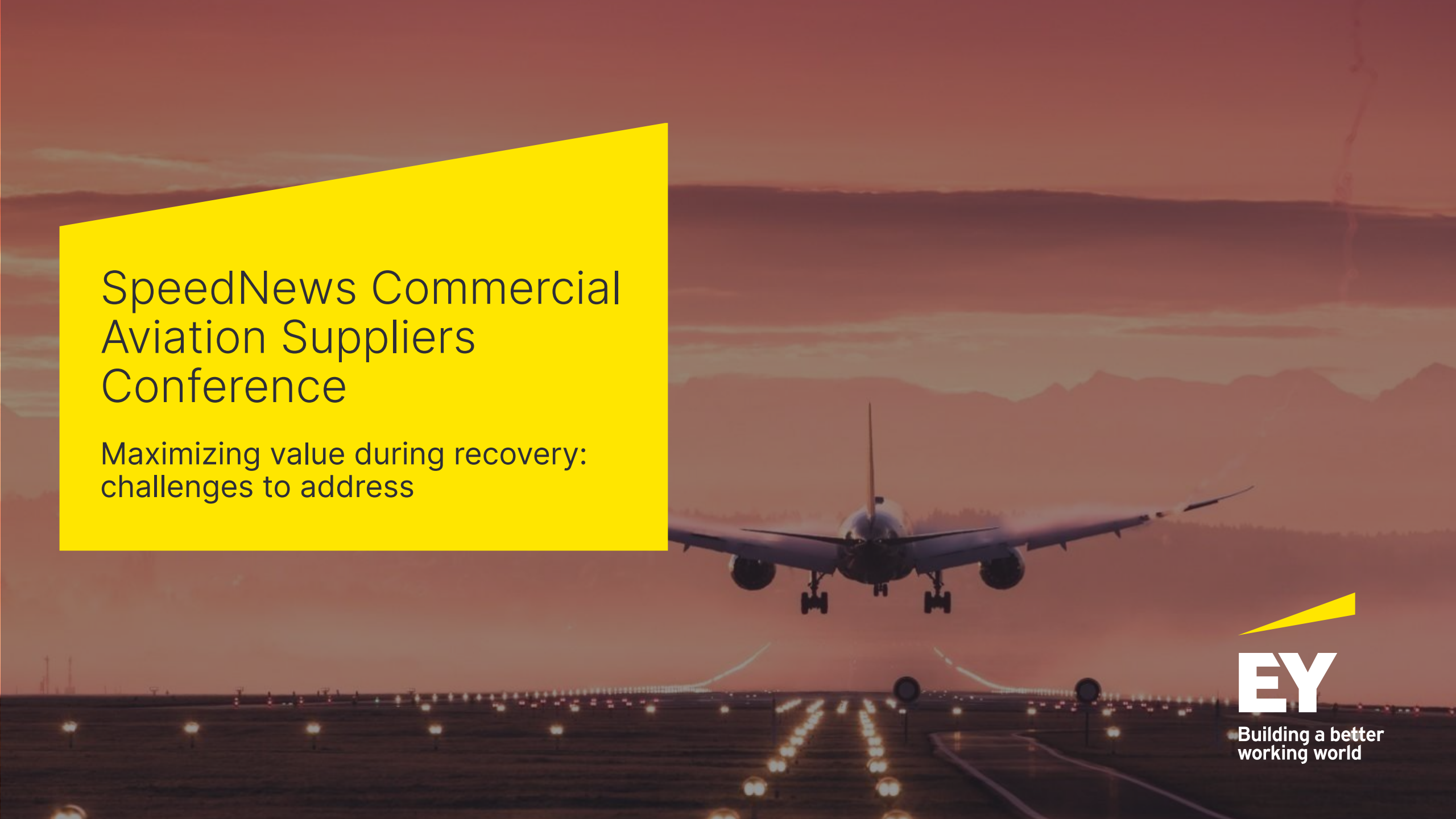

SpeedNews Commercial Aviation Suppliers Conference

Maximizing value during recovery: challenges to address

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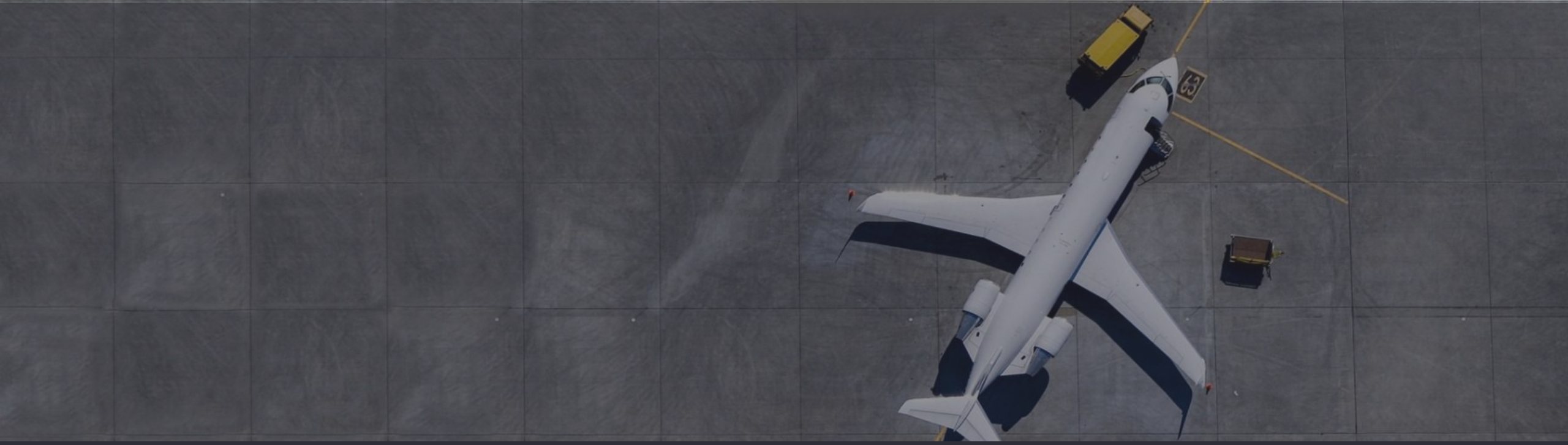

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Meet the speaker

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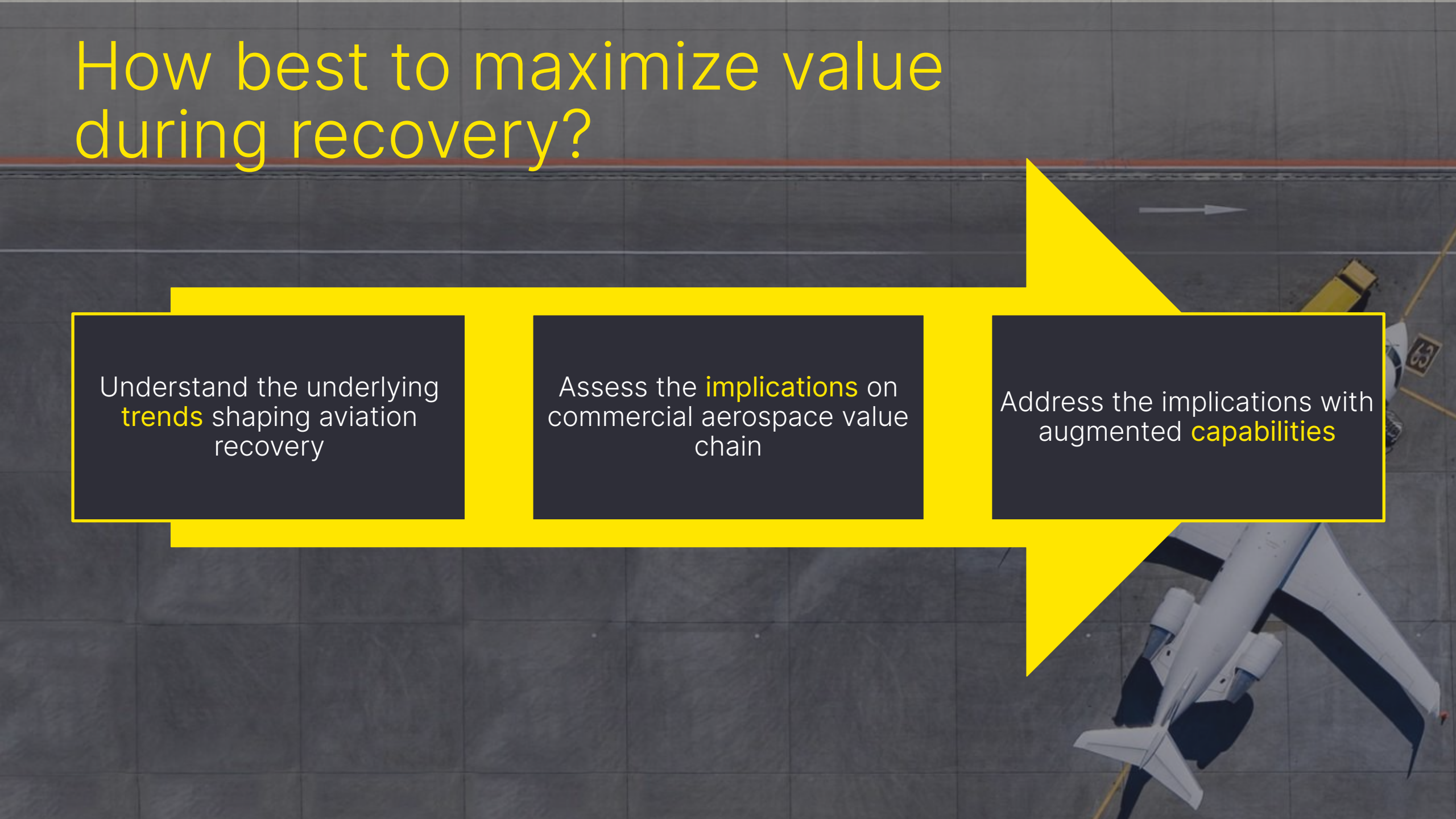
How best to maximize value during recovery?

Understand the underlying trends shaping aviation recovery

Assess the implications on commercial aerospace value chain

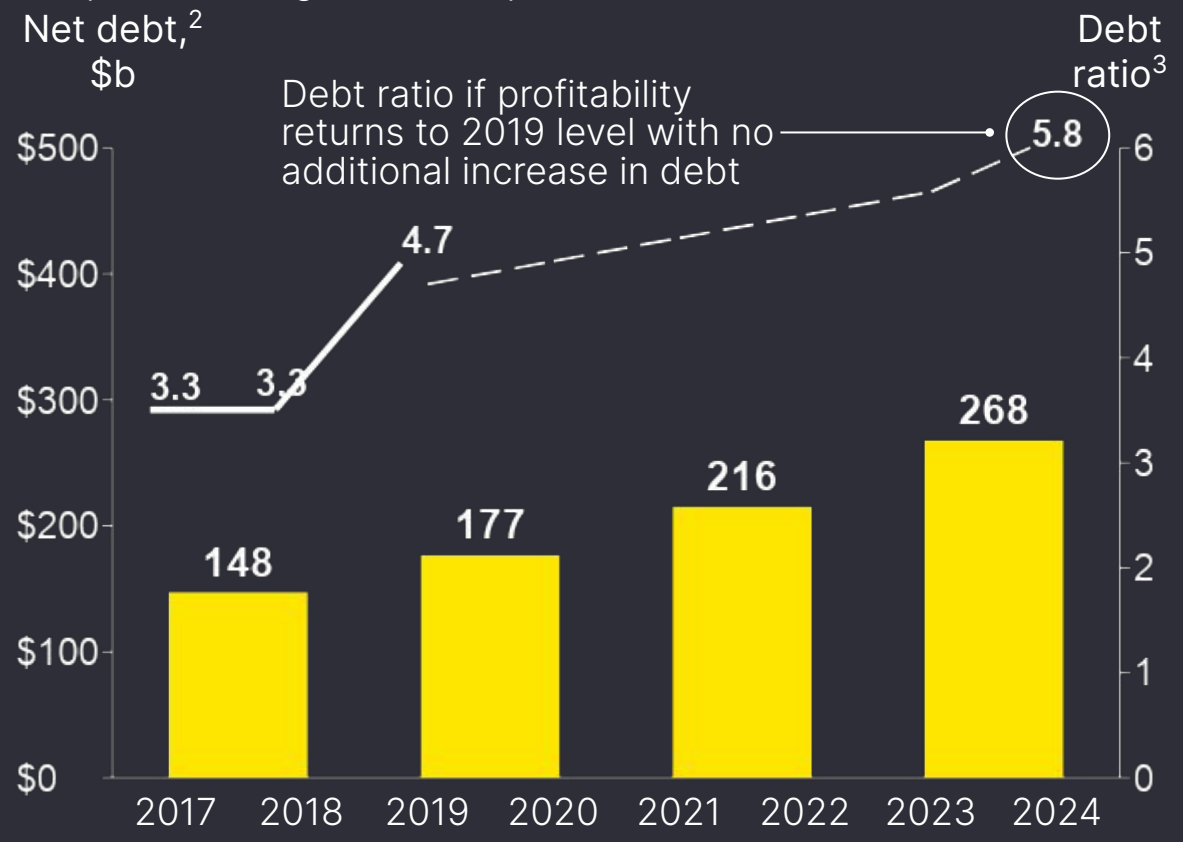
Address the implications with augmented capabilities



Increasing airline debt could impact the timing of airlines' investments in new orders

Airline debt level

Sample of 20 largest listed operators[1]



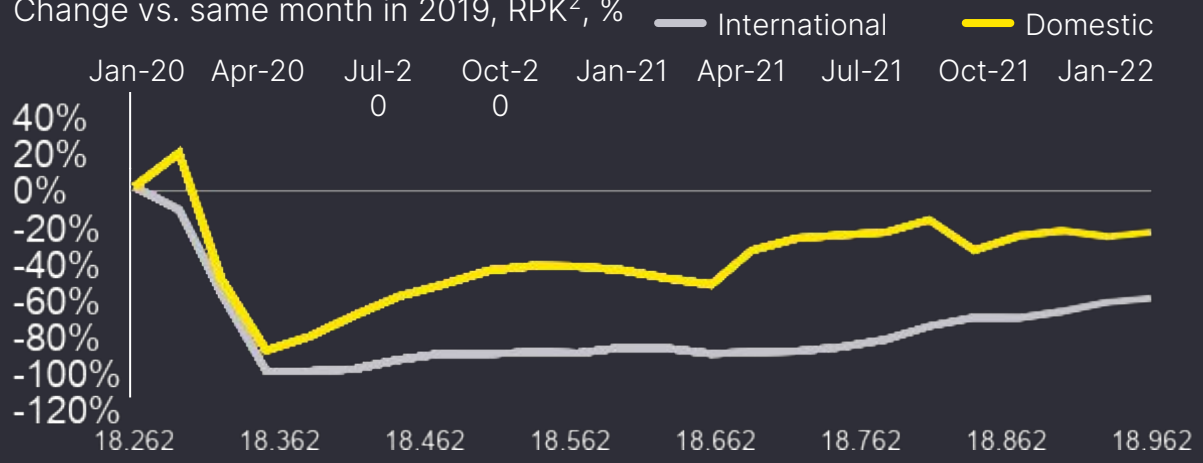
- Air traffic recovery is enabling airlines to improve profitability
- However, debt levels have increased considerably during the pandemic
  - Net debt of top six operators in the US and Europe increased $44b — this is larger than their combined EBIDTA
  - Assuming airline industry profitably returns to pre-pandemic levels by 2024, debt ratio will almost double
  - De-leveraging to pre-pandemic levels could take several years
- Rising debt level could constrain airline investment creating head wind for new orders in the near-term

[1] Jacqueline Poh, "Airlines' Debt Pile Hits $340 Billion as Covid Chokes Travel," *Bloomberg*, 13 September 2021, ©2022 Bloomberg L.P. All Rights Reserve.
[2] Net debt includes: total debt (short- plus long-term) net of cash and cash equivalents (liquid assets).
[3] Ratio of net debt to forward-looking earnings before interest, taxes, depreciation and amortization (EBITDA).

Reduction in business travel and increase in leisure segment flying premium could impact airlines' fleet mix and configuration

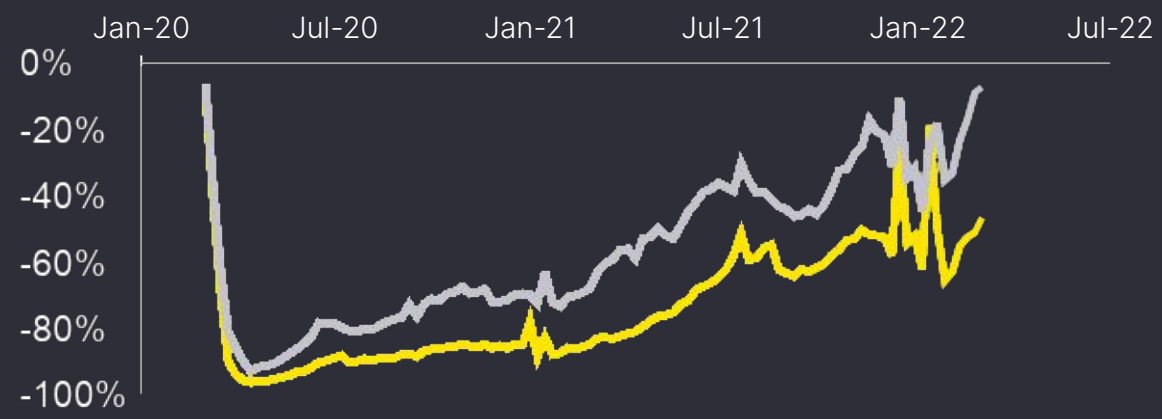
Change in global air traffic[1]

Change vs. same month in 2019, RPK[2], %



Change in US airline tickets sold by segment

Change vs. same month in 2019, %

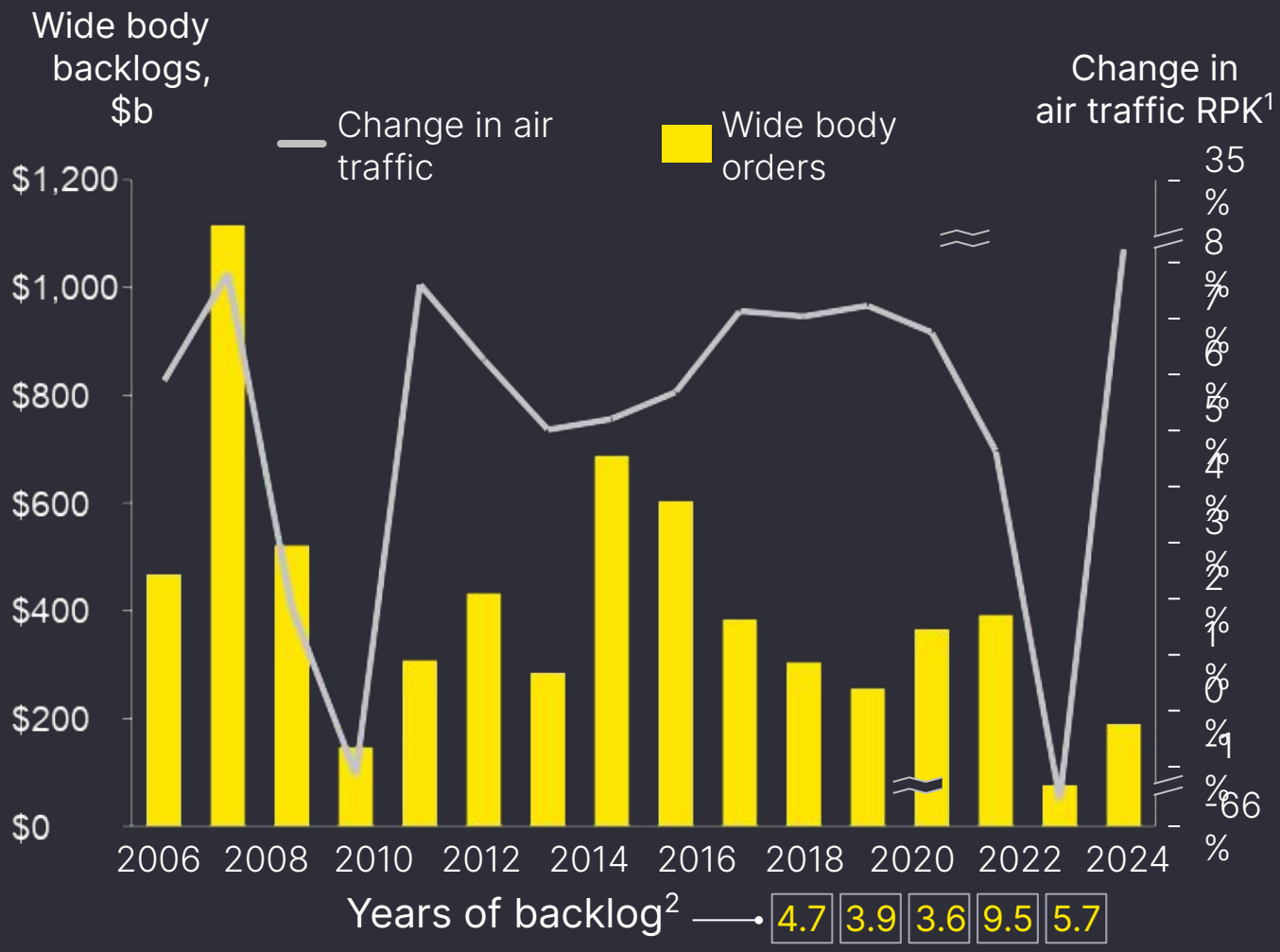


- Business travel continues to trail visual flight rules (VFR) and leisure segments during the recovery
- While still early to conclude, there is likelihood for structural reduction in business travel
  - Extensive adoption of digital tools
  - New ways of working
  - Increased emphasis on sustainability
- Emerging indications of increase in premium class travel by VFR and leisure segments
- Larger aircraft at lower unit cost
- Configuration changes, e.g., increase premium economy density

[1] Based on EY research and analysis on: "From Setback To Surge: Business Travel Expected To Fully Recover by 2024, *Global Business Travel Association website*, www.gbta.org/blog/from-setback-to-surge-business-travel-expected-to-fully-recover-by-2024/ and "'Forever Changed': CEOs Are Dooming Business Travel — Maybe for Good, *Bloomberg website*, www.bloomberg.com/news/features/2021-08-31/will-business-travel-come-back-data-show-air-hotel-travel-forever-changed, both accessed 4 March 2022.

[2] Revenue-passenger kilometers (RPK).

Uncertainty in wide body recovery could impact timing of new orders as well as volatility in parts and MRO demand



- Wide-body orders were depressed even prior to the pandemic
  - Decline in air traffic growth rate
  - Profitability of Middle East carriers
  - Narrow bodies replacing some widebody routes
- Reopening of borders and recent wide body orders are encouraging …
- … but recent air space closures due to geopolitical issues will impact utilization, air traffic, and consequently Maintenance, Repair and Overhaul (MRO) demand
- Wide body production rates may not grow or be sustainable at pre-COVID-19 levels without growth in new orders

[1] "Aerospace chiefs prepare for bumpy ride in recovery of long-haul flights, *Financial Times website*, www.ft.com/content/16329645-6dba-45df-a7b4-5c1d9c766cf1, accessed 4 March 2022.
[2] EY analysis: year of backlog = backlog/annual production rate (company reported current and projected production rates); for 2022-25, calculated on unfilled orders.

New airlines driving up competitive intensity which could further impact airlines' profitability delaying financial recovery

To date, more than **90** airlines launched during the global pandemic and additional airlines are expected to enter the industry this year[1]

1 VFR focused

- Targeting leisure segment
- New international city pairs
- Differentiated positioning

2 Regional focused

- Domestic or regionally focused within continent
- Peer to peer (P2P) to secondary cities

3 Low-cost, long-haul focused

- Wide body in high density configuration
- Narrow body on moderately long and thin routes

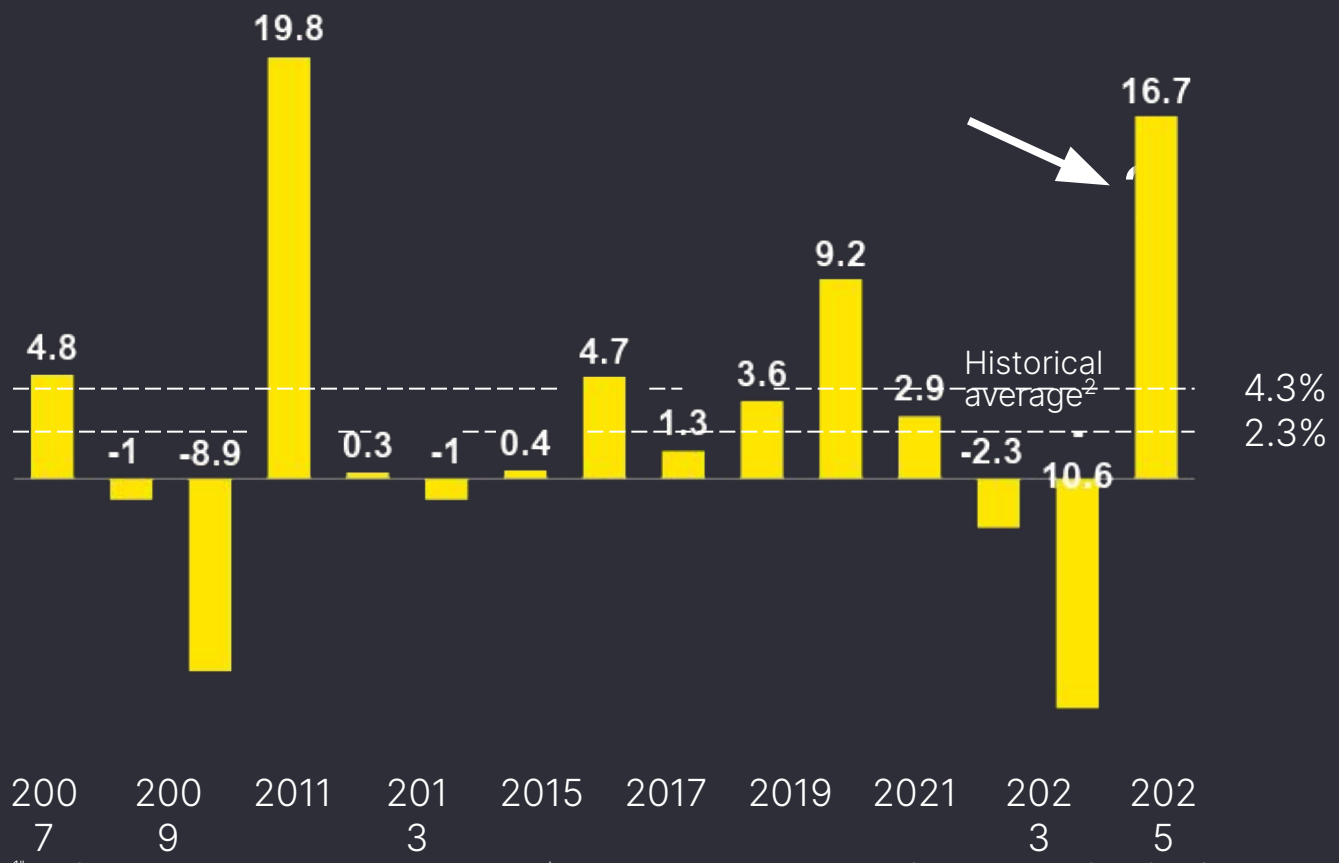
- Increase in competitive intensity could pressure airlines' yield
- Challenges for airlines to increase yield and profitability has implications on new orders and expansion

[1] "More Than 90 New Airlines Are Launching in 2021. They Say It's the Perfect Time," *Wall Street Journal website*, www.wsj.com/articles/more-than-90-new-airlines-are-launching-in-2021-they-say-its-the-perfect-time-11619793036, accessed 4 March 2022.

Continued near-term cargo surge could likely revert to historical average growth rates

Growth in air cargo volume demand[1]

% change year-over-year



- Continued strong demand in 2022 for air cargo driven by:
  - Manufacturing output and low inventory levels
  - Continued eCommerce growth
  - Near-term demand for vaccine transportation
  - Limited lower hold capacity of pax aircraft as pax traffic recovers
- Recent growth rate spikes are more than twice that of historical long run average
- Historically, air cargo growth rates have returned to long-run average after spiking during or post shocks

[1] "IATA forecasts 2021 air cargo revenues to hit record $175B," *FreightWaves website,* www.freightwaves.com/news/iata-forecasts-2021-air-cargo-revenues-to-hit-record-175b, accessed 4 March 2022.
[2] EY analysis based on historical average resource

Labor supply constraints could pose head winds for airlines to meet demand during recovery

~0.5m job loss[1] in 2020 in the global airline industry

10.8% expected growth[2] in airline workforce demand in 2022

~30,000 shortage of commercial pilots[3] by 2025 if traffic demand increases above 2019 levels

30% fewer mechanic certificates issued[4] by FAA in 2020 vs. 2019

[1] "Can Airline Recovery Transcend Ongoing Pandemic Challenges?" *Aviation Week* website, aviationweek.com/air-transport/airlines-lessors/can-airline-recovery-transcend-ongoing-pandemic-challenges, accessed 4 March 2022.
[2] "Airline Recovery Could Be Stifled Due To Pilot Shortage," Travel Daily Media website, traveldailymedia.com/airline-recovery-could-be-stifled-due-to-pilot-shortage, accessed 4 March 2022.
[3] Nasdaq website, nasdaq.com/articles/a-massive-pilot-shortage-is-coming, accessed 4 March 2022.
[4] Travel Weekly website, travelweekly.com/Travel-News/Airline-News/Aircraft-mechanic-shortage-could-hamper-operations, accessed 4 March 2022.

Summary of implications for commercial aerospace suppliers and capabilities to address the challenges

Emerging trends ...

Increasing airline debt levels

Changes in premium travel

Uncertainty in wide-body rebound

New airlines driving up competitive intensity

Near-term cargo surge

Labor supply shortage

Net-zero emphasis and new technology

... and implications and

- Production **rate increases** amid **uncertainty in mix**
- **Demand volatility** due to mix in MRO demand and increase in new air conditioning (a/c) production rate
- **Labor constraints** impacting capacity
- **Material availability** impacted by supplier readiness
- **Insufficient resources** in supply chain and production
- **Commodity price inflation**
- Increasing **emphasis on cost and cash** post-pandemic

... capabilities for addressing

1. **Integrated digital planning** powered by artificial intelligence (AI) and/or machine learning (ML)
2. **“Real-time” supplier risk monitoring and mitigation**
3. **Digital twin of supply chain and factory** to enable simulations to predict and act
4. **Smart operations** to maximize asset and labor productivity
5. **Win the battle for talent** with differentiated employee value proposition

1 Integrated digital planning: using ML for improved forecasting and planning

An analytics-driven approach to forecasting

- Eliminates biases inherent in manual forecasts …
- … while minimizing forecast errors and process inefficiencies
- Model can enhanced with unstructured and external data from diverse sources

A continuous feedback loop identifies emerging patterns in the data to adjust the models

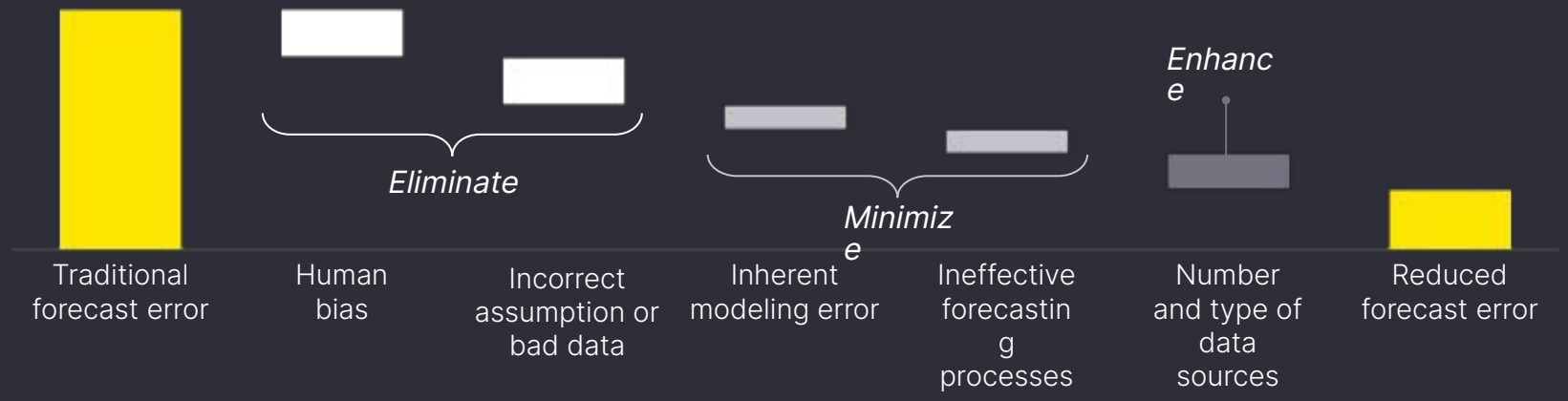
Recognize patterns in data to identify what data points are important

Look for learned patterns in new data using analytics on historical data

Predict future outcome based on observed patterns in current and historical data

Review the results and *take action* as model can seamlessly integrate into existing technologies

Improved accuracy in forecasting



2 ‘Real-time’ supply risk monitoring and mitigation approach

Aerospace supply chains inherently lack resilience due to their characteristics:

- Concentrated supply base
- Poor visibility to sub-tier supply base
- Moderate rate production
- Long lead-time for parts
- Real (and perceived) high switching costs
- Real (and perceived) high switching costs
- Legacy contingency and crisis management plans

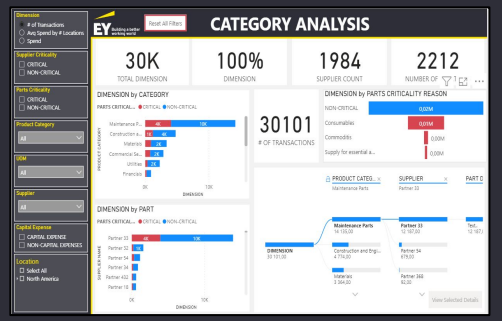
Three step approach for real-time risk monitoring and mitigation

A Stratification and prioritization of supply base

- Prioritize suppliers and parts that post the biggest risk …
- … using factors such as: historical performance, greatest impact, value, single source, safety stock, etc.

B Automated risk monitoring and alerting

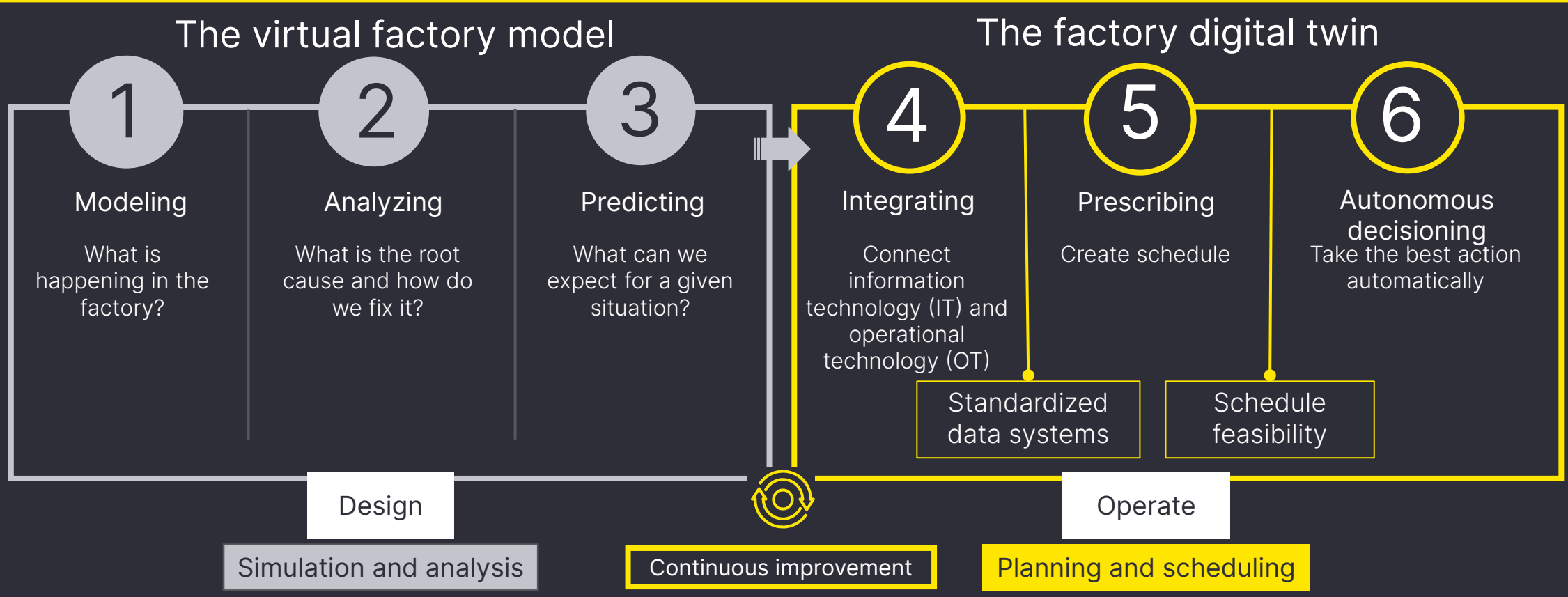
- Adopt digital tools to automate real-time risk monitoring using publicly available data, e.g., sites, labor issues, financial challenges, litigations
- For critical suppliers, augment with automated data feed from suppliers, e.g., inventory, cycle time, quality



C Supply risk mitigation actions

- Operational support and supplier management
- Supplier financing
- Consolidation and long-term strategies

3 Digital twin: integration of virtual model with live data enables rapid planning, rescheduling and better decision-making



Enabled capabilities (examples)

- Model capacity
- Create feasible schedule for demand
- Model improvement
- Plan capacity on a flexible time horizon
- Replicate the reality that bottlenecks shift
- Justify capital decisions

4 Smart operations: digitally enable shop floor and connect to supply chain to handle demand volatility, schedule instability and maximize performance

Digitally enabled operations help address operational challenges …

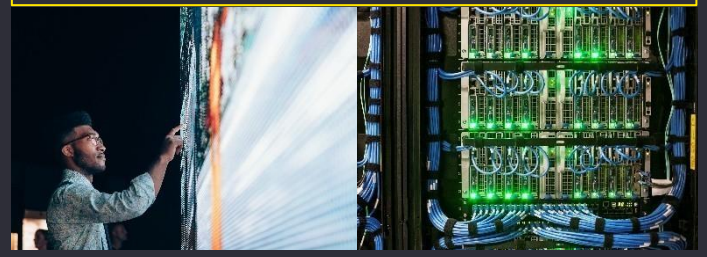
- Underperforming operations
- Workforce capability gaps
- Inconsistent performance reporting
- Disconnected operational improvement programs
- Poor use of available data and advance analytics
- Adoption and value realization challenges

Digital applications, supported by standard ways of working, help empower a capable workforce to deliver incremental value

People

Ways of working

Digital enablement



Benefits of smart factory

- Performance as measured by overall equipment effectiveness (OEE) approaches 90%
- Digital embedded in the culture and eliminates low-value touches
- Knowledge is captured with multimedia and accessible by all
- Manufacturing capability progression is digitally enabled
- Digital standard work processes to drive efficient execution
- Automated and integrated data management reduces loss
- Culture of employee ownership improves workforce engagement

4 Build and scale digital factory — use cases on a common data across ET, IT and OT

ILLUSTRATIVE — NOT EXHAUSTIVE

Data-driven manufacturing use cases

Scalable and secure architecture

Standardized data foundation

OT/IT data connectivity, integration

Use cases

Digital lean	Digital worker	Smart assets/ maintenance	Smart quality	Smart production	Smart scheduling	Smart technology
Advanced analytics	Shopfloor execution apps	Machine health	Automated fabrication	Physical automation	Digital twin	Additive manufacturing
Digital tier meetings	Augmented reality (AR) and virtual reality (VR) work instructions	Machine optimization	Automated visual inspection	Assembly collaborative robots (co-bots)	AI/ML scheduling	Industrial robots
Digital Kanban	Performance visibility	Condition-based maintenance	Digital thread	Digital parts picking	Route optimization	Co-bots
Digital skill development	Rework visibility	Downtime and failure prediction	Component traceability	Automatic guided vehicle (AGV) parts delivery	Make-to-stock and make-to-order optimization	Renewables
Energy optimization	Remote assists	Asset analytics	Digital quality management system	Modular manufacturing	Mix modelling scenarios	
Automated data entry	Digital coach	Autonomous maintenance	Predictive quality			
Digital key performance indicators (KPIs)		AR/VR part inspection	Wate management			

Manufacturing data fabric

Data integration	Data hubs	Governance	Data lake	Data catalog	Data models	Analytics	Data quality	Provisioning	Consumption

Supporting technology

Mobility	Barcode scanning	RFID	Visual inspection tools	Augmented reality	Virtual reality	RPA	Wearables	Smart meters	Sensors

Foundation

Industrial internet of things (IIoT) platform							
Manufacturing and engineering systems foundation							
Product lifecycle (PLM) and computer-aided design (CAD)	Enterprise resource planning (ERP)	Manufacturing execution system (MES)	Supervisory control and data acquisition (SCADA)	Distributed control system (DCS)	Historian	Programmable logic controllers (PLCs)	Devices
OpEx/lean system							
Manufacturing strategy, vision, and road map, i.e. engineering technology (ET), information technology (IT) and operational technology (OT)							

5 Winning the battle for talent: build a differentiated employee value proposition

2021 Aerospace and Defense Workforce Study[1]

Top six differentiated benefits cited by companies, % of respondents in survey

- **97%** Recognition
- **94%** Career development opportunities
- **94%** Tuition reimbursement
- **85%** Flexible work arrangements
- **76%** Overtime pay
- **70%** Retirement

- Evaluate employee value proposition and employee brand and effectively market it to candidates and employees
- Implement thoughtful workforce planning activities further into the future — monetize skill sets to make informed hiring develop and retaining decisions
- Maximize return-on-people investment through conjoint analysis on total rewards offered
- Proactively address retention using analytical models to predict attrition likelihood at the role and employee level
- Safeguard that competitiveness of pay assessments are conducted in local markets to inform decision-making
- Consider offering greater flexibility to access unfound workforce capacity
- Leverage automation in talent acquisition process to determine root causes for candidates exiting the process as well as quality of talent sources vs. investment committed

[1] "2021 A&D Workforce Study: how to prepare now for the work of the future," study jointly conducted by Aerospace Industries Association (AIA) and Ernst & Young LLP.

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