial Services

Recognized as best-in-class for maintenance cash flow projections and modeling for capital markets and P/E firms, ICF is able to support complex structures and transactions of aircraft lease portfolios and securitizations.

Valuation

ICF’s ISTAT-certified appraisers routinely value aircraft, engines, spare parts, simulators, plus intangible assets like routes, slots, and gates—backed by ICF’s best-in-class methodology and models.

Due Diligence

ICF provides aircraft trading due diligence services for single aircraft or full portfolios, and for investors or lessors during M&A or IPO transactions—combining our analytical expertise with our team’s executive experience with lessors, airlines, and MRO providers.



Aerospace and MRO

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

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 develop 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 asset advisory 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.

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.