IATA AVIATION DATA SYMPOSIUM

ATHENS, GREECE 25 – 27 JUNE 2019

SAFETY & FLIGHT OPERATIONS

IATA

Opening Remarks

Chris Markou, Head Operational Cost Management, IATA

Skywise & Predictive Maintenance by aiming to be the data platform used by all major aviation players

Frederic Sutter, Digital Transformation Leader, Airbus

IATA AVIATION DATA SYMPOSIUM
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AIRBUS

Skywise: a collaborative ecosystem across the aviation industry

skywise.

Frederic SUTTER
Digital Transformation Leader, Airbus

The Fundamental Problem

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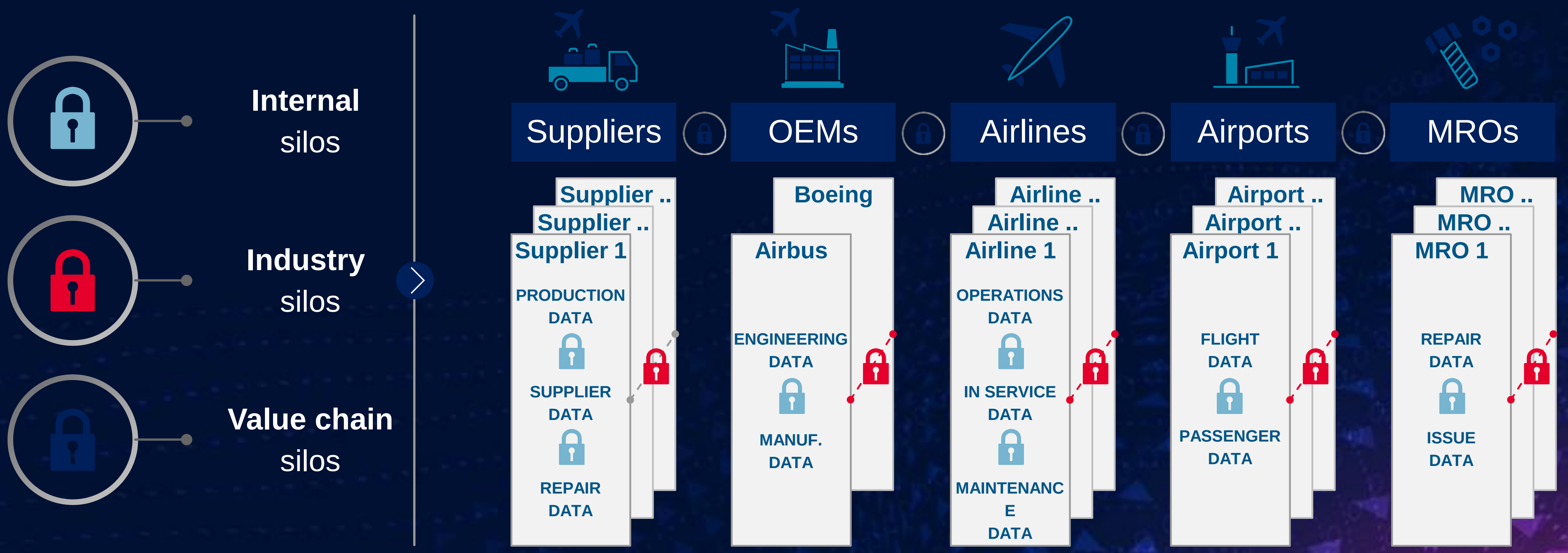
Eliminating industry wide friction costs can generate significant value



Examples

Poor ops data feedback for product def. / improvement

Limited data sharing on issue identification / root cause analysis

No real time optim. of routes / fleet / crew

No bench-marking vs. best in class players

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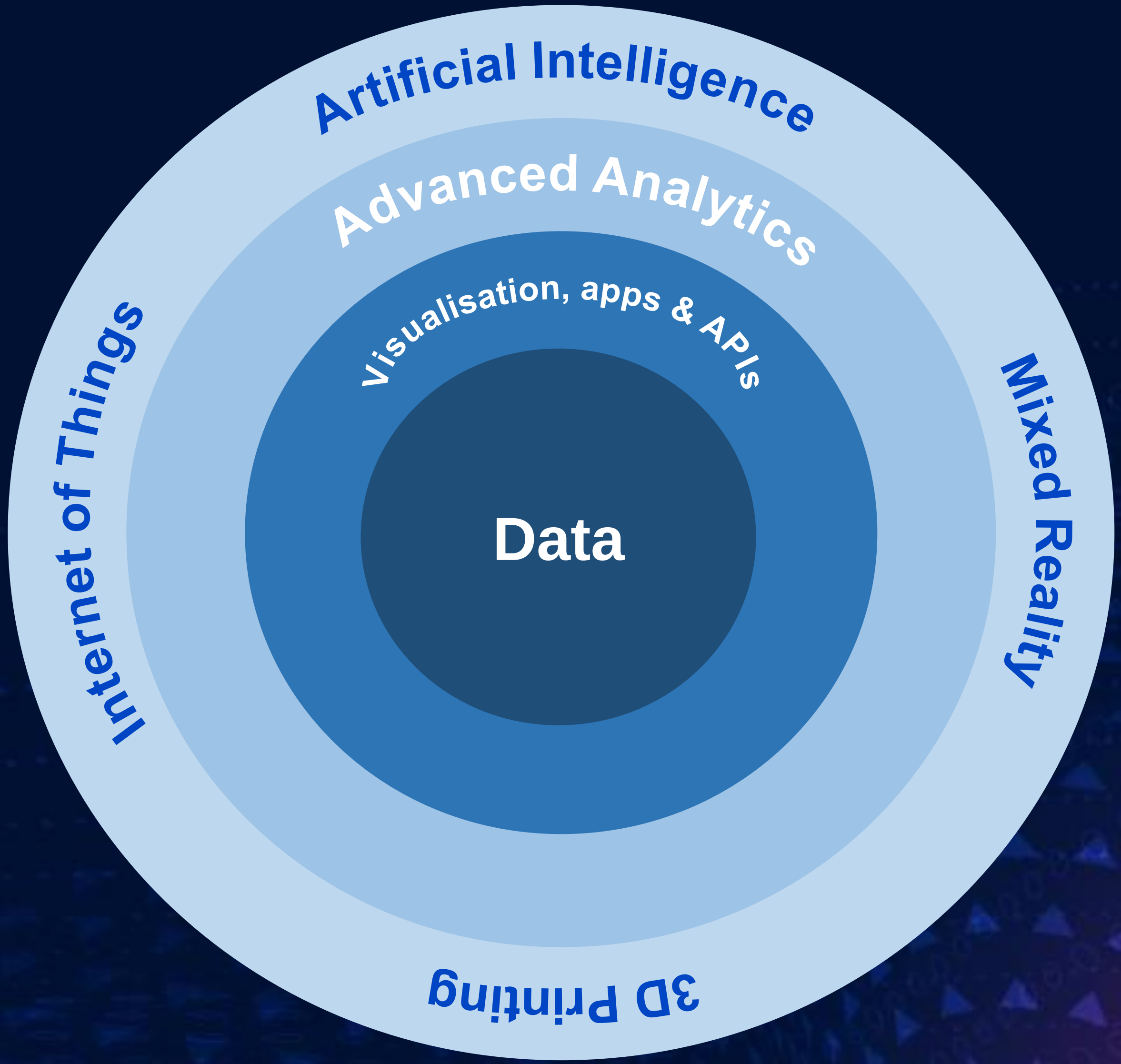
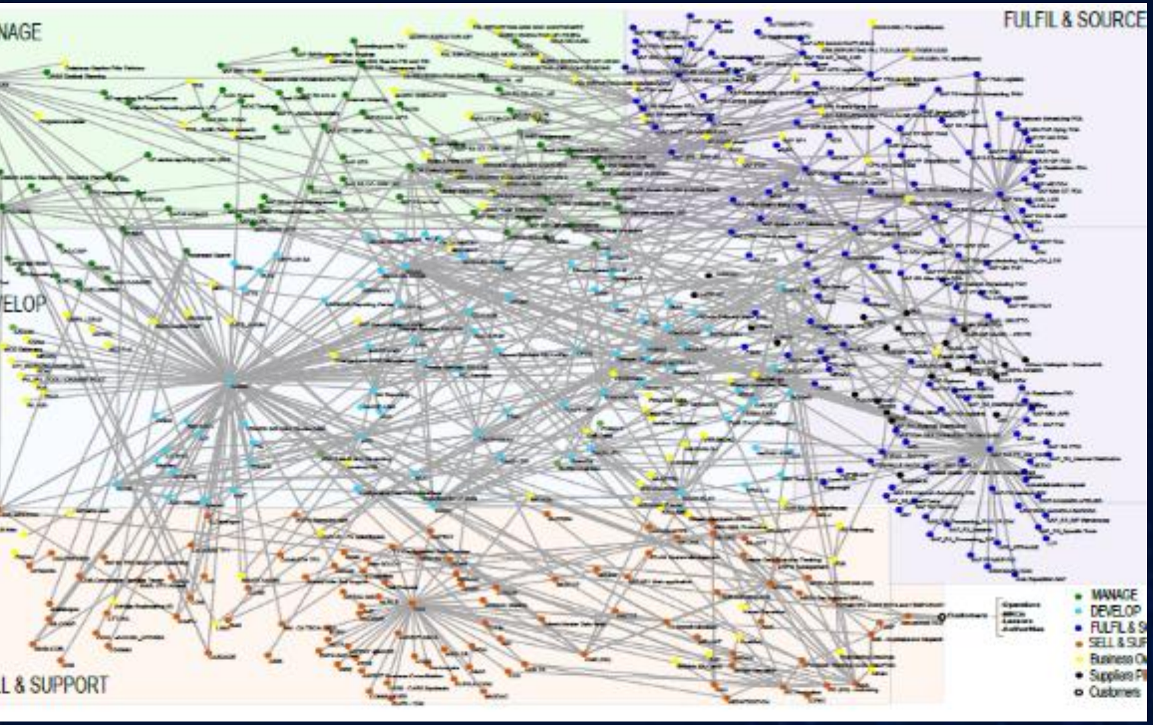
Data is THE foundation



Solving the data problem through integration, first

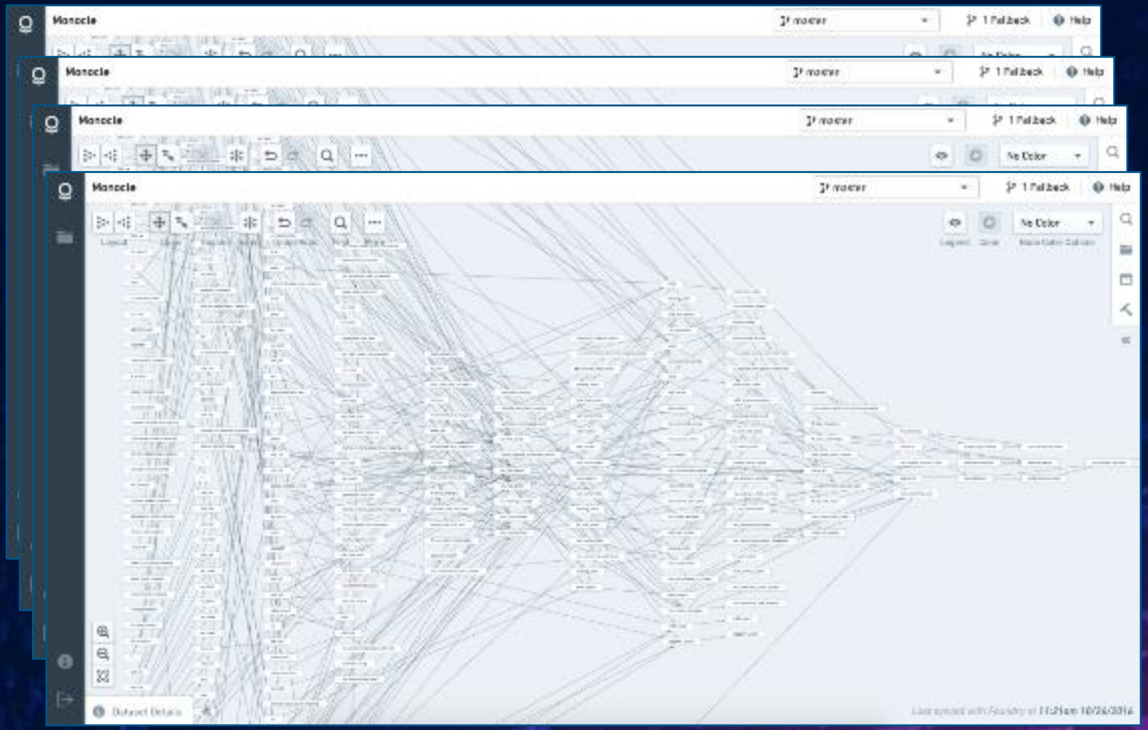
From static, heterogeneous systems…



Extraction

Integration

…To extracted, curated and actionable data



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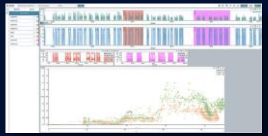
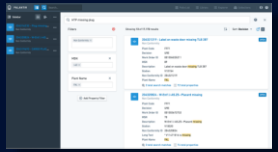
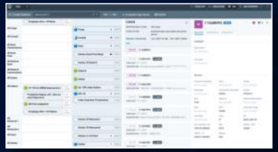
Skywise: Delivering value inside Airbus


A350 maturity acceleration


A350/A320 quality


A350/A320 production


Predictive maintenance

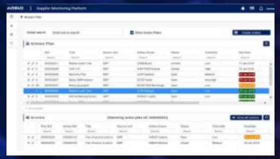

Product Control Tower


Smart Repair Wizard


Bill of Materials


Time to get a fix


Industrial processes monitoring


Supplier monitoring portal


Procure to Pay

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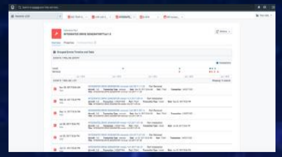
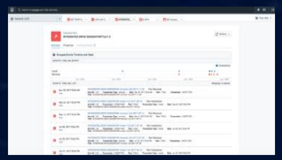
Skywise: Delivering value for airlines

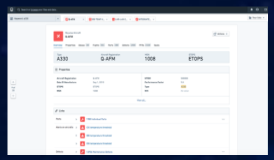
Digital Services



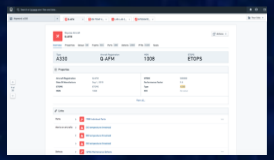
Warranty claims automation



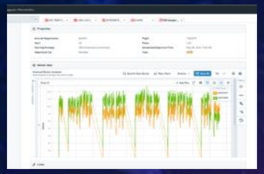
Defect management



Fleet wide reliability



Root cause analysis



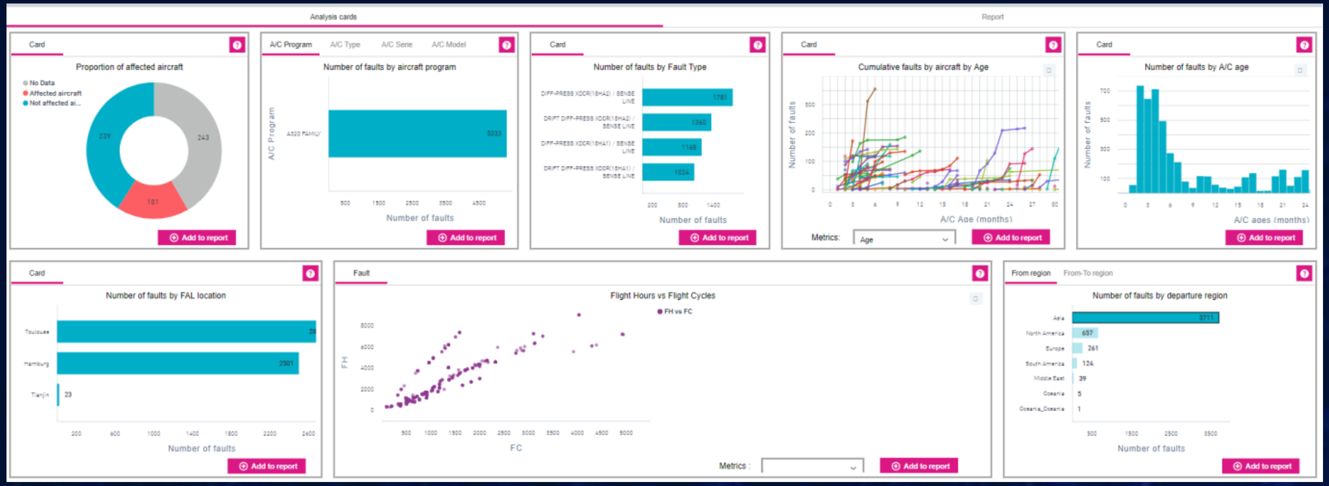
Operational safety investigations

Skywise for Supplier – RCA collaborative environment use case

Airbus only

Issue data collection and selection

Share anonymized dossier with supplier



Airbus
Supplier

Supplier anonymized issue dossier

Event analysis based on anonymised time series

Issue key drivers identification

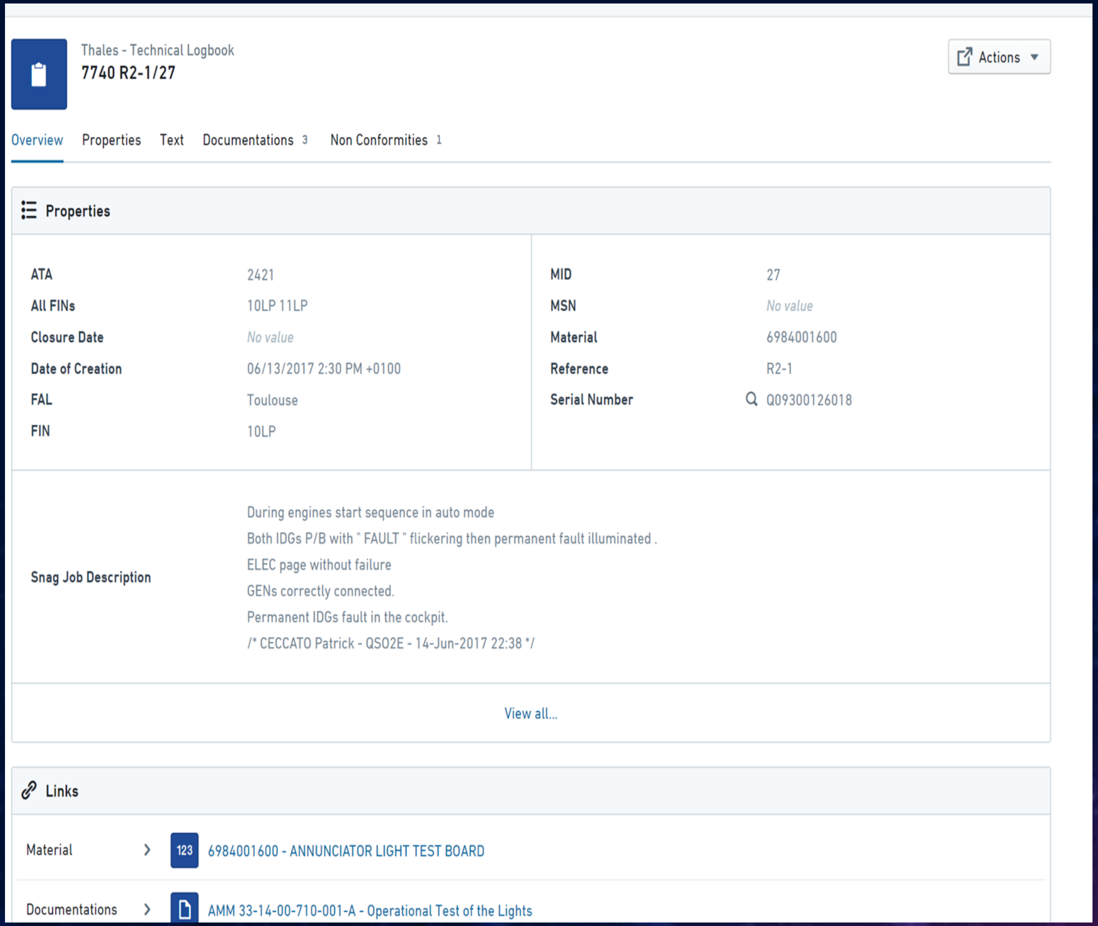
Define test conditions to reproduce the issue

Skywise: Delivering value for suppliers

Quality

With Skywise Quality, I can now reproduce the failures exactly as they occurred in the Airbus production line, with a full understanding of the root cause and how to eradicate it

QUALITY ENGINEER AT SUPPLIER



Helps quality engineers quickly contain sudden quality issues and eradicate recurring defects in the long term

AIRBUS

Skywise Partners
Unleashing the potential of data. Together.

We believe in opening the Skywise platform to seamlessly integrate cutting-edge developers with aerospace data will create even greater value.

With our partners, we provide collaborative power that unleashes potential and increases utility of data to create impactful, high quality solutions with a shorter time to market.

The program is dedicated to everyone in the aerospace ecosystem who wants to make the best possible use of data.

IBM FPT Software accenture Capgemini sopra steria

AIRBUS

Skywise Today

skywise.

80+
Airlines

10+
Suppliers

6500+
Aircraft

10000+
Unique Monthly Users

35M+
Maintenance Actions

120+
Systems Integrated

5+
Skywise Partners

Building an open data platform for aviation

AIRLINES
Services for improved flight operations, maintenance, asset utilisation, disruption mgmt.

LESSORS
Asset utilisation optimisation

SUPPLIERS
Predictive maintenance
Improved component design

MROs
Optimised issue identification with in-flight data

AIRPORTS
Services for optimised air / ground traffic mgmt.

Air Traffic Control
Real time visibility on flight status

AIRWORTHINESS
Accelerated certification process

THIRD PARTIES DEVELOPERS
Market for value-added services

AIRBUS INTERNAL
Higher operations efficiency and productivity
Improved aircraft design

AIRBUS

Skywise: A robust and sound approach to data

- Airlines own and control their data
- Shared value – participating in Skywise and sharing data is a choice
- Airlines cannot see each others’ data but benefit from anonymised aggregated data
- Skywise supports the full breadth of airline operations – “private area” can host operation sensitive or non-Airbus multi-fleet data
- Open by design to airlines and 3rd party Developers through APIs
- First Skywise Partners announced in PAS 2019
- Built-in data governance and cyber security

AIRBUS

Skywise User Testimony

Myths v/s Facts

Myths		Facts
In aviation, digital is challenging to apply and to benefit from	›	**WRONG**! We have achieved 2-digit improvements in over 60 implementations
Our current business models will be difficult to challenge and will ultimately prevail	›	**WRONG!** New paradigms such as 'zero aircraft on ground' (Zero-AOG) will emerge
Data science creates business value by itself	›	**WRONG!** Only the right blend of digital capabilities and domain knowledge, with specific process, delivers industrial value creating use cases
EXCLUSIVE Data OWNERSHIP is the path to value	›	**WRONG!** SHARING data creates common value, enabled by technology with no compromises on security

AIRBUS

Thank you!

Predictive Maintenance Already Providing Benefits to Operators?

Rodolphe Parisot, VP Digital & Innovation, Air France Industries
KLM Engineering & Maintenance

AIRFRANCE INDUSTRIES KLM Engineering & Maintenance

ADAPTIVENESS®

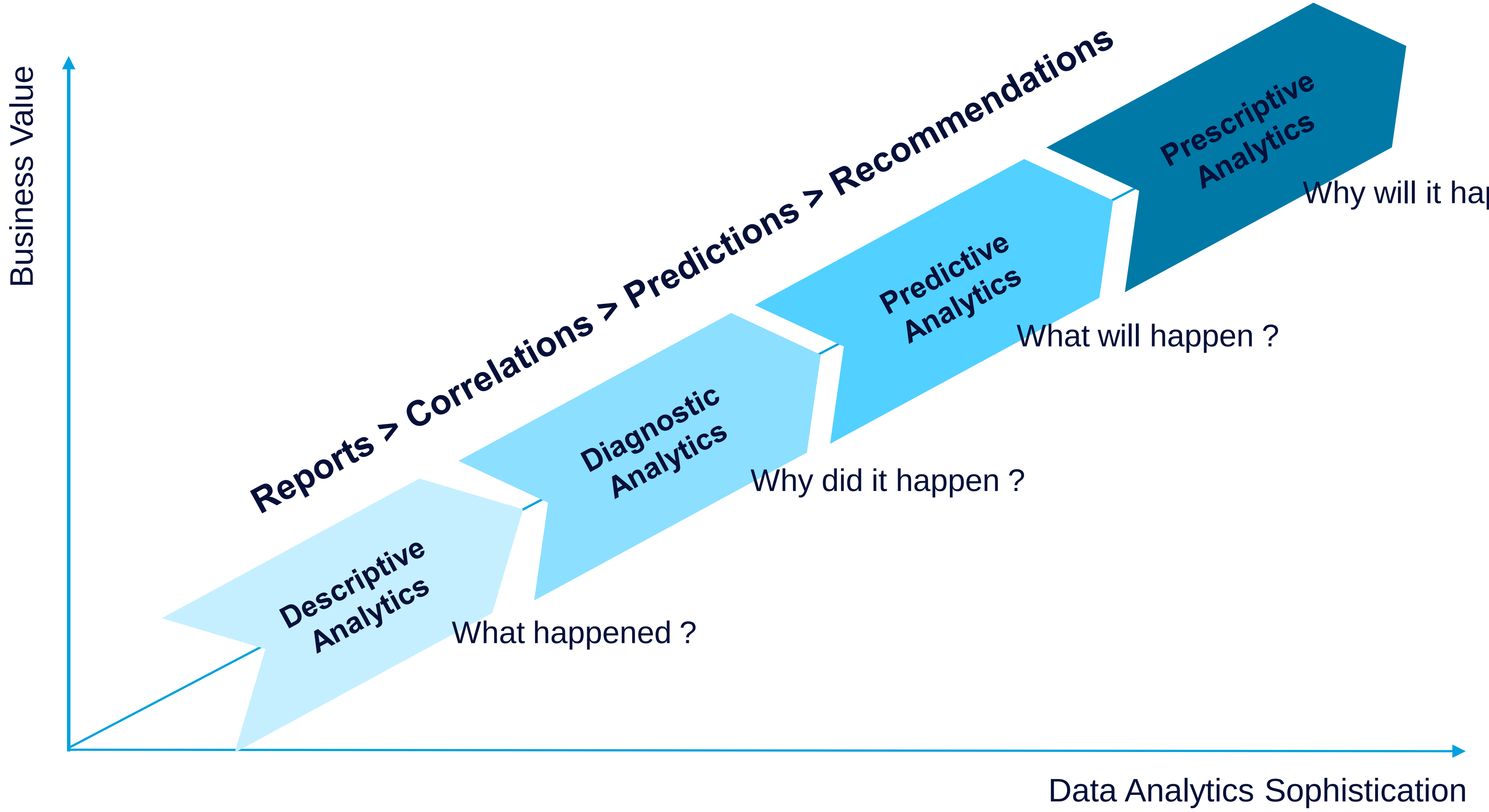
PREDICTIVE MAINTENANCE
ALREADY PROVIDING BENEFITS TO OPERATORS?

Rodolphe Parisot – VP Digital & Innovations

IATA Aviation Data Symposium 2019

BIG DATA: OPTIMIZE MAINTENANCE OPS

THE PROGRESSION OF ANALYTICS



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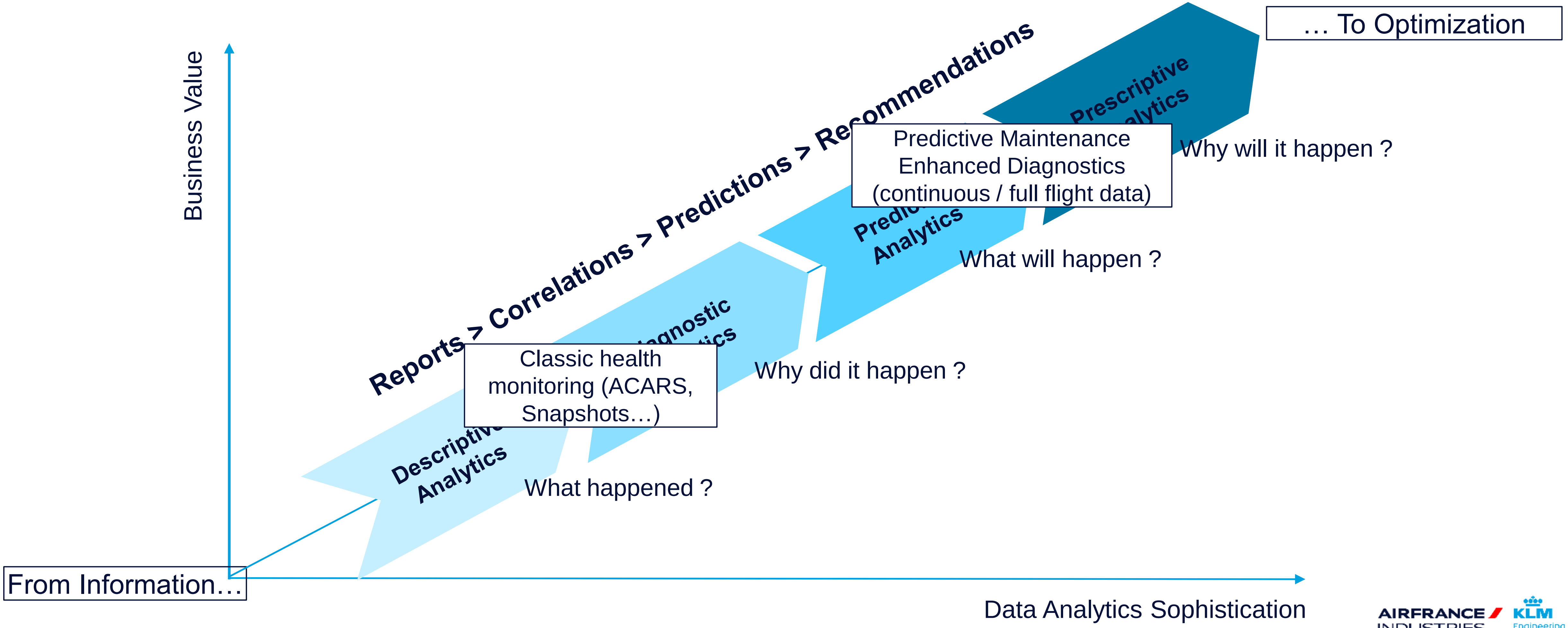
BIG DATA: OPTIMIZE MAINTENANCE OPS

THE PROGRESSION OF ANALYTICS



OPERATION NEEDS VS. MARKET OFFER

WHY DOES AIR FRANCE KLM DEVELOP ITS OWN PRODUCTS?

OEM **AHM** tools: advanced users (pilot airline for development)

- Agnostic solutions?
- Predictive capabilities?
- Focus enough on operator’s concerns?

ECM tools

- Agnostic solutions?
- Advanced analytics?
- Customization of algorythms?

APU condition Monitoring tools

- ?
- Agnostic solutions?
- Advanced analytics?

Remaining **Operational Disruptions**

- Predict failures before occurrence (MMSG)
- Use of Full Flight Data ($x10^7$ more data !)
- Business value? Feasability?

WHY PREDICTIVE MAINTENANCE?

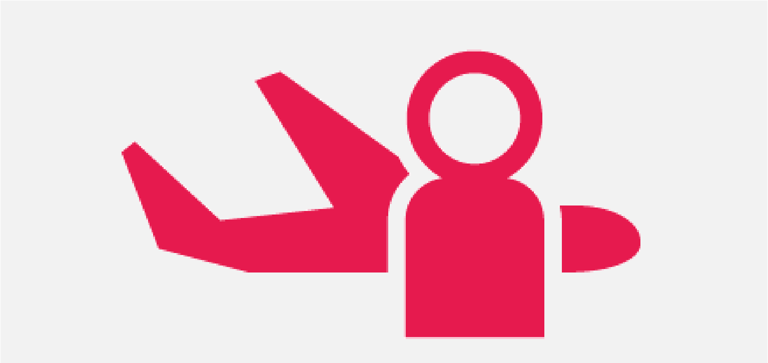
ADDRESSING OPERATIONAL CONSTRAINTS AT FIRST

Beyond Value	Goals
• Curative / preventive limitation • Agnosticity • No existing solution available • Need of (more) anticipation • Focus on multiple systems ranked by operational impact • Use of data generated by new and legacy aircraft	• Improve operations / aircraft dispatch • Limit technical delays • Avoid flight cancellations • Reduce unscheduled maintenance • Prevent NFF by more accurate monitoring of system performance with full flight data • Reduce troubleshooting duration by targeting the exact failing parts • Contribute to Operations Integrity • Improve stock management

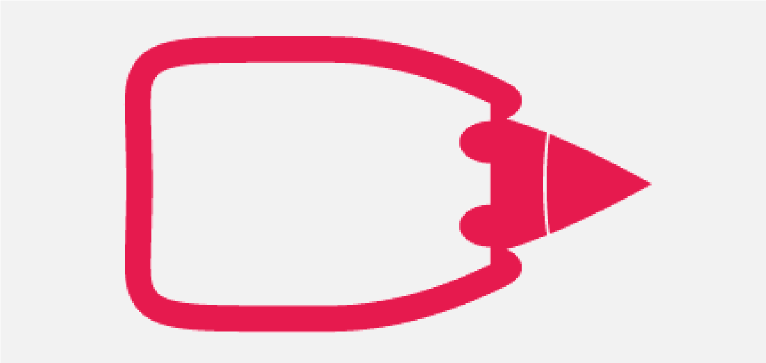
PREDICTIVE MAINTENANCE: MORE THAN YOU ALREADY KNOW

PROGNOS PREDICTS AND AVOIDS FAILURES

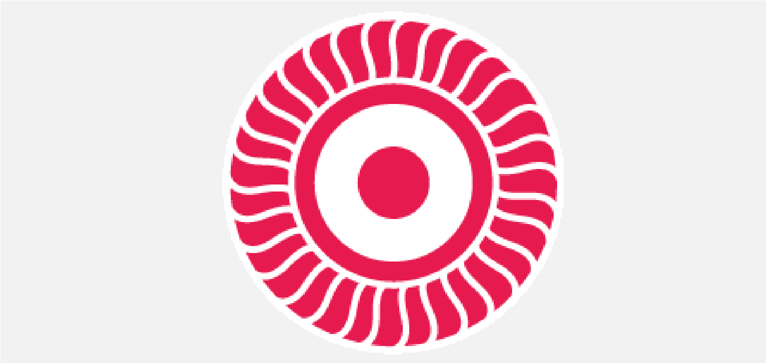
Prognos® for AIRCRAFT



Prognos® for ENGINE



Prognos® for APU



PROGNOS FOR APU

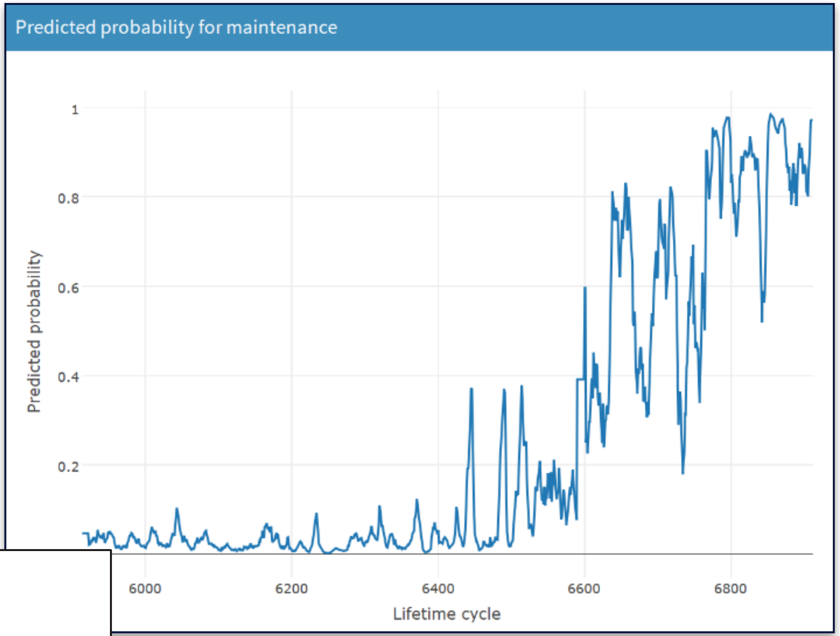
PREDICTING AND AVOIDING FAILURES

- Advanced health monitoring based on big data
  - helps airlines maintain maximum control over their APU assets
  - keeping them operating for as long as possible with minimal effort.

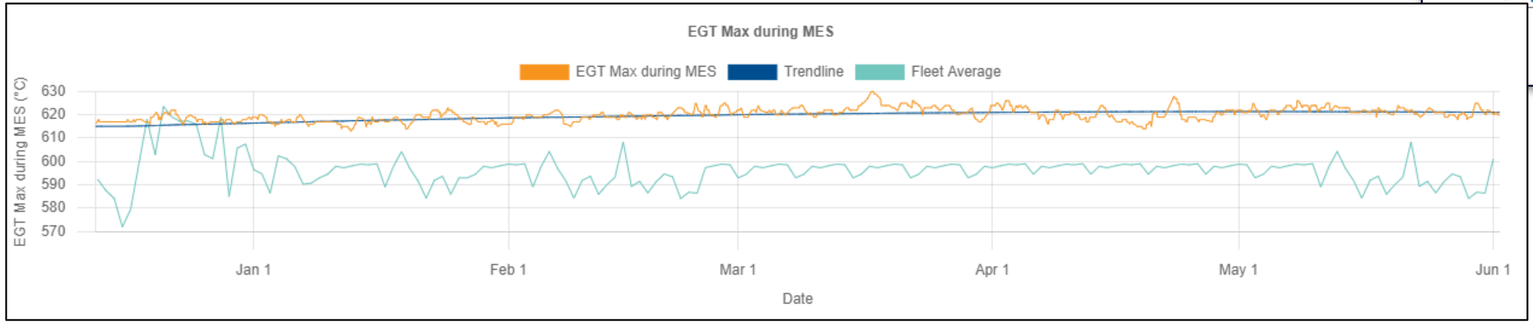
- Features
  - APU start time, exhaust gas temperature, bleed system, oil system, generate load
  - Life limit parts monitoring, fleet average
  - Smart dashboard, degradation model

- Available for
  - Airbus 319-321, 330 and 340
  - Boeing 777, 737 and 787
  - Embraer 175 - 190

Prognos® for APU



Prediction Algorithm APS2300



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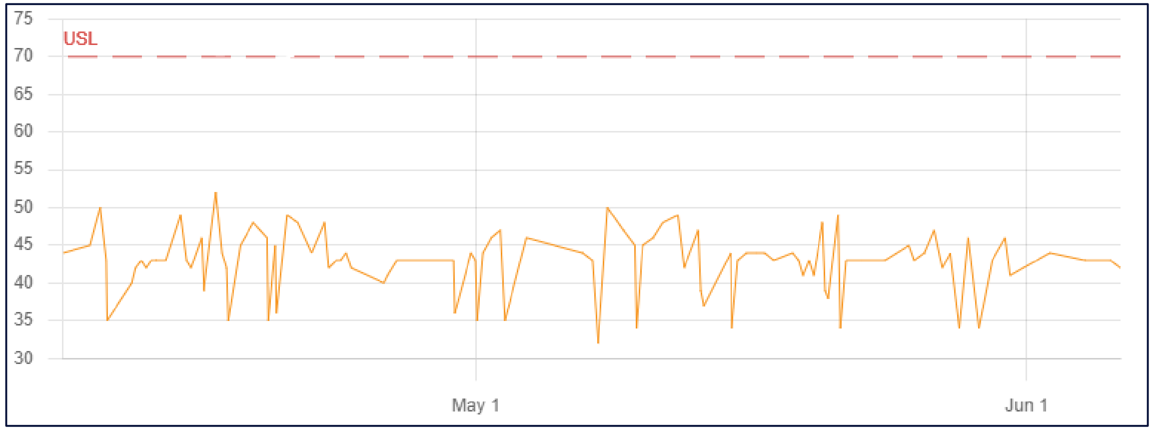
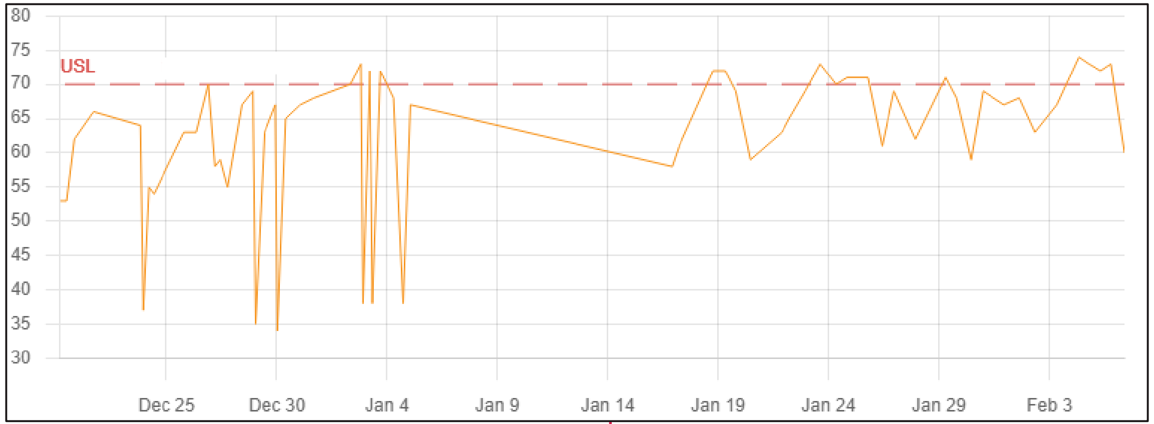
PROGNOS FOR APU

CONCRETE USE CASE – BOEING 787 APU

Normal
behaviour:



APU "X"
behaviour:



APU Engineer noticed abnormal behaviour and advise the airline to plan inspection of the oil filter.

= € € € €

Extra cost if APU was not removed

= €

Repair cost

Particles were found

"Generator" started to fail which contaminated the gearbox. The APU was removed serviceable and failure was prevented. That resulted in preventing repair of the powerhead.

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A D A P T I V E N E S S®

PROGNOS FOR ENGINE

PREDICTING AND AVOIDING FAILURES

Prognos® for ENGINE

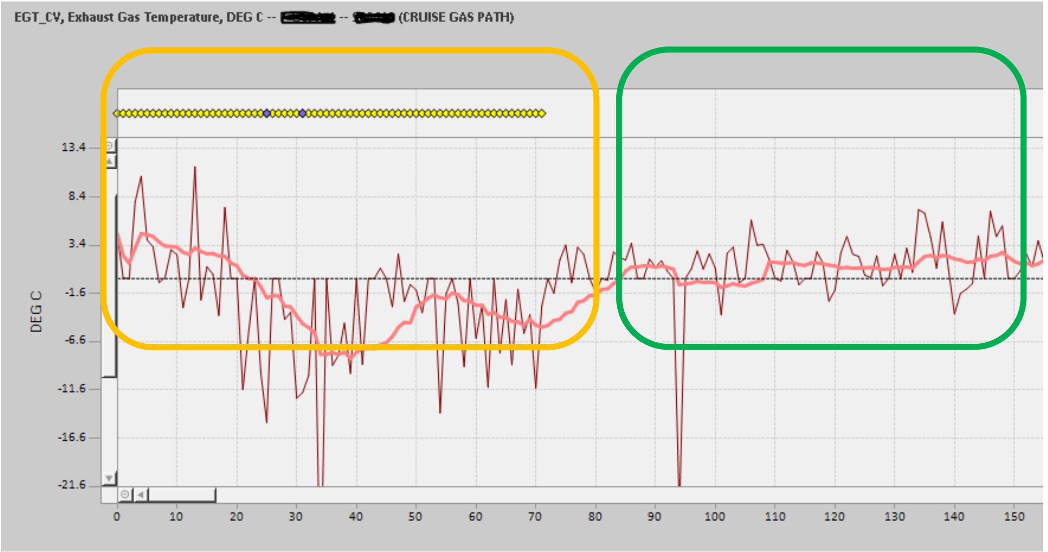
- Advanced Engine Health Monitoring solution
  - **Agnostic** solution
  - 1600+ assets monitored

- **Predict engine defects** to drive maintenance operations more precisely than ever

- 3 different usages
  - **Daily** monitoring: if “No Data” or any other Urgent Alerts.
  - **Weekly** monitoring: Normal Alerts, trend review per fleet, email reports
  - **Monthly** monitoring: Degradation Trends and Predictive Maintenance Planning
- **Advisory view**: alert status with comprehensive workflow.
- Charts of Engine data: analysis of parameters to assess Engine Condition Monitoring.

- More **advanced** monitoring
  - Monitoring and alert setting combine many sensors
  - Monitoring is customized by engine models
  - Tailored to operating environment
  - Solution learns what is normal behavior for a specific ESN (self adaptation)
  - Increase trend accuracy

→ **better identification issues / impeding failures** !



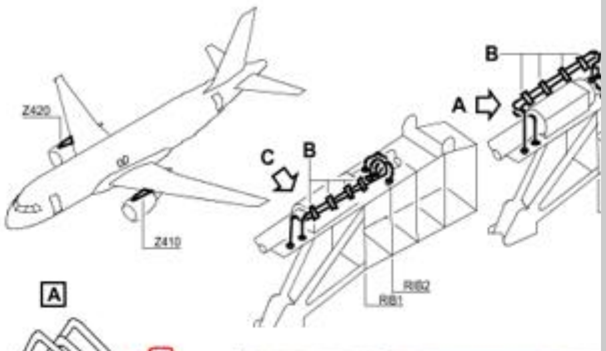
Generic Model

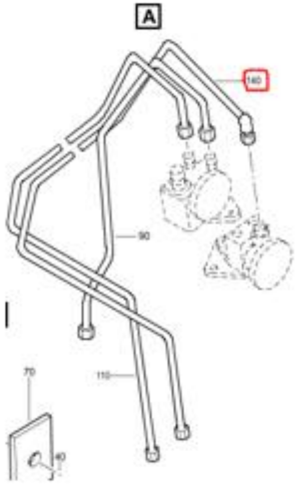
Customized model (ESN level)

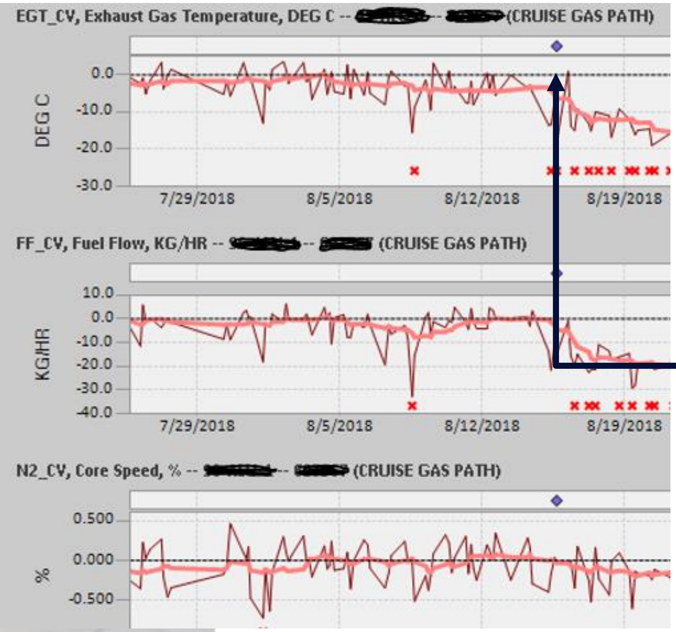
PROGNOS FOR ENGINE

CONCRETE USE CASES

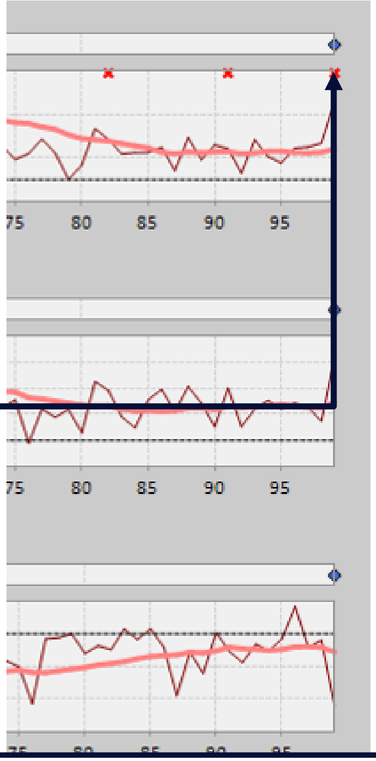
#1 : Pneumatic pipe failure – CFM56-5B







#2: HPC airfoil defects – GE90-115

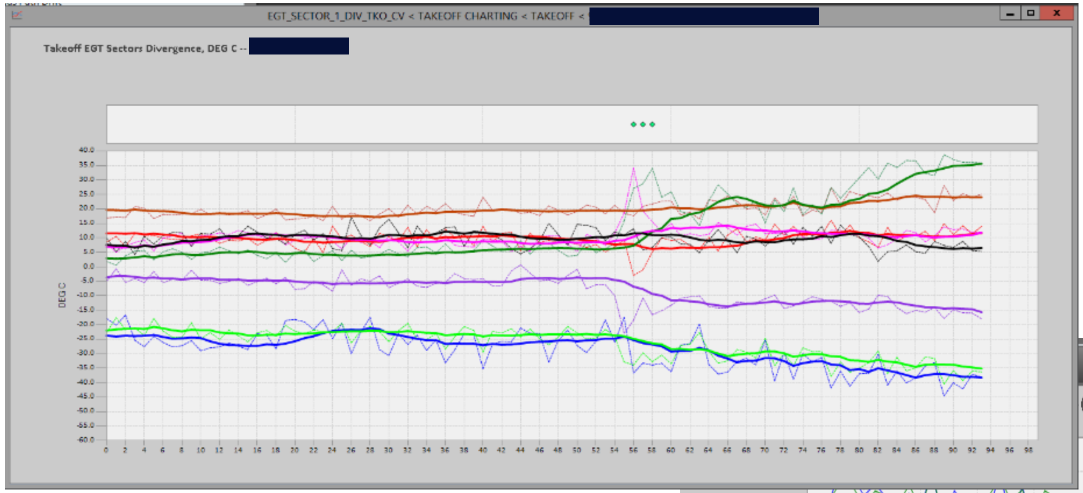


- Alerts triggered before any impact on Ops integrity
- Operational disruption prevented, Maintenance visit was planned. Extensive engine damage prevented.
- Defects not seen by other ECM products !

PROGNOS FOR ENGINE

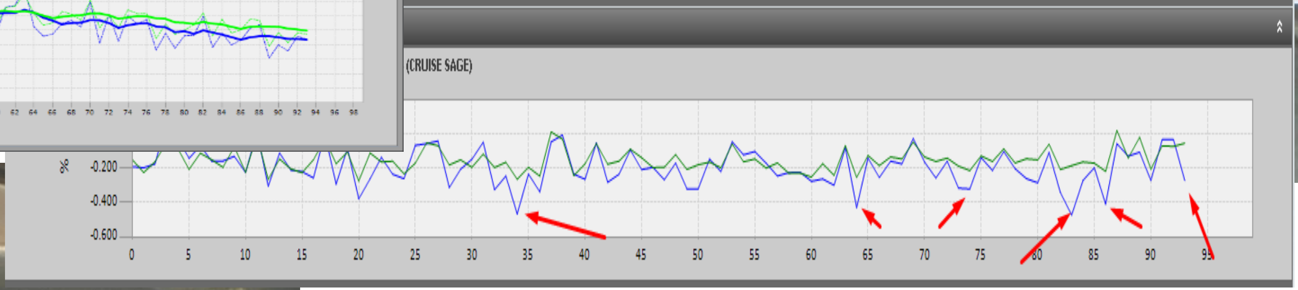
CONCRETE USE CASES

#3: 787 GEnx OGV piston ring liberation

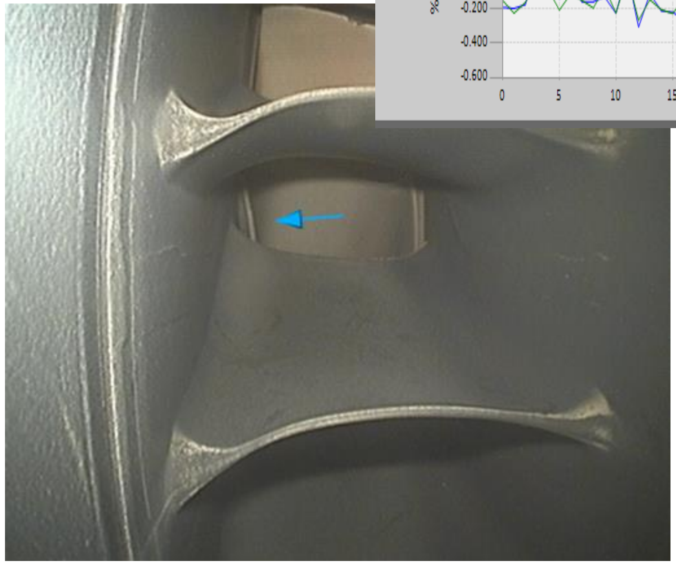


EGT sector shift observed in early stage

Compressor efficiency diverted from the estimate.



BSI showed OGV piston ring in flow path.



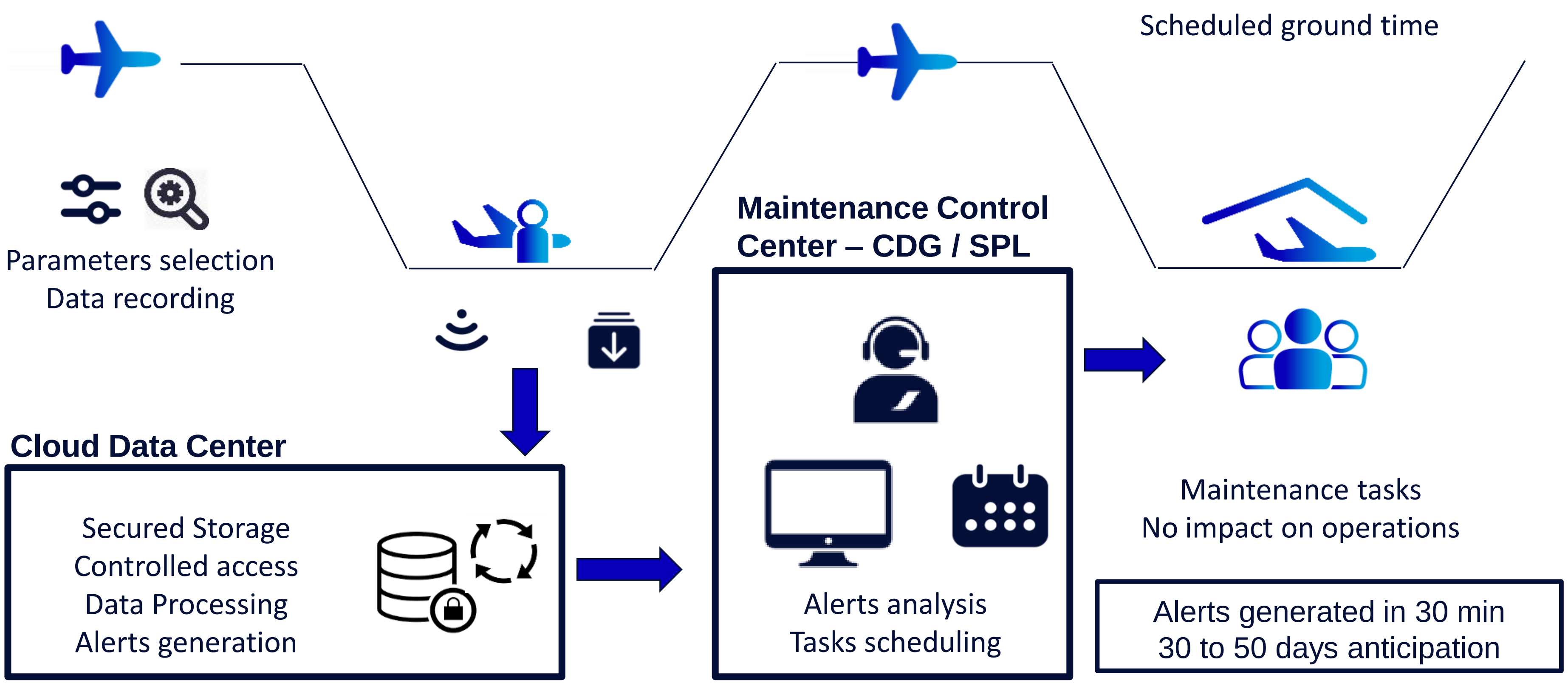
- Alerts triggered before any impact on Ops integrity
- Operational disruption prevented, Maintenance visit was planned. Extensive engine damage prevented.
- Defects not seen by other ECM products, and no CNR's received (7 cases)

PROGNOS FOR AIRCRAFT

WORFLOW OVERVIEW: COLLECT, PROCESS, ANALYZE, PROVIDE RECOMMENDATION

- Get recommendations to avoid delays and flight cancellations from **30 to 50 flights ahead**
- By collecting and recording data from the aircraft, and then processing and analyzing them, **PROGNOS detects failures before it happens**

Prognos® for AIRCRAFT



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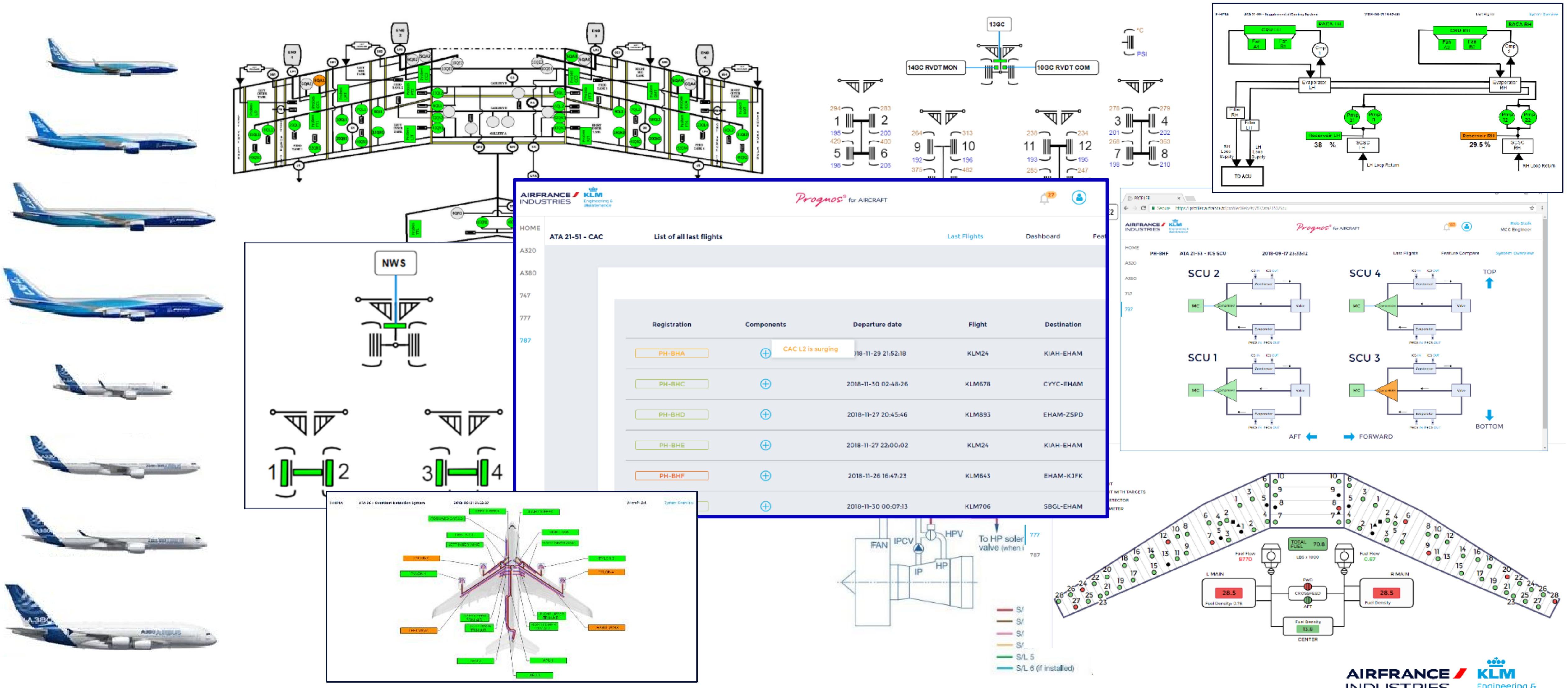
AGNOSTIC SOLUTION

TO ADDRESS OPERATORS CONCERNS



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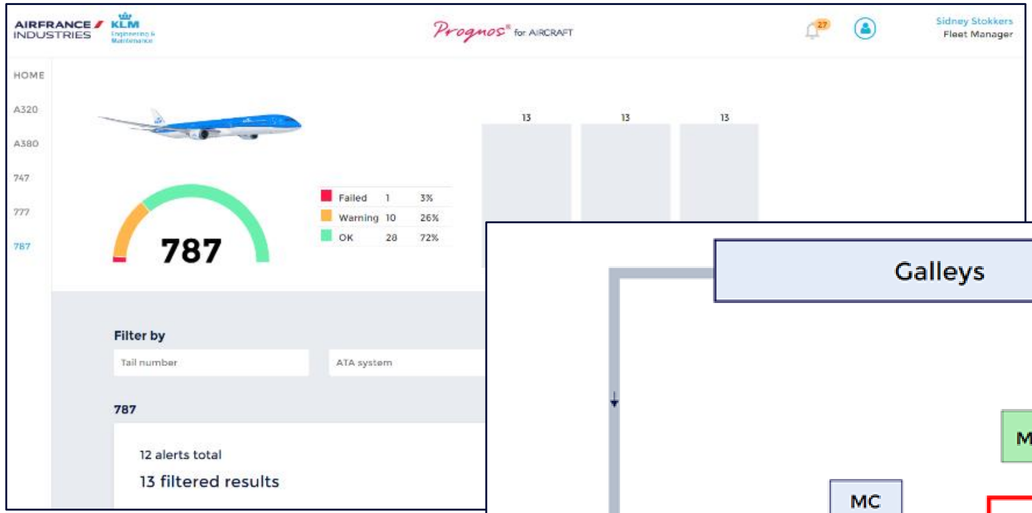
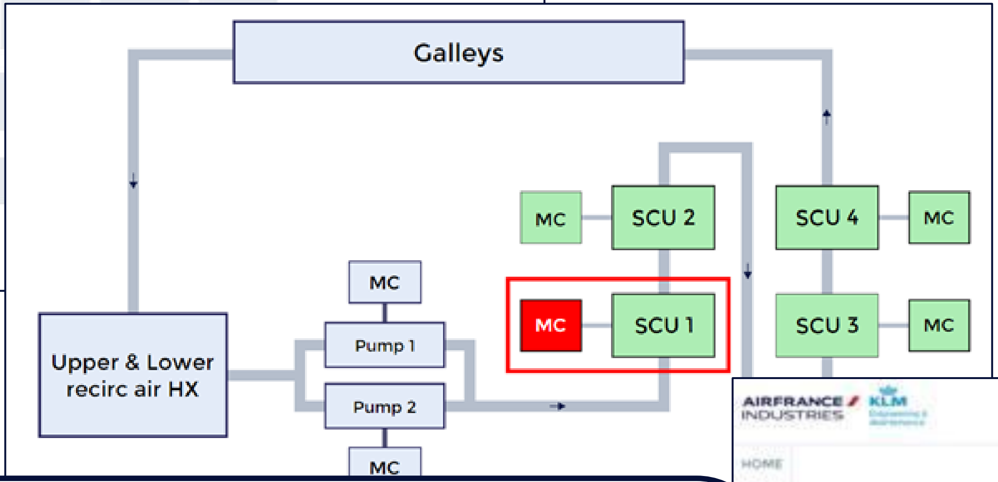
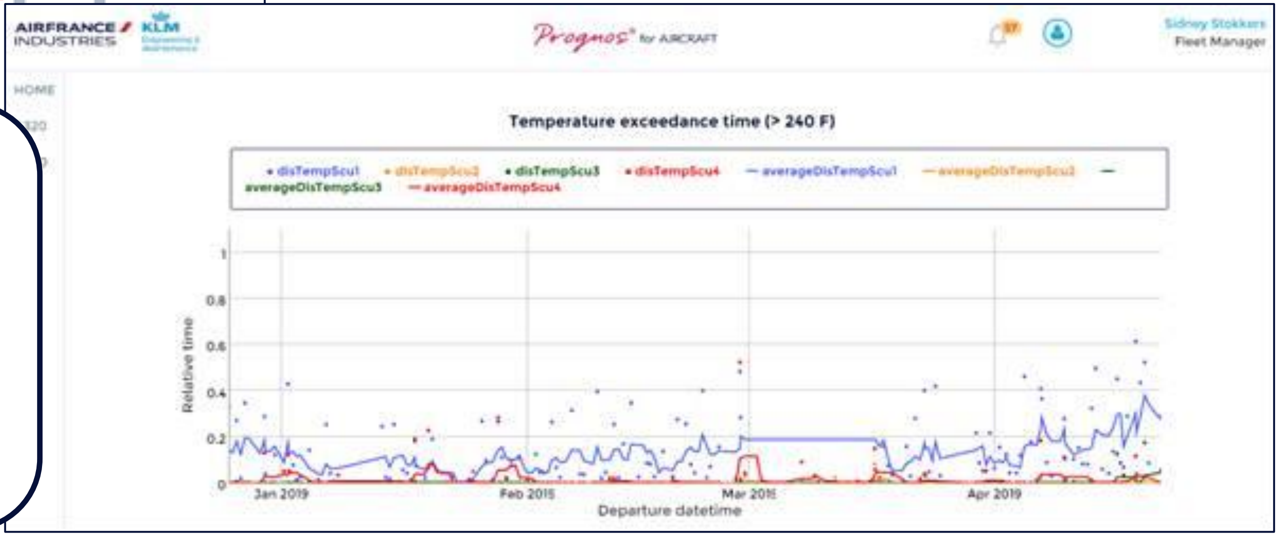
A D A P T I V E N E S S®

CONCRETE USE CASE 787

ATA 21 SUPPLEMENTAL COLLING UNIT (SCU) + SCU MOTO CONTROLLERS (MC)



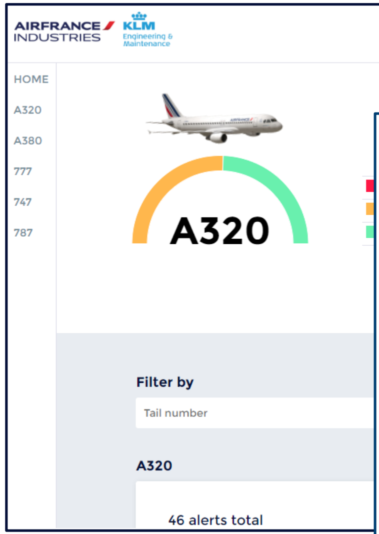


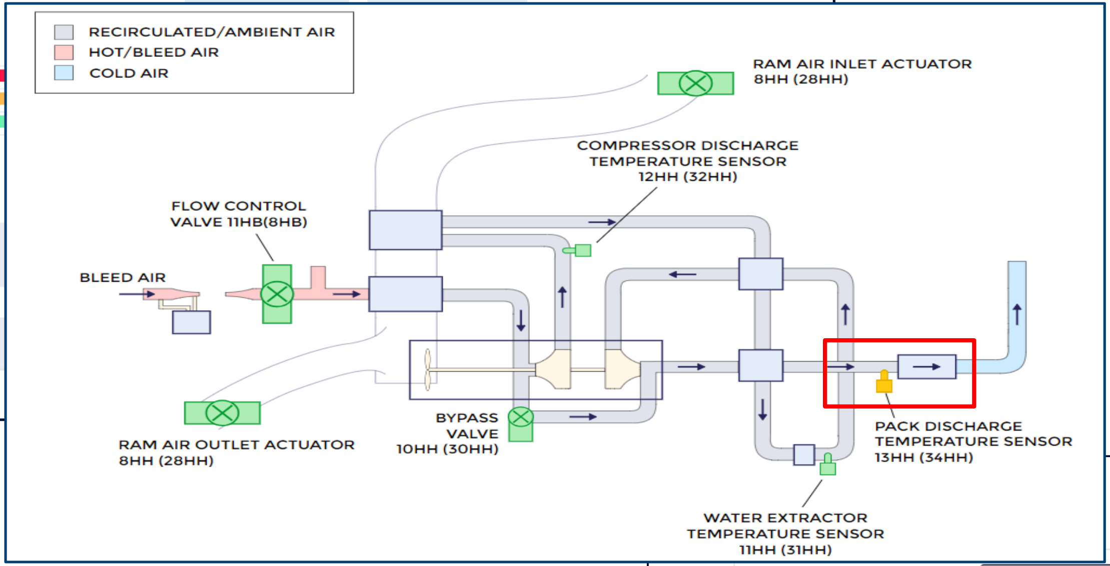


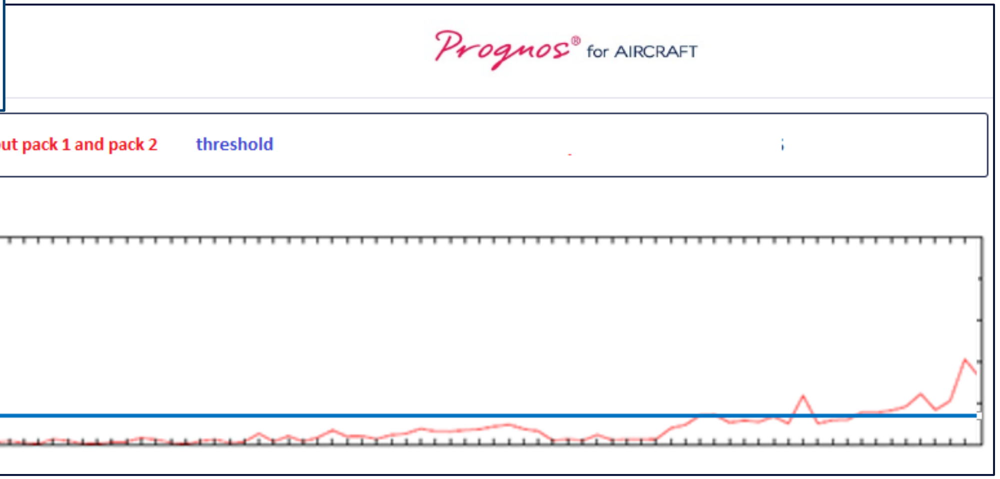
- Avoid operational impacts / D&Cs / restrictive MEL + dry ice
- Much better anticipation of SC needs (very expensive parts) + very effective Troubleshooting
- 100% accurate (no NFF so far) and highly sensitive (prediction rate)

CONCRETE USE CASE A320

ATA 21 AIR COOLING SYSTEM







- Avoid operational impacts / Quick Return and delay. 34500Ft flight limitation and no Etops and risk of Emergency descent in case of inflight failure
- Much better anticipation + very effective Troubleshooting
- First results show very good sensitivity

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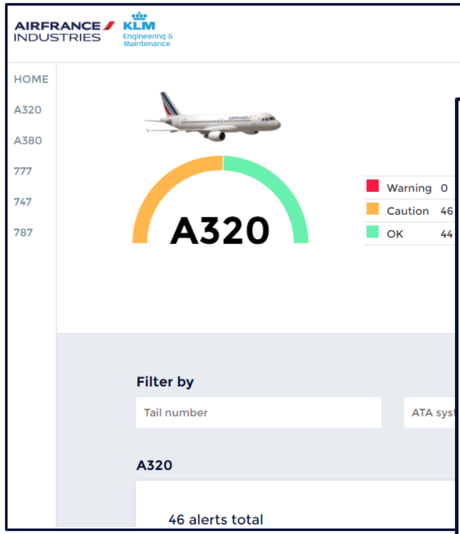
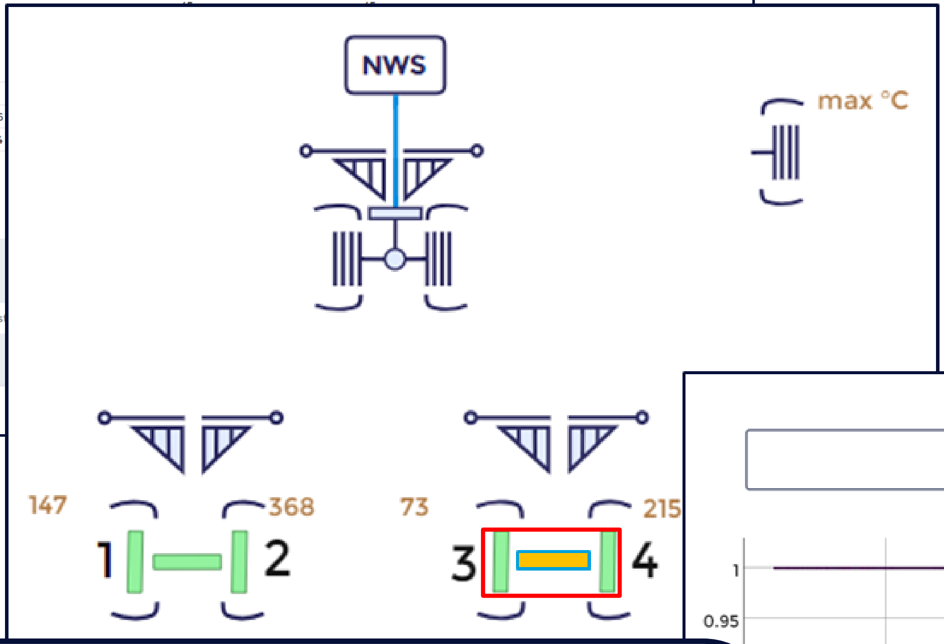
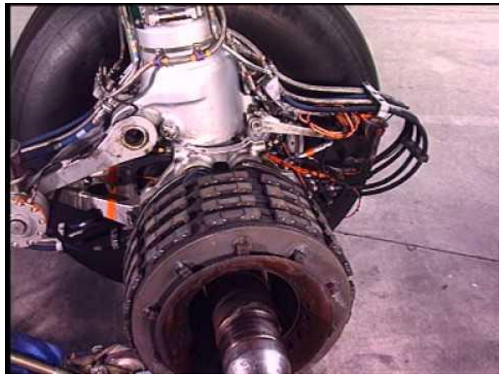
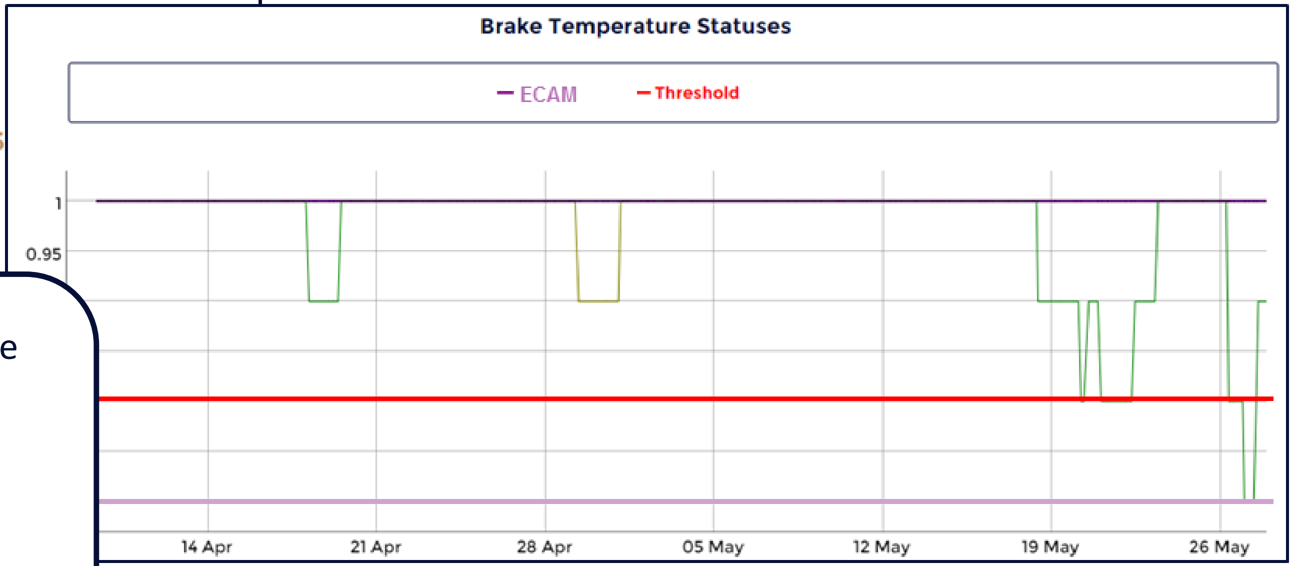
CONCRETE USE CASE A320

ATA 32 BRAKES TEMPERATURE SENSORS









- Avoid operational impacts / Quick Return and delay. Restrictive MEL (D&Cs)
- Better anticipation, also from SC perspective (improvement to come)+ very effective Troubleshooting
- High accuracy (still no NFF) and good sensitivity

KEEP YOUR AIRCRAFT FLYING!

OPERATOR BENEFITS

- **Combining** big data and engineering **expertise** with operator **experience** → develop **focused** solutions

- Brings the best of **Health Monitoring and Predictive** capabilities to airlines
  - Increase operational performance (delays and cancellations)
  - Increased operational reliability
  - Improve operations Integrity (decrease MEL items and PIREPS)
  - Improve aircraft availability & trouble-shooting procedures
- 100% **accuracy**: 200+ removals / **no NFF** (with tests performed by OEM)
- Very high **prediction rate** (65%+, still improving with experience acquired)
- No unscheduled Engine/APU Shop Visits or removals through event prediction

- **Agnostic**

- Rely on a **potent Supply Chain** to **extend** analytics **value** beyond Ops benefits
  - Reduce Safety Stock
  - Reduce unnecessary removed components and number of NFF

- **Easy** implementation & **Secure data** environment and delivery

THANK YOU FOR YOUR ATTENTION

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Operational efficiency driven by data & analytics

Rita Barata Silva, Head of Data & Analytics, Vueling Airlines

HOW **DATA & ANALYTICS** IS AN FOR VUELING **OPERATIONAL EXCELLENCE**

IATA Data Symposium
26th June 2019

IAG & VUELING: being part of one of the worlds' largest airline groups

	IAG	vueling
Aircraft (2019)	573	118
Passengers transported in LTM	c.113M	c.33M
Total employees (indirect)	c.64.300	c.4000 (+2000)
Destinations	268	+120
Revenues (2018)	24.406 M (+6.7%)	2.398 M (+6.7%)

VUELING CONNECTIVITY:
VY is the #1 airline in domestic flows in Spain and within France & Spain

1 — **SPAIN** – Leader Domestic Traffic
31% Market Share

1 — **FRANCE** – Leader flows with Spain
30% Market Share

2 — **ITALY** – Second flows with Spain
23% Market Share

2 — **SPAIN** – Second in all flows
16% Market Share

vueling

TOURISM
is key for the Spanish economy growth

82,8 millions of tourists in **2018** (1)

+1,1% vs. 2017 (2)

+80% of tourists travelled by **plane**

81.857 millions €
Total **foreign spending**

+3,3% vs. 2017

1.086 €
average / tourist (3)

Tourism represents
11,7% GDP

Main destinations

1	19,1M
2	13,8M
3	13,7M

(1) Foreign tourist
(1, 2) Source 2018: Estadística de movimientos Turísticos en Fronteras (FRONTUR). INE
(3) Source 2018: Encuesta de Gastos Turísticos (GASTUR). INE

VISION
unlock the potential of our people

Gain competitive advantage

Flawless execution

Personalization

OPERATE BETTER

Real time pain points

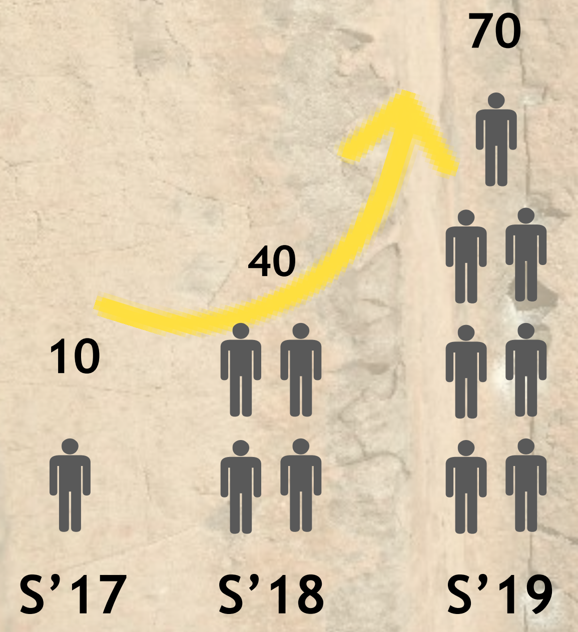
Risk management & quantification

Uncertainty reduction

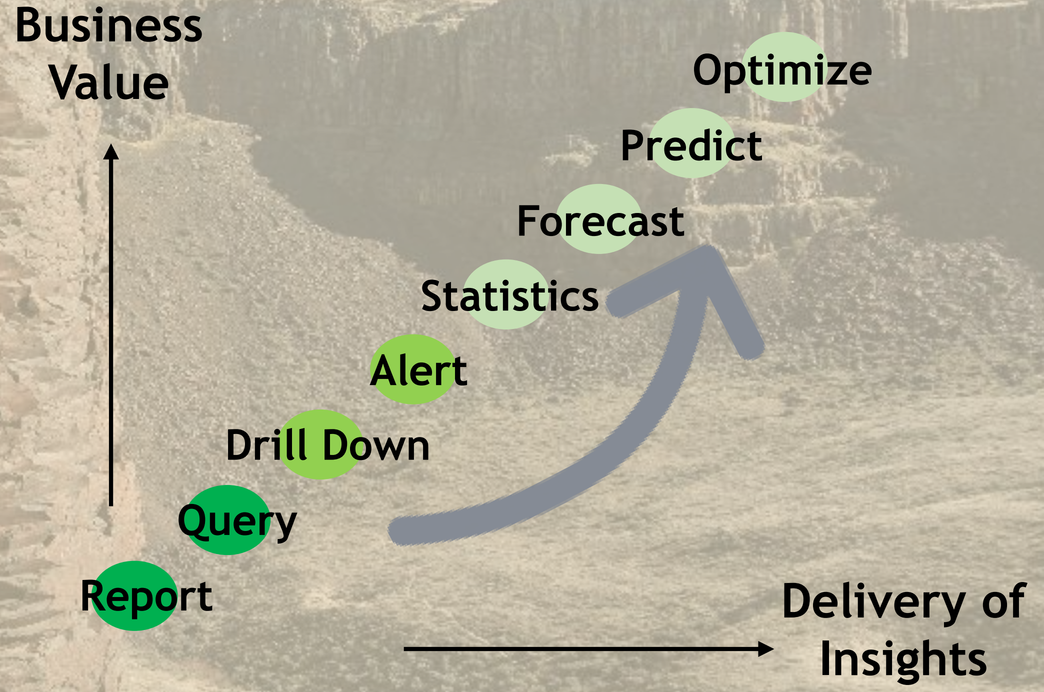
OPERATE SAFER

OUR FLIGHT PATH
From MS Excel to data-driven

Highly diverse, hands-on and collaborative team..



… working toward delivering insights and value to Vueling (especially quick wins)



Gartner Maturity Score 3,35

FRAMEWORK
Simplicity & exhaustivity

Data-driven Strategy

VISUALIZATION
Easy Data

DATA SCIENCE
Advance analytics

DATA MANAGEMENT

people

Big Data
Cloud Architecture

Scalability
Anywhere Business
Innovation
Costs Effectiveness
Agility
Speed

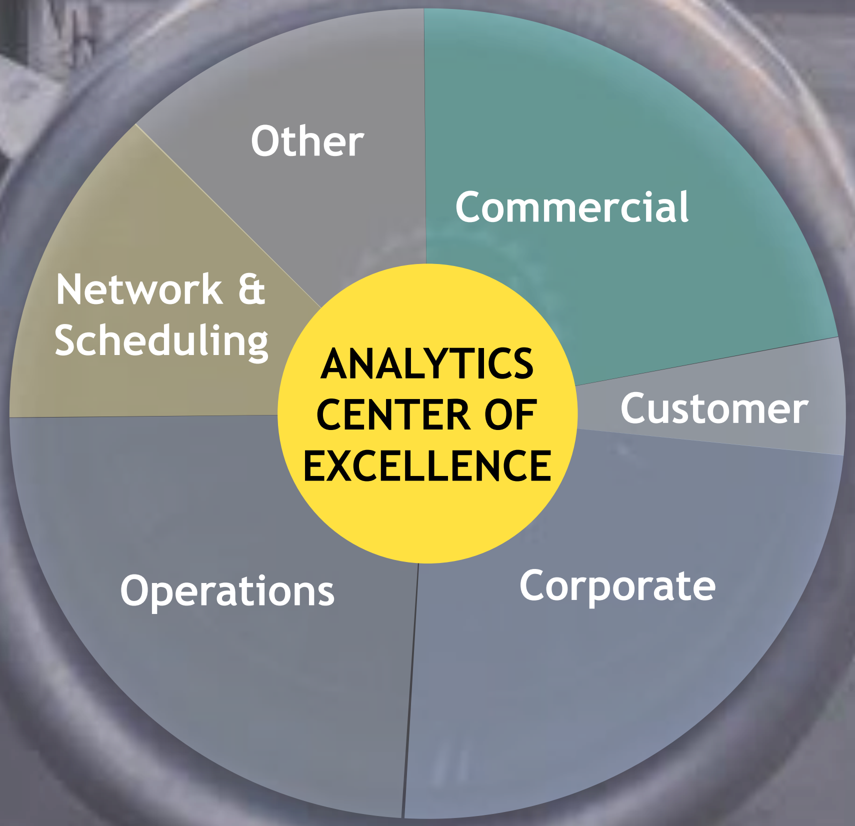
Data has a better idea

Value
What is the question, business problem or target outcome?

Information
What data is involved?
Where is the Data?

Analytics
What analytical or data science methods are?

ANALYTICS CENTER OF EXCELLENCE
a Hub & Spoke model

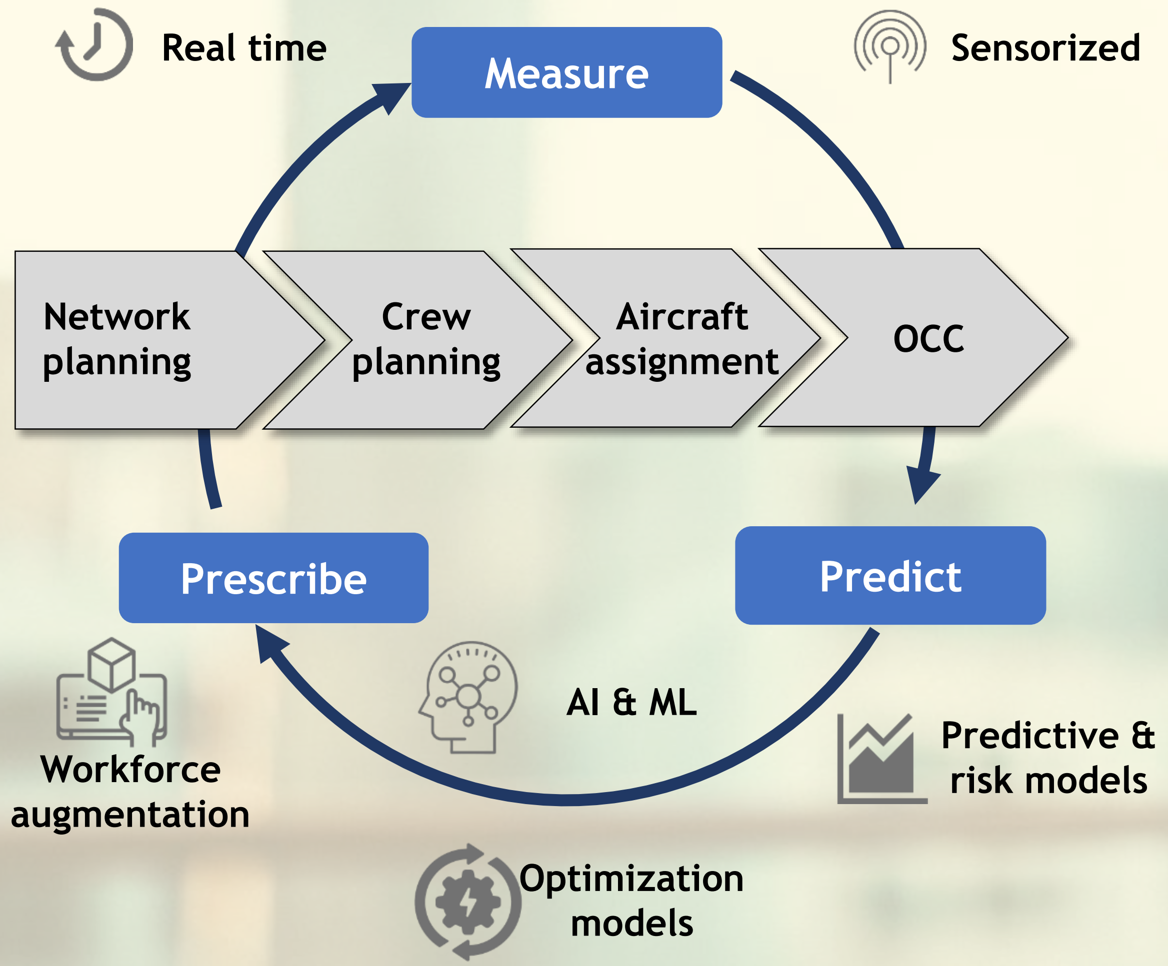


IMPROVEMENTS ACHIEVED

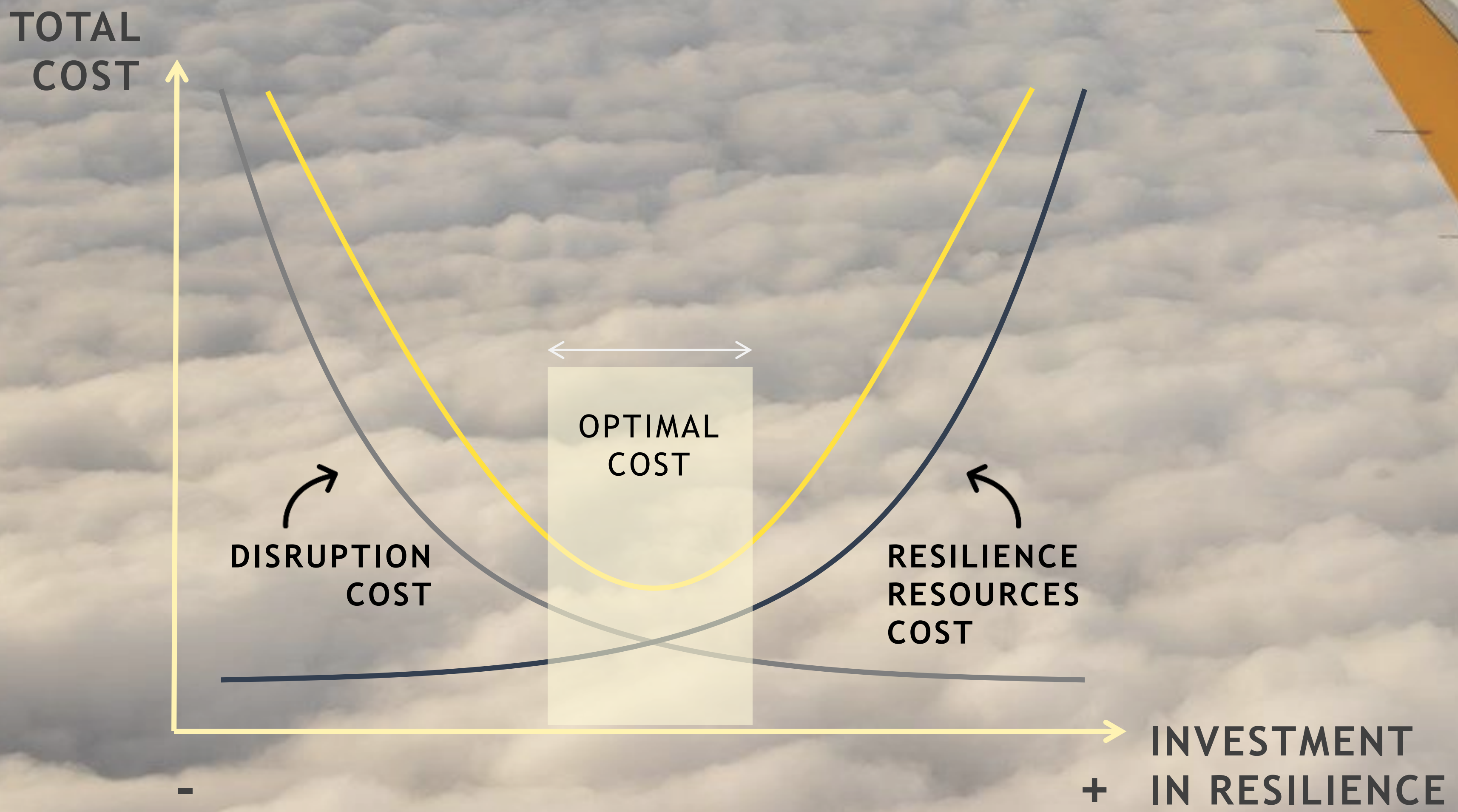
- Single version of truth
- Breaking silos
- Advanced analytics
- Real time
- Self-service
- Automation

PLANNING 2.0
A new feedback-based paradigm

Data & Analytics Layer



LCC trade-off



- Break silos: crew info, network info, flight ops & maintenance restrictions,
- Build a Single source of Truth (flights status & delays)
- Real time tracking of operational KPIs
- Historify every minute of operational status, decisions & resources
- Customer 360 vision improving service, commercial offers and disruption management
- Network Simulator
- Dynamic Allocation (maintenance tasks and ops feasibility, stand optimization, intelligent buffer allocation, fuel efficiency)

- Disruption management (flight, crew and passenger reacommodation)
- Flight Plan optimization to avoid regulations minimizing costs
- Post-operations analysis and technical specs optimization
- ATC forecast
- Self service capabilities and tools
- Maintenance program optimization
- Crew Control Monitoring and Automation
- Crew stand-by allocation model
- Handling monitoring and performance KPIs
- Handling resource allocation optimization (ex. Checkin counters)

vueling

In a competitive, fast-paced and challenging world...

We need to develop strong in-house capabilities...

- Advanced analytics, Artificial Intelligence and Machine Learning
- Scalable and reliable technology & architecture
- Data quality & Governance
- Influence business processes

... at the same time that we learn from external accelerators

Gartner
Google
amazon web services
JEPPESEN A BOEING COMPANY
AIRBUS GROUP
MIT
UPC
aena
ENAIRE
EUROCONTROL
ESADE Business School

At Vueling, we truly believe technology is a real game changer...

...TO HELP OUR OPERATIONS COLLEAGUES AND LOOK AFTER OUR CUSTOMERS.

vueling

THANKS!

Using data for Preventive Maintenance for Embraer E190 aircraft

Yuliya Gerasymchuk, Financial Manager and Head of PMO, Ukraine International Airlines

USING DATA

Preventive Maintenance for Embraer 190/195

Ukraine International Airlines UIA

Vadym - Chief Engineer,
Avionics Systems

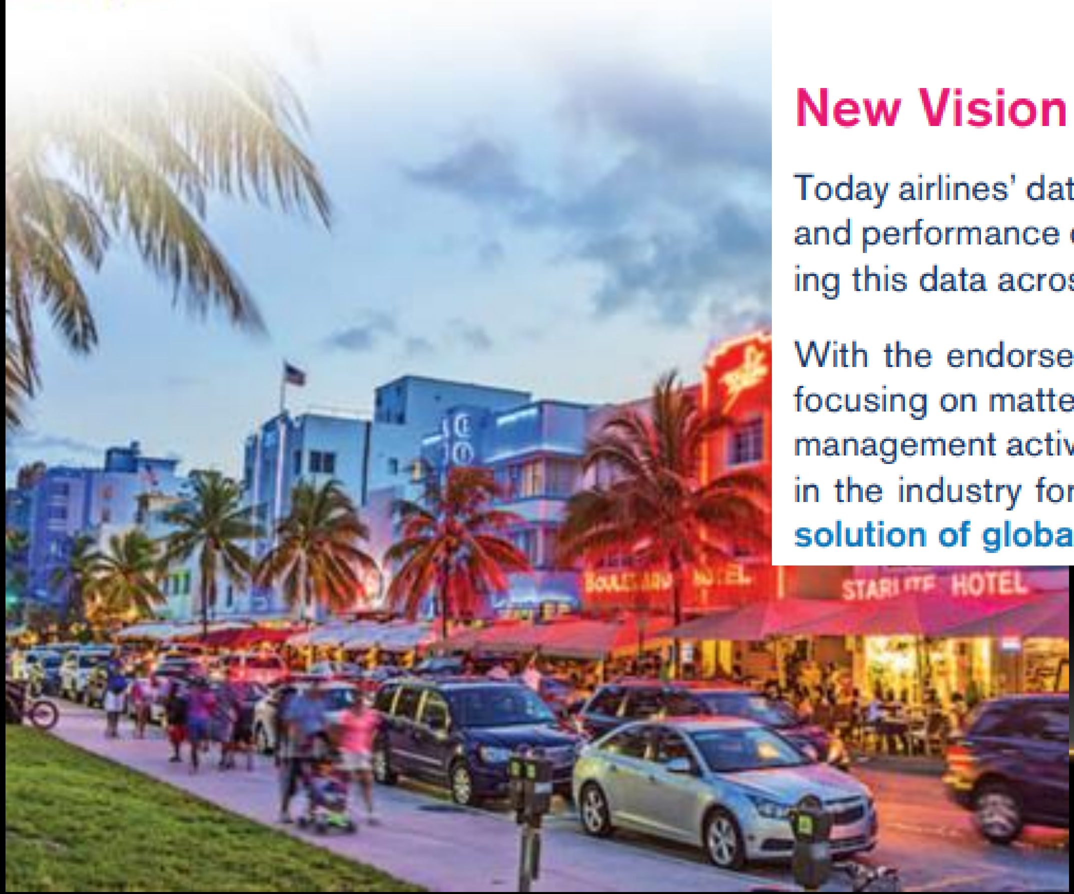
Andrey - Captain,
E190 Technical pilot

UR-EMA	LH HPSOV closed	AFT PAX door LKD snsr adj recomm	EDP 1 PRESS SW/SPDA2/LRM3/MAU2/GIO2	MAU 2 GIO2A FAULT	FLAP LO RATE
12.07.2017	OK	OK	OK	45452139CMC	OK
13.07.2017	OK	OK	OK	45452139CMC	27530001ACE
14.07.2017	OK	OK	29310009UT1	45452139CMC	OK
15.07.2017	OK	OK	OK	45452139CMC	OK
16.07.2017	OK	OK	OK	OK	OK
17.07.2017	OK	OK	OK	OK	OK
18.07.2017	36111103AM1	OK	OK	45452139CMC	OK
19.07.2017	OK	OK	OK	OK	OK
20.07.2017	OK	OK	OK	OK	OK
21.07.2017	OK	OK	OK	OK	OK
22.07.2017	OK	OK	OK	45452139CMC	OK
23.07.2017	OK	OK	29310009UT1	45452139CMC	OK
24.07.2017	OK	52122111PSS (CRUISE)	OK	OK	OK
25.07.2017	OK	52122111PSS (Cruise)	OK	OK	OK
26.07.2017	OK	OK	OK	OK	OK
27.07.2017	OK	OK	OK	OK	OK
28.07.2017	OK	OK	OK	45452139CMC	OK
29.07.2017	OK	OK	OK	45452139CMC	OK
30.07.2017	OK	52122111PSS (Cruise)	OK	OK	OK
31.07.2017	OK	OK	29310009UT1	45452139CMC	OK
01.08.2017	OK	OK	OK	OK	OK
02.08.2017	OK	OK	OK	OK	OK
03.08.2017	OK	52122111PSS (Cruise) need	OK	45452139CMC	27530001ACE (APPROACH)
04.08.2017	OK	OK	29310009UT1 (may be caused by Generic I/O)	45452139CMC	OK
05.08.2017	OK	OK	OK	OK	OK
06.08.2017	OK	OK	29310009UT1	OK	OK
07.08.2017	OK	OK	OK	OK	OK
08.08.2017	OK	OK	29310009UT1	45452139CMC + EICAS AVNX MAU 2A FAULT	OK
09.08.2017	OK	OK	OK	Generic I/O was replaced iaw WO 889283	OK
10.08.2017	OK	52122111PSS (Cruise)	OK	OK	OK
11.08.2017	OK	OK	OK	OK	OK
12.08.2017	OK	52122111PSS (Cruise)	OK	OK	OK
13.08.2017	OK	52122111PSS (Cruise)	OK	OK	OK
14.08.2017	OK	OK	OK	52139CMC (may be caused by transitory condition) + EICAS AVNX MAU 2A FAULT if msg will appear one more time than continue trou	OK
15.08.2017	OK	OK	OK	OK	OK

IATA 5th Airline Cost Conference

PROGRAM

November 13-14, 2017
Eden Roc Hotel
Miami | USA



Ukraine International Airlines UIA

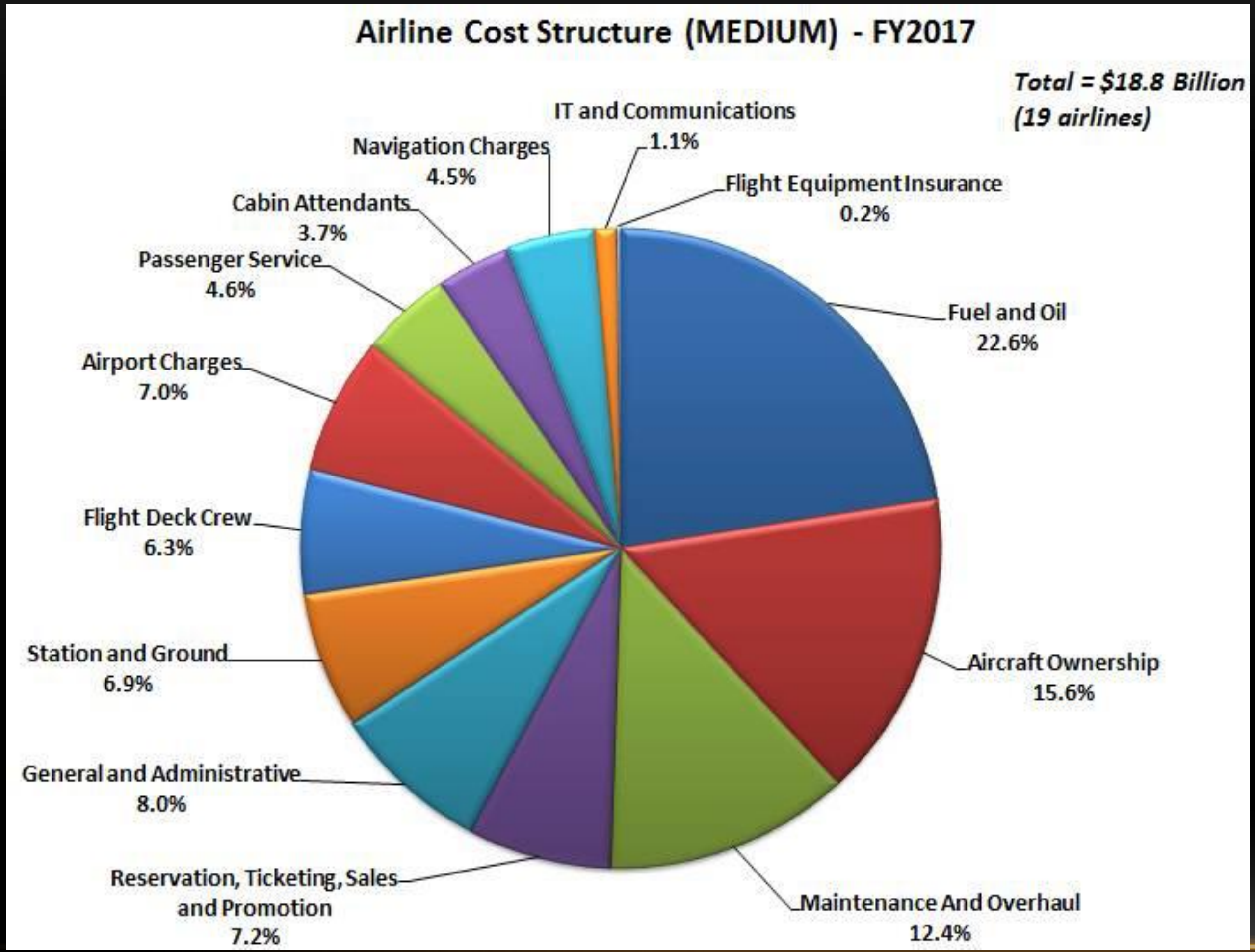
AIRLINE COST MANAGEMENT GROUP

New Vision for Airline Cost and Operational Data

Today airlines' data-driven strategies require a trusted data source to keep a tight control over cost and performance data. Unlike passenger and cargo sales data, there is no standard for consolidating this data across different areas within an airline.

With the endorsement of the Airline Cost Management Group (ACMG), a group of **65 airlines** focusing on matters concerning airline costs and measures to optimize them, IATA is moving cost management activities into a next generation. The Airline Cost Center will become a unique source in the industry for **benchmarking airline cost and performance data**, a **business intelligence solution of global reach**.

COST STRUCTURE



Source: ACMG 2017 Annual Report

STRATEGIC KPIs

UKRAINE INTERNATIONAL AIRLINES UIA

Cost Structure	FY2017 ACMG Airlines			UIA 2017
	US Cents/ASK	$/FH	$/Pax	
Fuel and Oil	1.69	2.40	48.10	
Aircraft Ownership	0.91	1.29	25.80	
Maintenance and Overhaul	0.77	1.09	21.90	
Reservation, Ticketing, Sales and Promotion	0.52	0.74	14.90	
General and Administrative	0.53	0.76	15.20	
Station and Ground	0.48	0.69	13.80	
Flight Deck Crew	0.47	0.67	13.30	
Airport Charges	0.43	0.61	12.10	
Passenger Service	0.36	0.51	10.20	
Cabin Attendants	0.35	0.50	10.10	
Air Navigation Charges	0.30	0.43	8.50	
IT and Communications	0.08	0.11	2.20	
Flight Equipment Insurance	0.01	0.15	0.30	
Total	**6.90**	**9.92**	**196.40**	

PRIORITIZING

- Fuel
- Maintenance
- Irregular Operations
- …

TEAM


Project Leader – Chief Engineer
Engineering
Pilots
MCC
OCC/Planning
IT
Finance

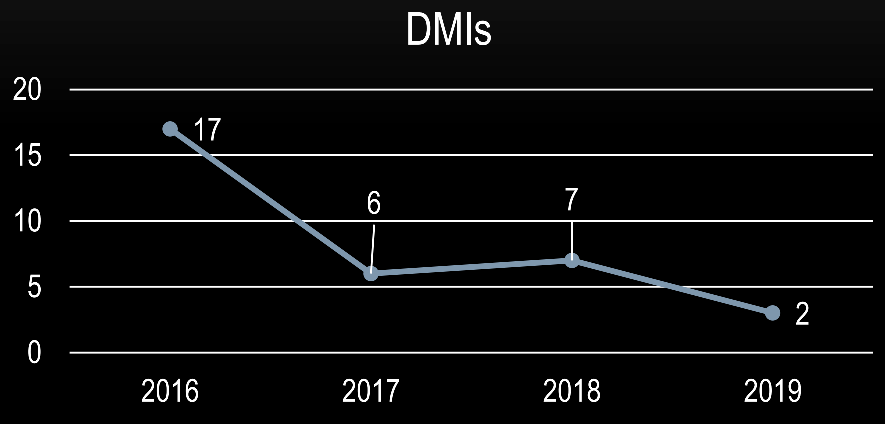
HOW CAN WE HELP?

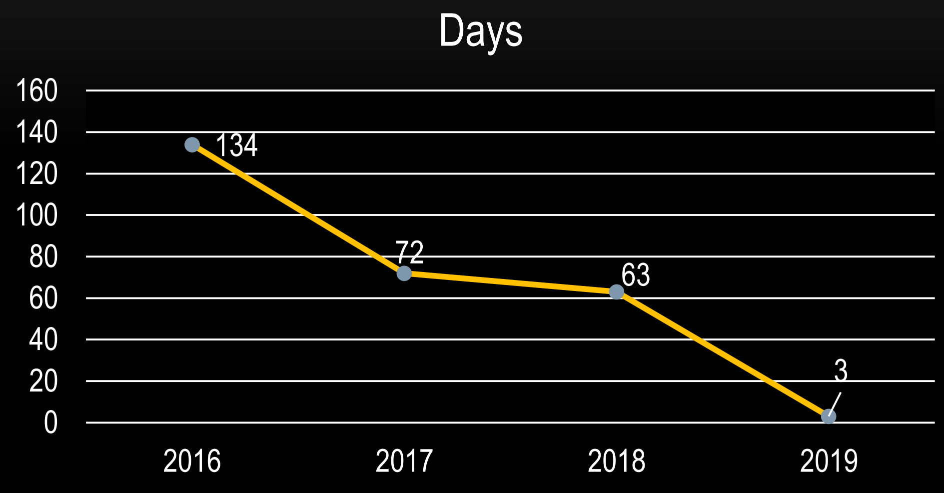
- Get connectivity for online
- Upgrade Aircraft software
- Setup analytical software
- Update internal processes

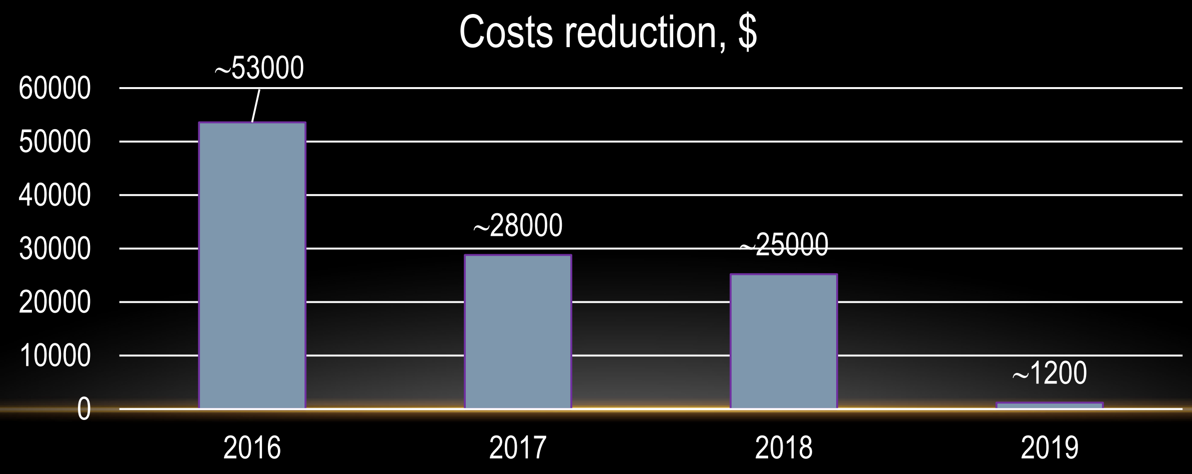
CLOSING THE LOOP

- Setup completed Oct 2018
- CAS/CMC Information
- Systems Trend Information

1.SINGLE-BLEED OPERATIONS







2. ENGINE FADEC

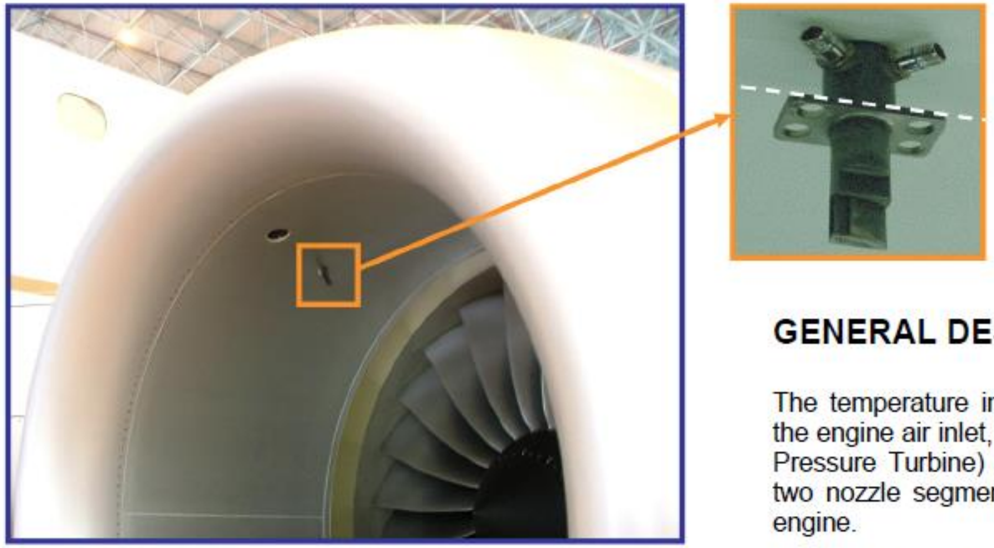
Full Authority Digital Electronic Control System controls the operation, performance and efficiency characteristics of the engine through full authority control over the entire engine fuel metering unit, variable stator vanes, operability bleed valve, T2 sensor heater, thrust reverser actuation, engine starting, ignition and also providing engine limit protection during ground starts.

2. ENGINE FADEC

- Engine FADEC 1 (no dispatch) <=> FADEC 2
- 7 days both worked properly
- A new fault message appeared (FIM executed → wire and sensor both ok, so only FADEC according to FIM)
- Solution – to replace FADEC?

2. ENGINE FADEC

T1.2 Sensor



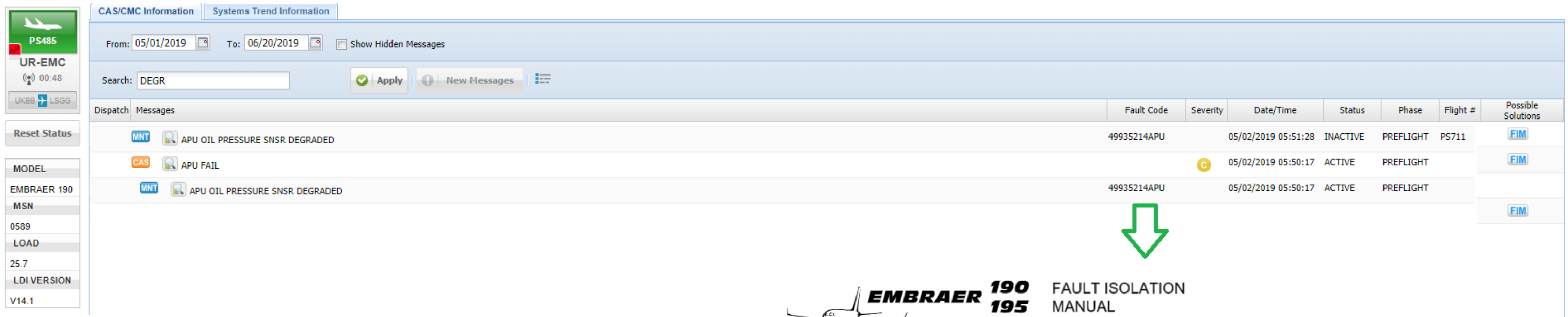
GENERAL DESCRIPTION

The temperature indicating system sensors provide temperature data of the engine air inlet, compressor air inlet, compressor discharge, HPT (High Pressure Turbine) case shroud, and LPT (Low Pressure Turbine) stage two nozzle segment. The FADEC uses these information to control the engine.

- The T 1.2 sensor is a dual-element RTD (Resistance Temperature Device) mounted in the flow stream, in front of the fan and above the engine centerline, with one element hardwired to each FADEC channel.

- Reviewed and decided to replace sensor
- ~2k \$ vs ~ 50-60k \$

3. APU FAIL



- Failure of oil pressure sensor
- Failure of APU FADEC
- Defective HARNESS

EMBRAER 190 195 FAULT ISOLATION MANUAL

TASK 49-93-00-810-801-A

Degradation of APU Oil Pressure Sensor Circuit

A. General

(1) This task is for fault code:

FAULT CODE	FAULT DESCRIPTION
49935214APU	APU OIL PRESSURE SNSR DEGRADED

(2) After completion of the troubleshooting, put the aircraft back to its initial configuration.

B. Fault Description

(1) This maintenance message gives an indication that the oil-pressure-sensor circuit is defective.

(2) The FADEC senses a fault in the oil pressure sensor and sends a fault message to the CMC.

(3) This failure is latched on the APU FADEC. To confirm the fault, it is necessary to turn the APU master switch to the OFF position and then operate the APU (AMM TASK 49-10-00-910-801-A/200).

C. Probable Causes

(1) Failure of OIL PRESSURE SENSOR (AIPC 49-93-03) (AMM MPP 49-93-03/401).

(2) Failure of AUXILIARY POWER UNIT (APU) FADEC (AIPC 49-61-01) (AMM MPP 49-61-01/401).

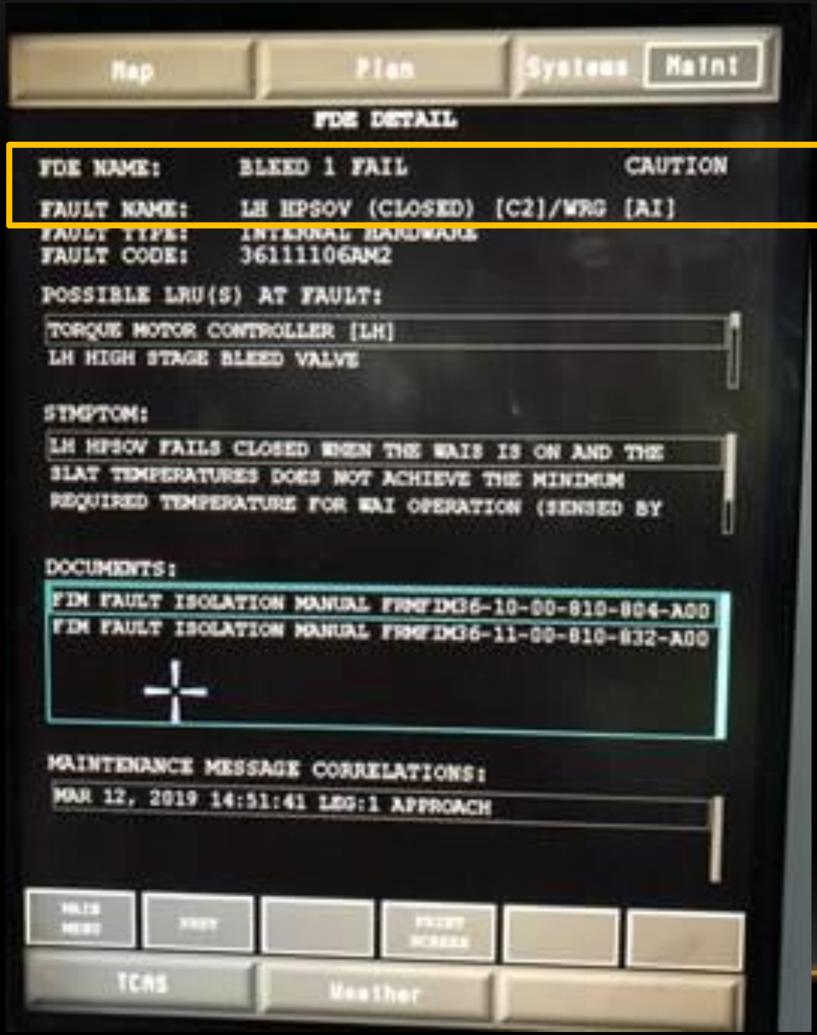
(3) Defective HARNESS (WM 49-41-50) (WM 49-71-50).

3. APU FAIL

UKRAINE INTERNATIONAL AIRLINES UIA

- Sensor was switched EMC <=> EMB (problem occurred and sensor was replaced)
- APU FADEC was switched (100% not the problem)
- After this EMC 10 days was okay, then fault was reported again
- Decision was to replace APU Wire (at ~100k $)
- Additional troubleshooting was performed and decision to replace sensor (~12k $) first was made
- And it worked!

4. BLEED FAIL

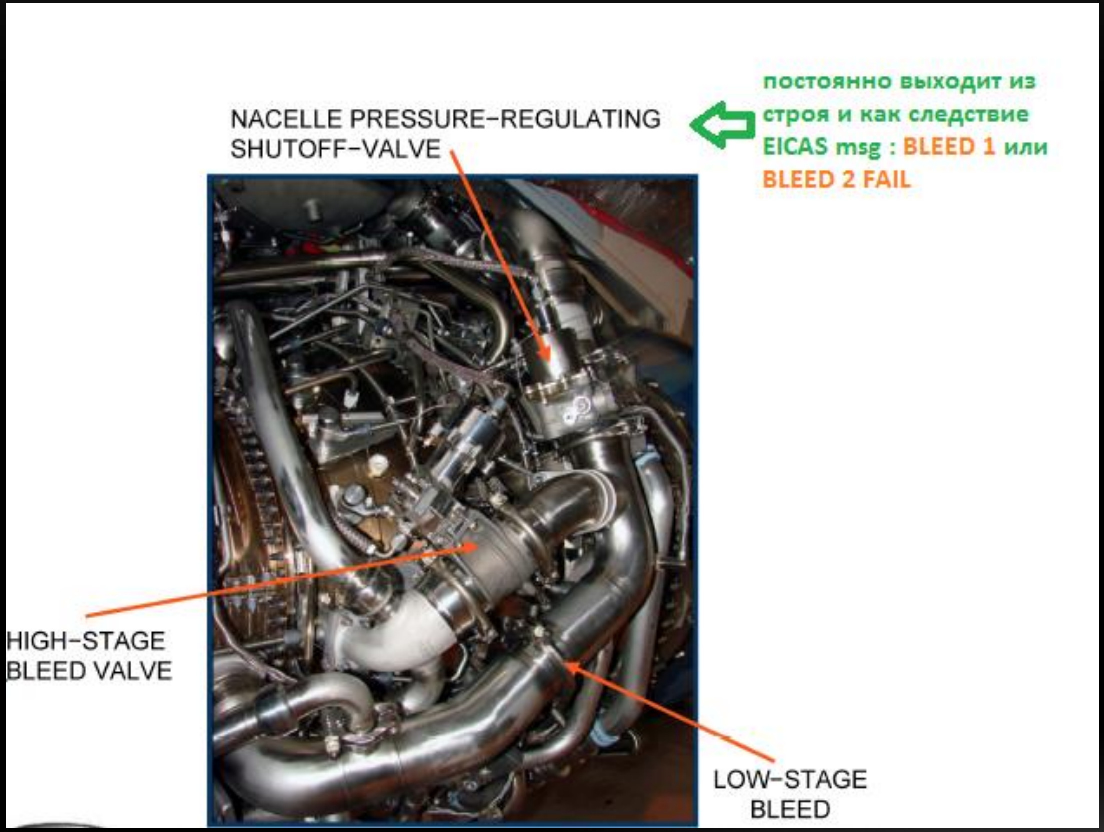


- "Bleed 1 fail" message
- HPSOV (High-stage pressure shut-off valve)
- Checked FHDB

4. BLEED FAIL

Main	A5536	1000,219,0,0,ACTIVE,03/11/2019 10:03:04,3,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,,,
Main	A5537	1000,219,344,2681,ACTIVE,03/11/2019 10:03:04,3,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,PRI HX IN TEMP SNSR (PK1)/WRG,21515061AM1,Internal Hardware
Main	A5751	1000,219,0,0,INACTIVE,03/11/2019 10:05:14,3,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,,,
Main	A6022	1000,219,0,0,ACTIVE,03/12/2019 14:51:41,4,7,APPROACH,BLEED 1 FAIL,CAUTION,,,
Main	A6023	1000,219,935,2523,ACTIVE,03/12/2019 14:51:41,4,7,APPROACH,BLEED 1 FAIL,CAUTION,LH HPSOV (CLOSED) [C2]/WRG FAULT,36111103AM2,Internal Hardwar
Main	A6024	1000,219,934,2868,ACTIVE,03/12/2019 14:51:41,4,7,APPROACH,BLEED 1 FAIL,CAUTION,LH HPSOV (CLOSED) [C2]/WRG [AI],36111106AM2,Internal Hardware
Main	A6027	1000,219,0,0,INACTIVE,03/12/2019 14:52:04,4,7,APPROACH,BLEED 1 FAIL,CAUTION,,,
Main	A6033	1000,219,0,0,INHIBITED,03/12/2019 14:56:34,4,8,ROLL OUT,BLEED 1 FAIL,CAUTION,,,
Main	A6034	1000,219,935,2523,INHIBITED,03/12/2019 14:56:34,4,8,ROLL OUT,BLEED 1 FAIL,CAUTION,LH HPSOV (CLOSED) [C2]/WRG FAULT,36111103AM2,Internal Hardw
Main	A6040	1000,219,0,0,ACTIVE,03/12/2019 14:56:47,4,8,ROLL OUT,BLEED 1 FAIL,CAUTION,,,
Main	A6041	1000,219,935,2523,ACTIVE,03/12/2019 14:56:47,4,8,ROLL OUT,BLEED 1 FAIL,CAUTION,LH HPSOV (CLOSED) [C2]/WRG FAULT,36111103AM2,Internal Hardware
Main	A6060	1000,219,0,0,INACTIVE,03/12/2019 15:51:31,4,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,,,
Main	A11866	1000,219,0,0,ACTIVE,03/18/2019 16:05:31,28,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,,,
Main	A11867	1000,219,344,2681,ACTIVE,03/18/2019 16:05:31,28,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,PRI HX IN TEMP SNSR (PK1)/WRG,21515061AM1,Internal Hardware
Main	A12278	1000,219,0,0,INACTIVE,03/18/2019 16:09:59,28,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,,,
Main	A16189	1000,219,0,0,ACTIVE,03/24/2019 16:14:36,58,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,,,
Main	A16206	1000,219,0,0,INACTIVE,03/24/2019 16:18:31,58,2,PREFLIGHT,BLEED 1 FAIL,CAUTION,,,

4. BLEED FAIL

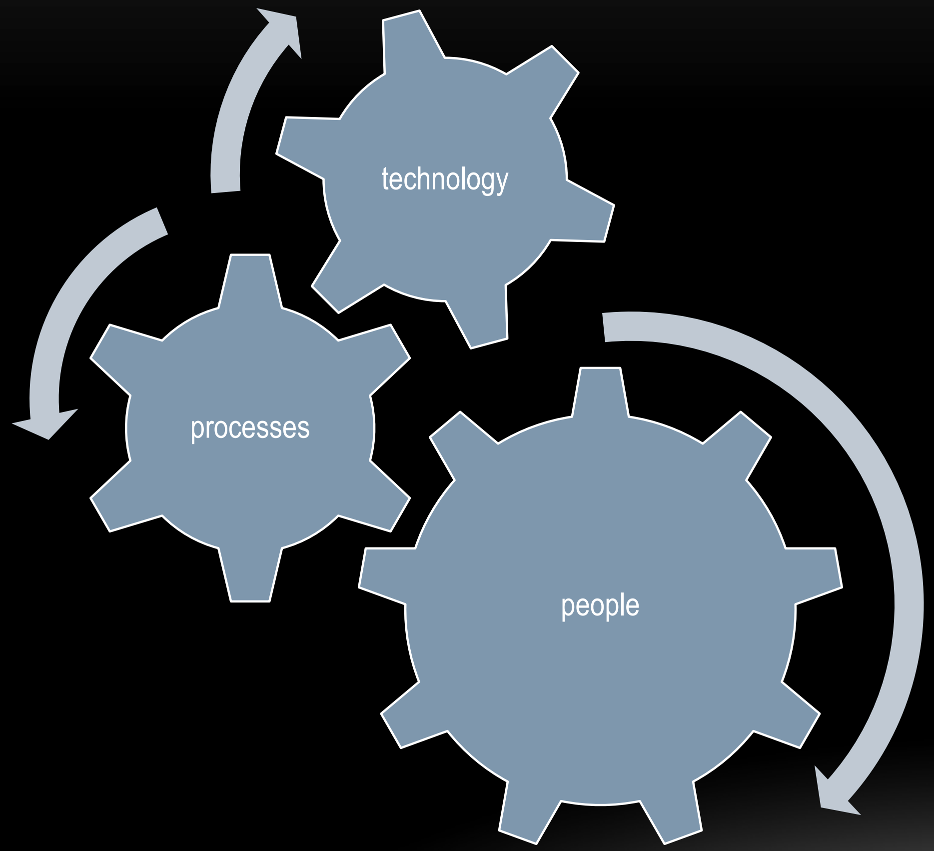


- Apparently there were multiple EICAS & maintenance messages, some resets (not during acceptance flight though)
- Situation was reported to lessor
- Valve at lessor’s cost (~30k $)

IS THE LOOP REALLY CLOSED?

- Logistics
- Analytics
- Internal procedures & Ownership
- Promotion
- Value
- Scale

SUMMARY



- Passion
- Hard work
- Constant challenge

Networking Break

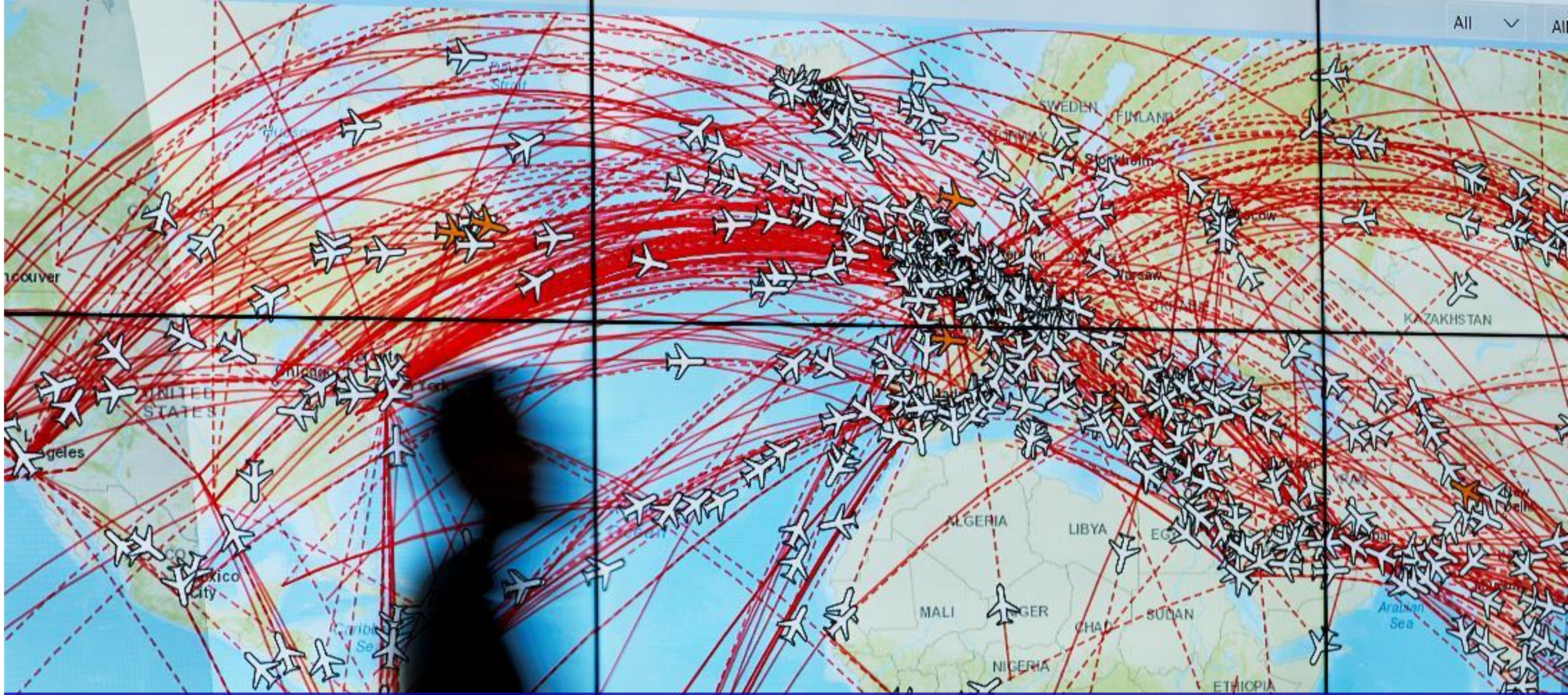
GROUPE
AZUR

Opening Remarks

Chris Markou, Head Operational Cost Management, IATA

Digital Collaboration – From insights to scalable value

Andrew Hutson-Smith, Director of Business Development, R2 Data Labs, Rolls-Royce Plc



Digital Collaboration
From insights to scalable value

Andrew Hutson-Smith
Director, Business Development, R² Data Labs

Rolls-Royce Analytics journey

Group wide digital strategy

- Re-invent with Digital
- Outside in thinking

Digital Organisation 3.0

Decentralised and Networked

- Guilds
- EcoSystem
- Academy
- Disruptive thinking
- Collaboration

Equipment Health	Generation 1 **Deployed Product**	Generation 2 **Centralised Intelligent Fleet**	Generation 3 **Self-learning and Predictive**	Generation 4 **Federated and Collaborative**

Digital Organisation	Org 1.0 **JV – IT Services and Industrial**	Org 2.0 **Central Specialist Group**	Org 3.0 **Decentralised Networked**

Project Melwood – Digital Future

Q1: Increase value and pace	Q2: Digital platform needs

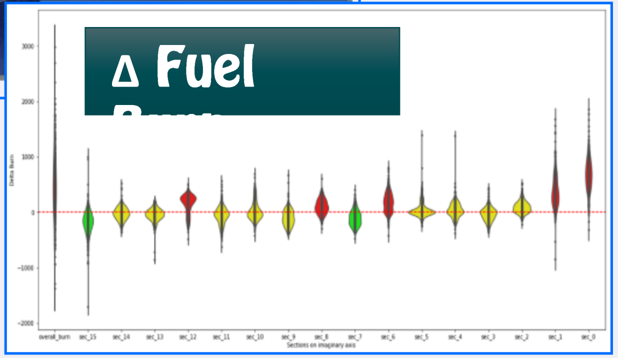
Innovation Example

Flight Efficiency

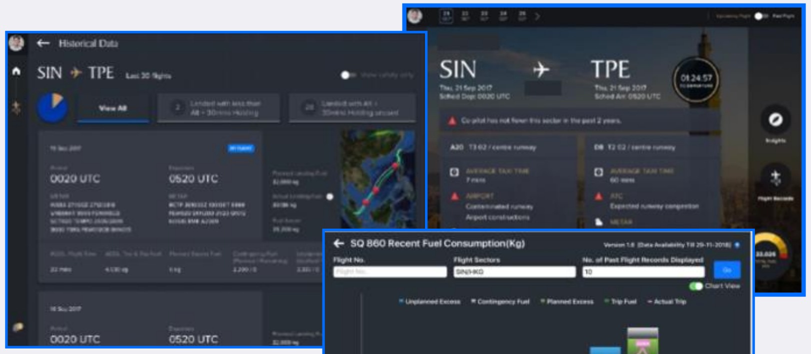
- Complex data sources
- Cross organization value
- Spectrum of analysis
- Spectrum of deployment methods

Discovery

Novel analysis and visualization



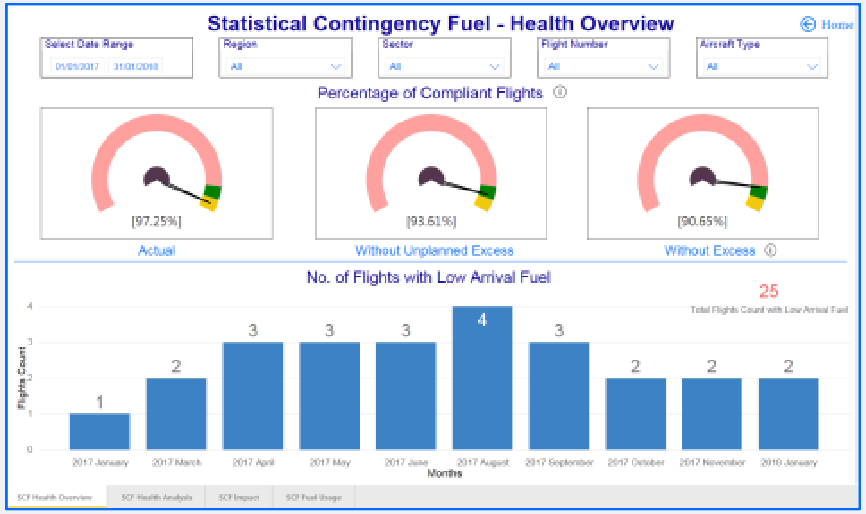
Pilot



Focus on decision flow and change management

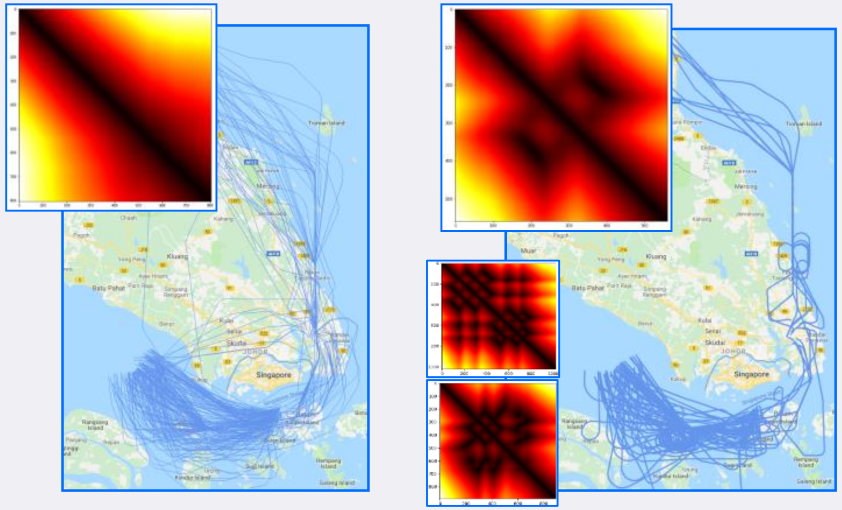
Planner

Customize contingency figure to route



Operations Control Centre

Prediction / automation - fuel and on-time performance

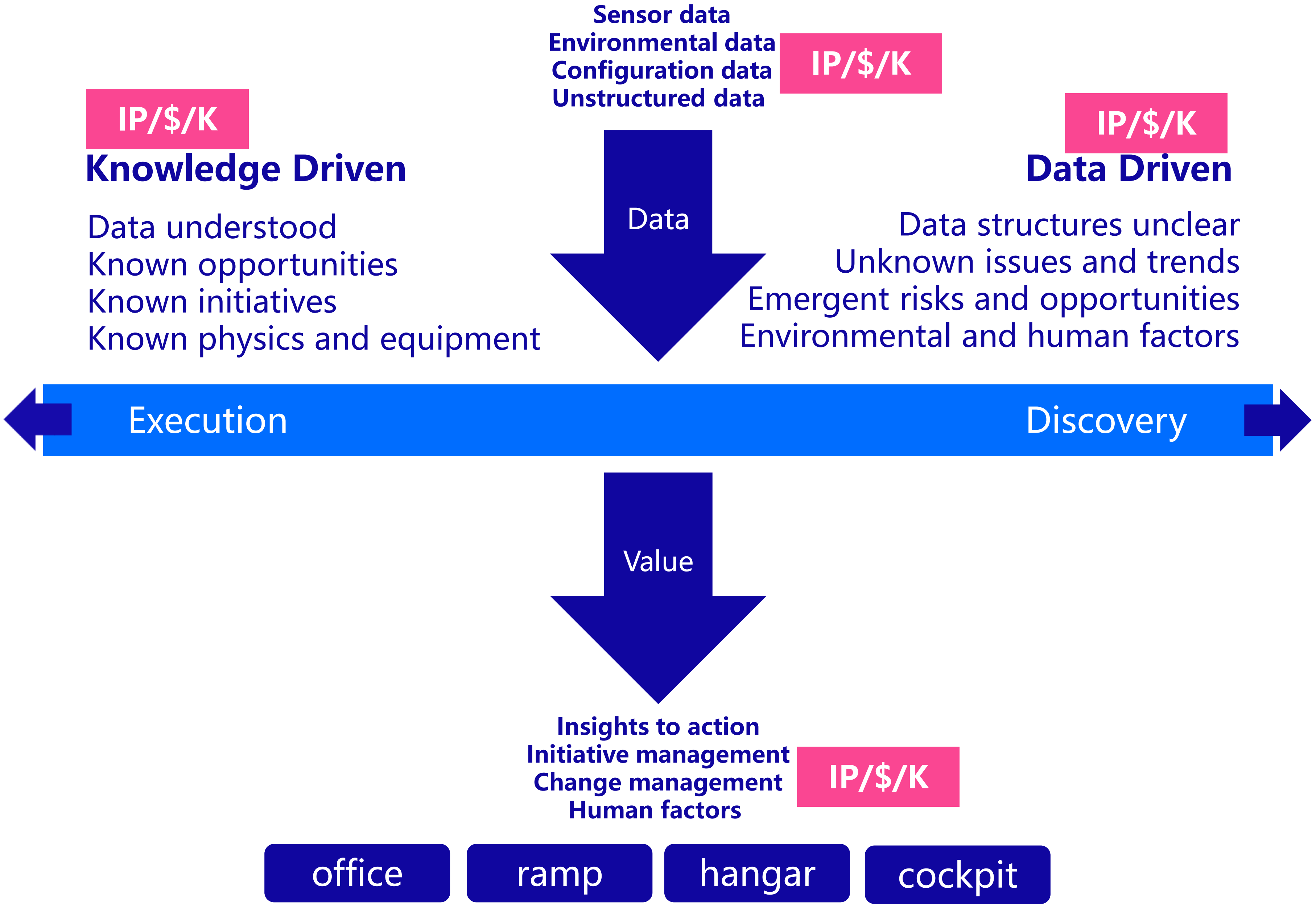


Breadth of applications and approach

There are a spectrum of approaches and deployment needs

Rather than monolithic products, companies will begin to manage and release value at a more granular level

IP/$/Knowledge



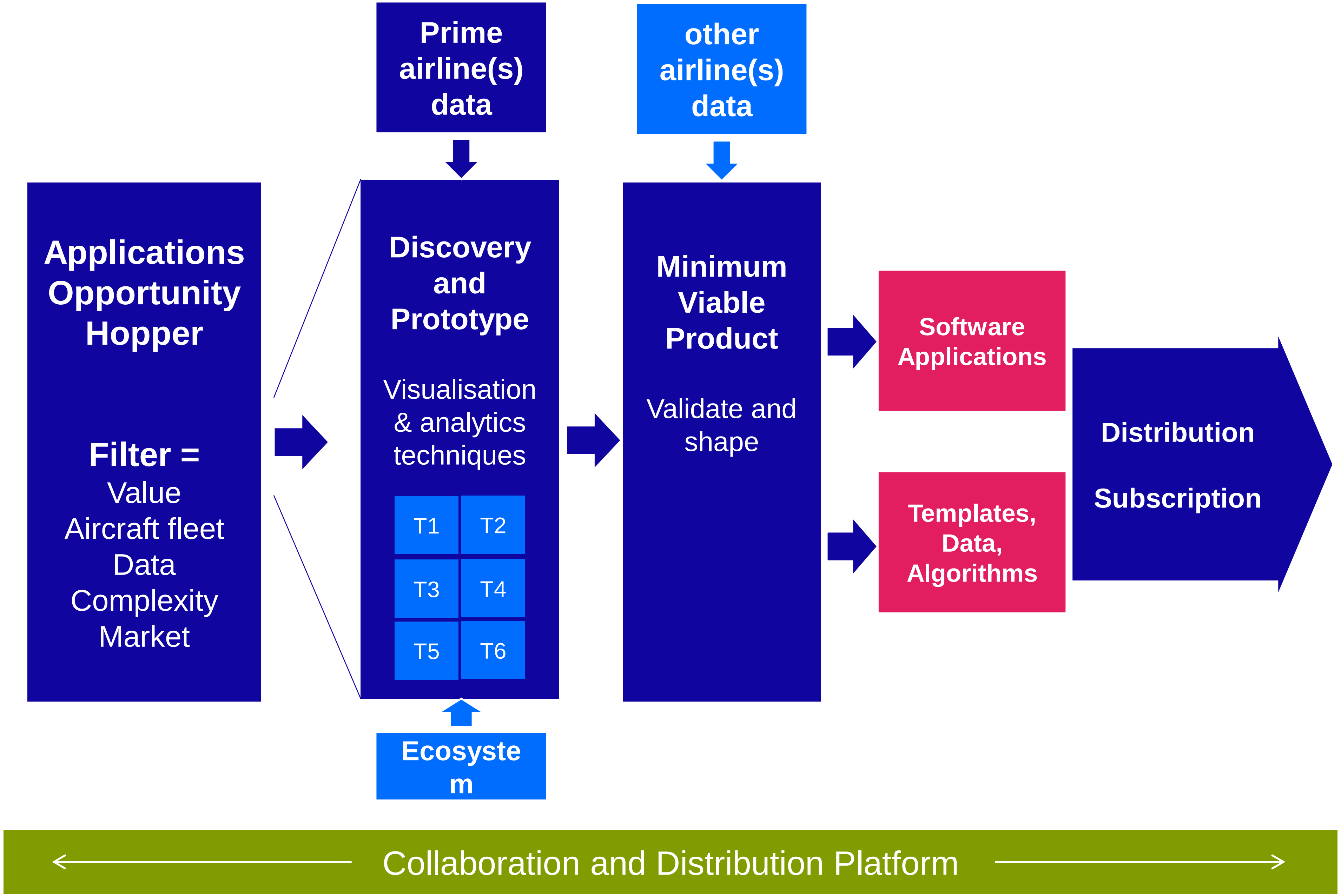
Applications

1. Safety and compliance
2. Operational efficiency
3. Availability

and their interactions

Innovation to integrity service process and platform

Innovation process



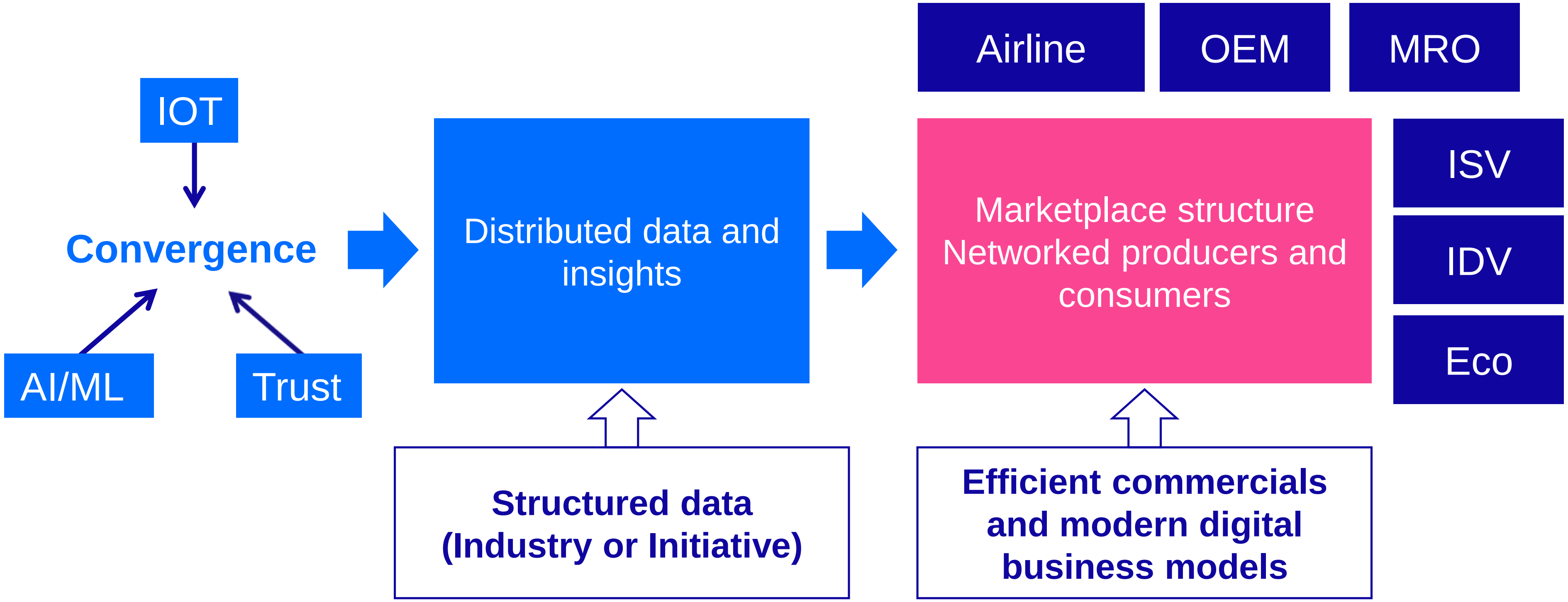
Enabling the network of value

Convergence enables Increased value and access

Distributed value where many parties contribute

Adjacent examples

- Marine
- Automotive
- Pharmaceutical
- Telecoms
- Banking

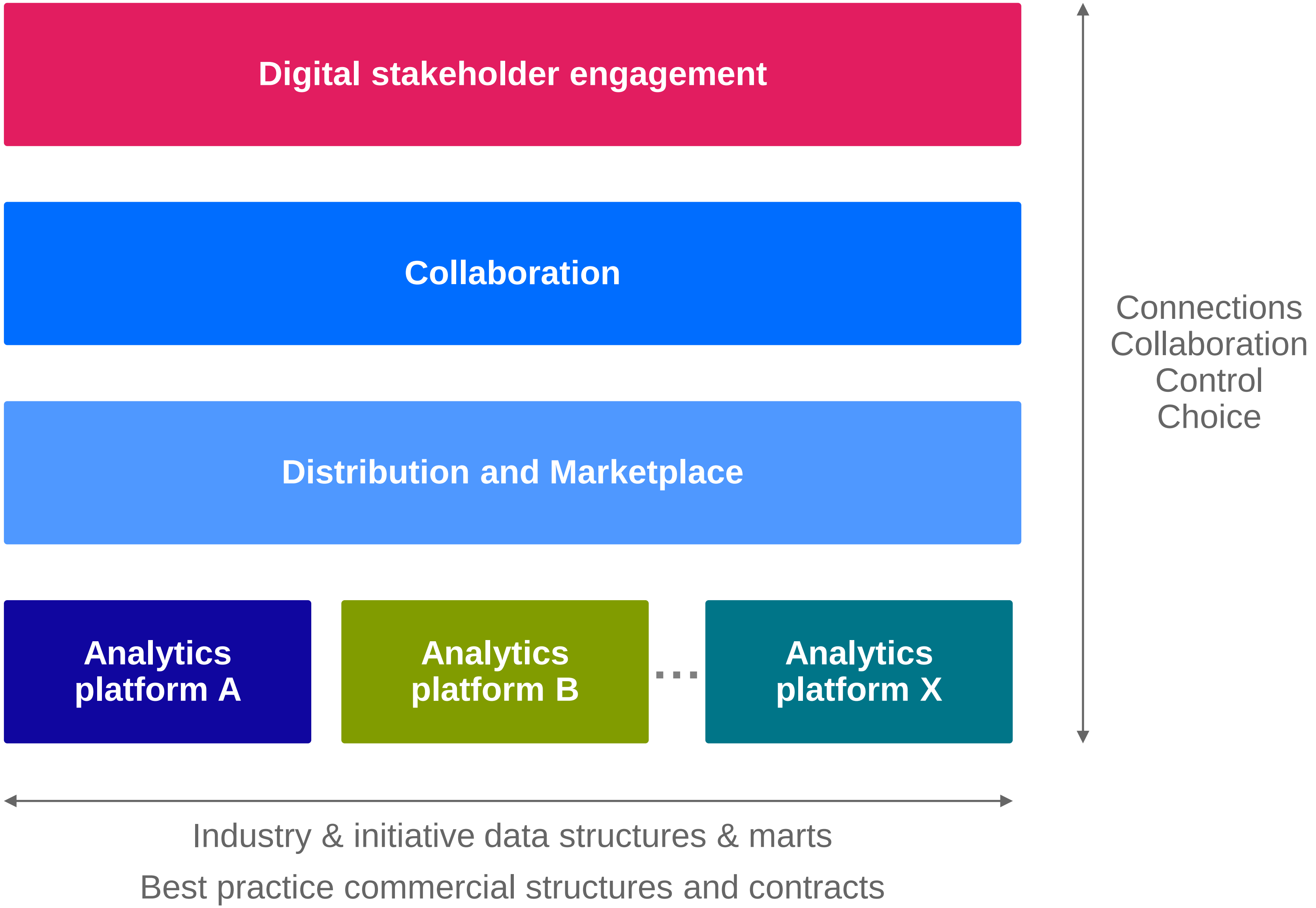


Project Melwood - A platform view

Conclusion

1. Enable distributed value
2. Networked effect & collaboration
3. Choice of analytics solutions
4. Controlled federation
5. Simplified commercial structures

Lifecycle management of above



ROLLS

ROYCE

Using data technologies to keep airline schedules on time

Margrét S. Otterstedt, Data Analyst, Operations Support, Icelandair

ICELANDAIR

Using data technologies to keep airline schedules on time

Margrét Sesselja Otterstedt

Aviation Data Symposium

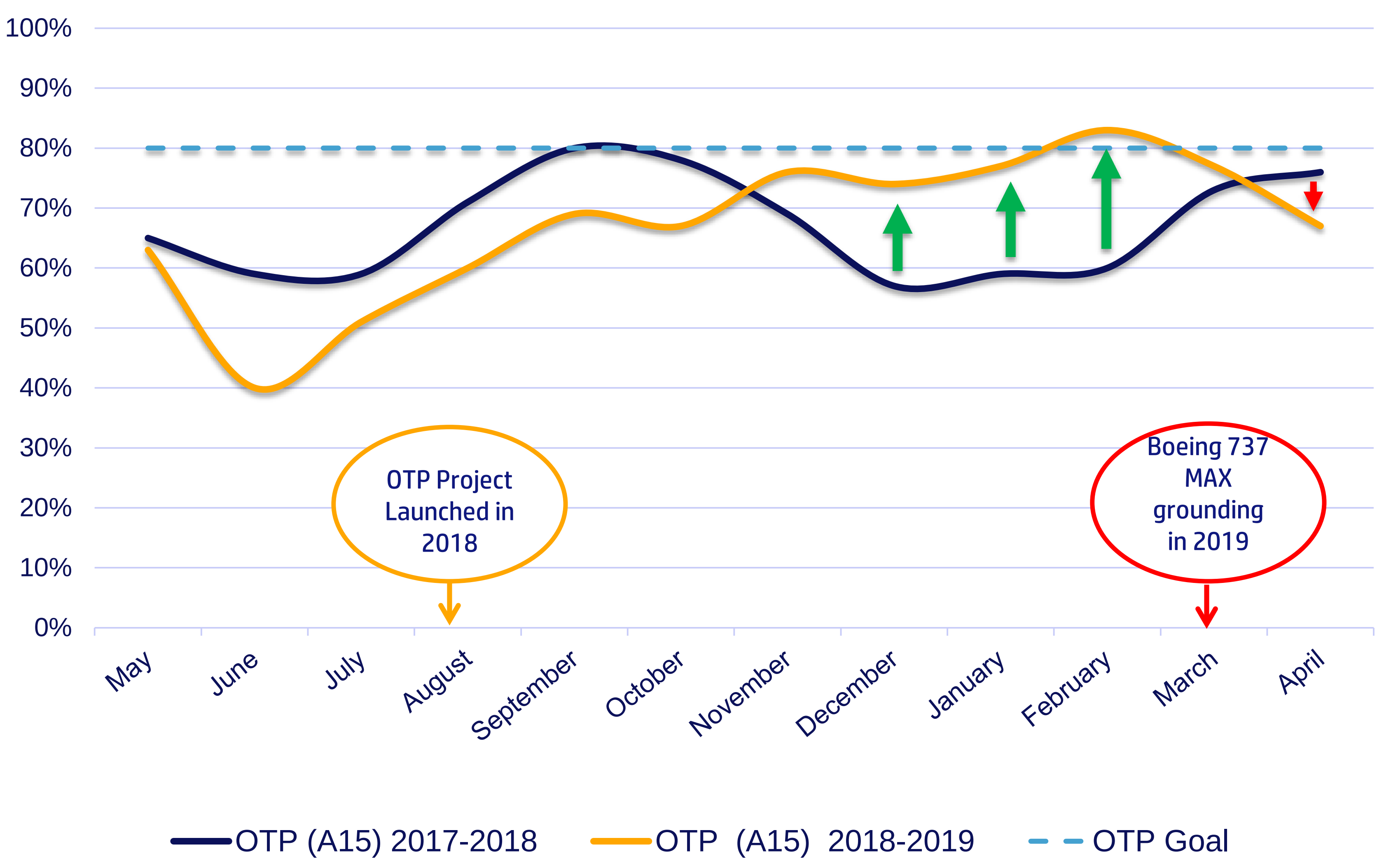
Athens, Greece

June 2019

ICELANDAIR

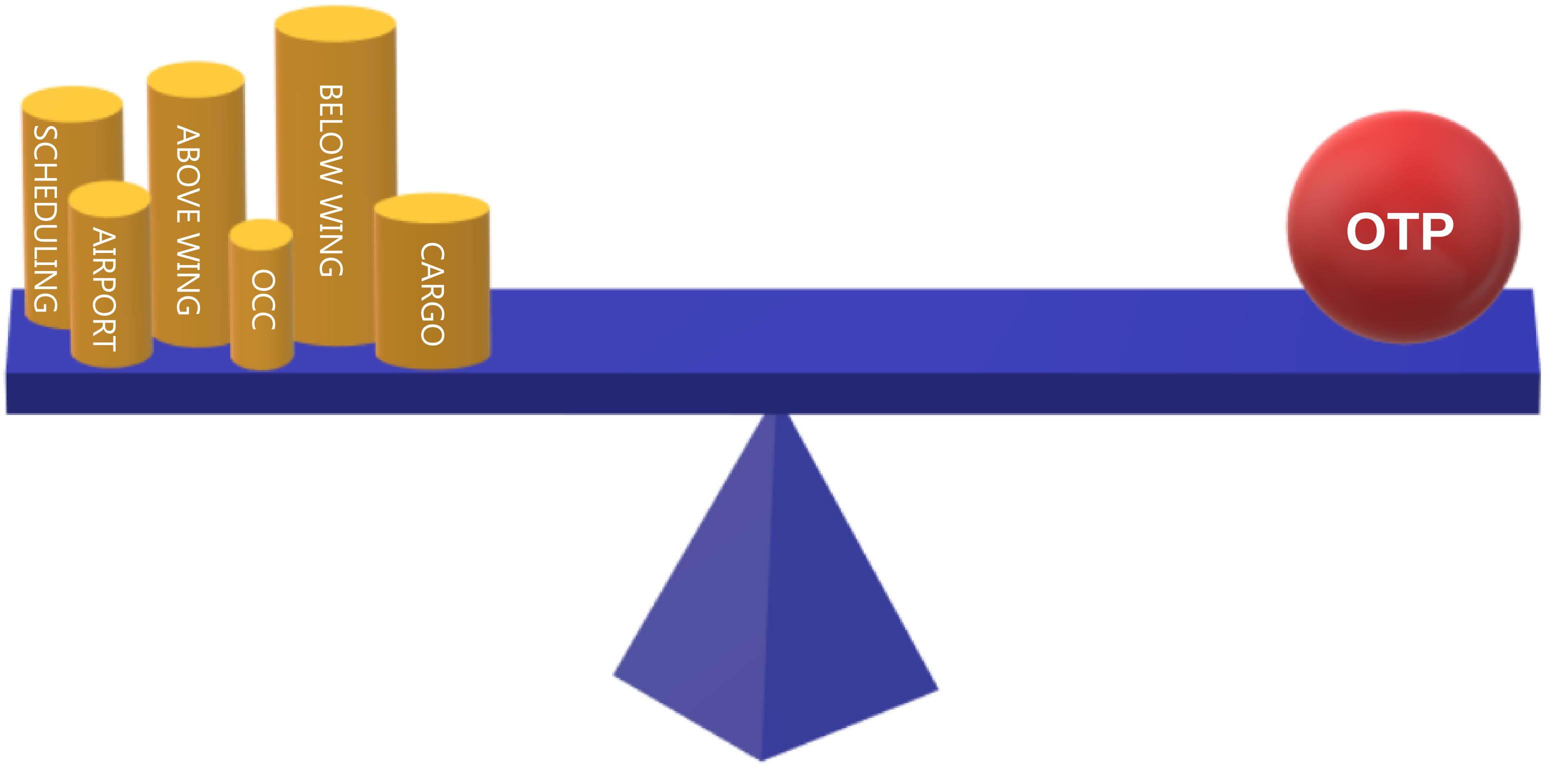
ABOUT ICELANDAIR

- Icelandair was founded in 1937
- Icelandair connects 23 gateways in Europe with 19 gateways in North America, through Iceland as a hub
- The network is based on 24-hour rotation, with connecting flights leaving Iceland in the mornings and afternoons
- The department Operations Support was founded in 2018 to connect Operations and drive operational improvements across departments

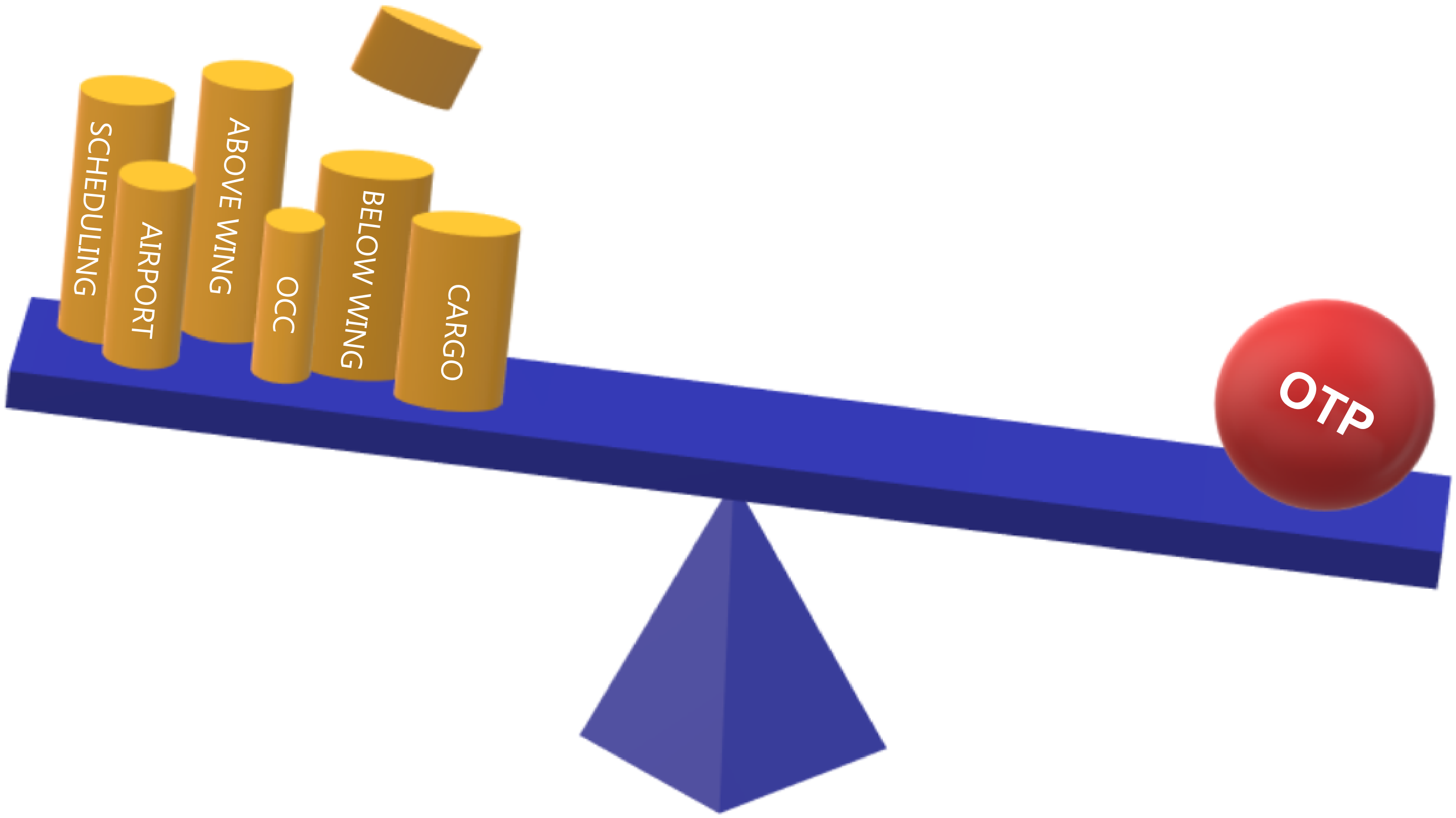

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
OTP Project Launched in 2018
Boeing 737 MAX grounding in 2019
May
June
July
August
September
October
November
December
January
February
March
April
OTP (A15) 2017-2018
OTP (A15) 2018-2019
OTP Goal

ICELANDAIR

WHICH CONTRIBUTORS TO FOCUS ON?



WHICH CONTRIBUTORS TO FOCUS ON?



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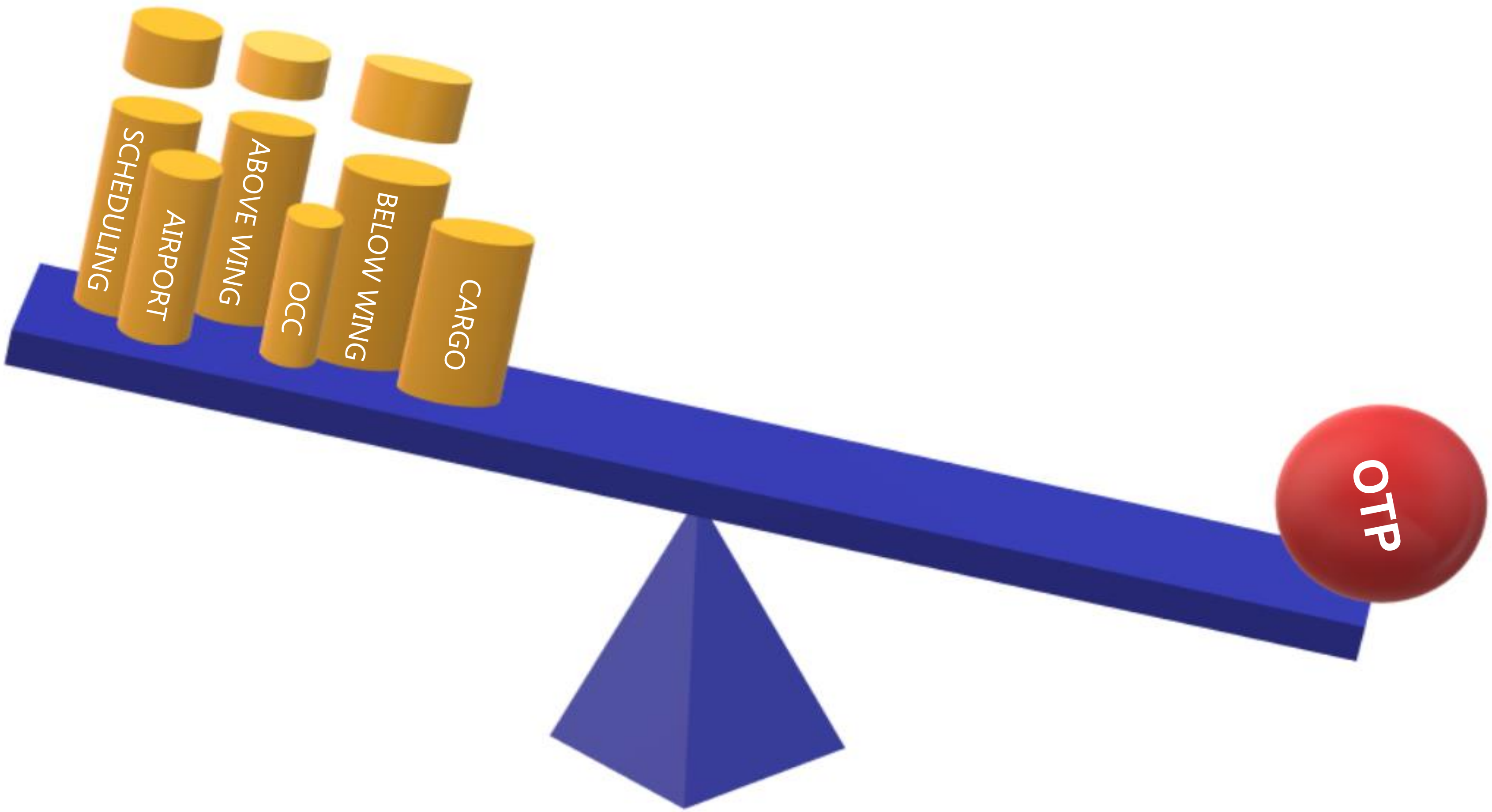
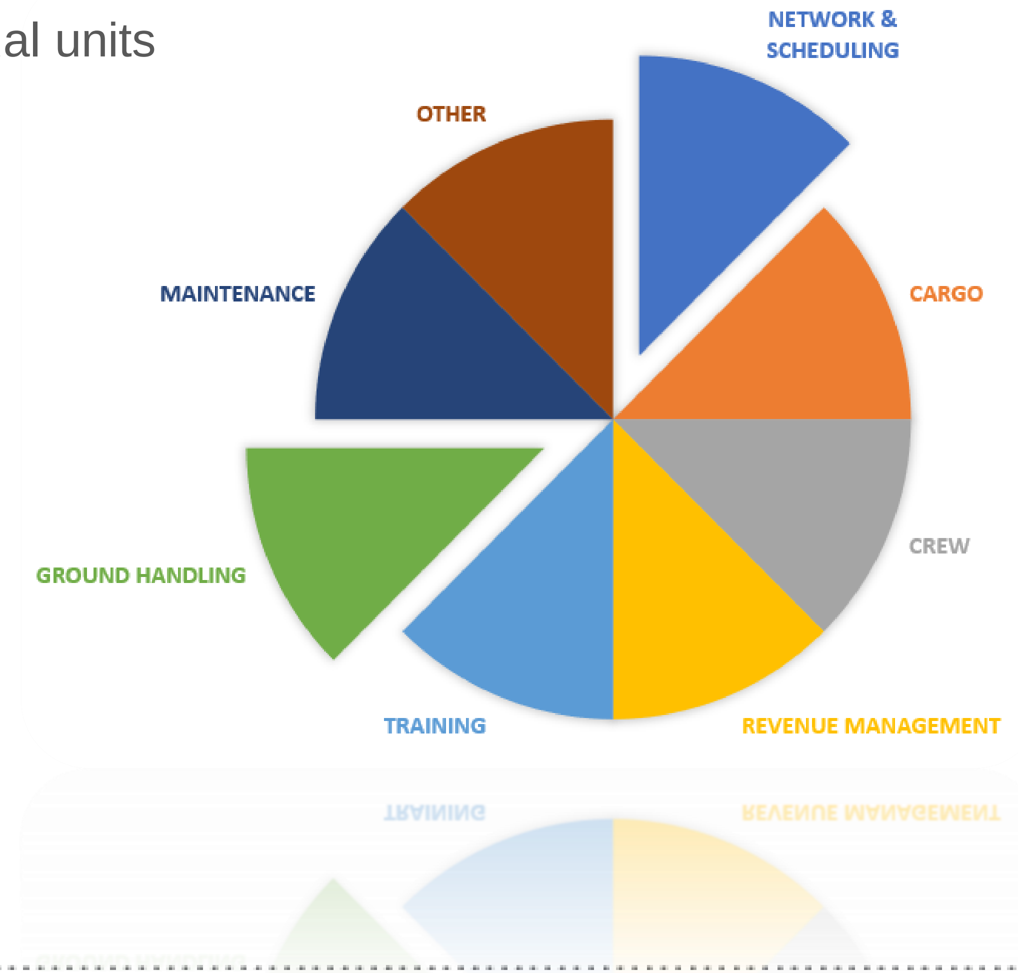
WHICH CONTRIBUTORS TO FOCUS ON?

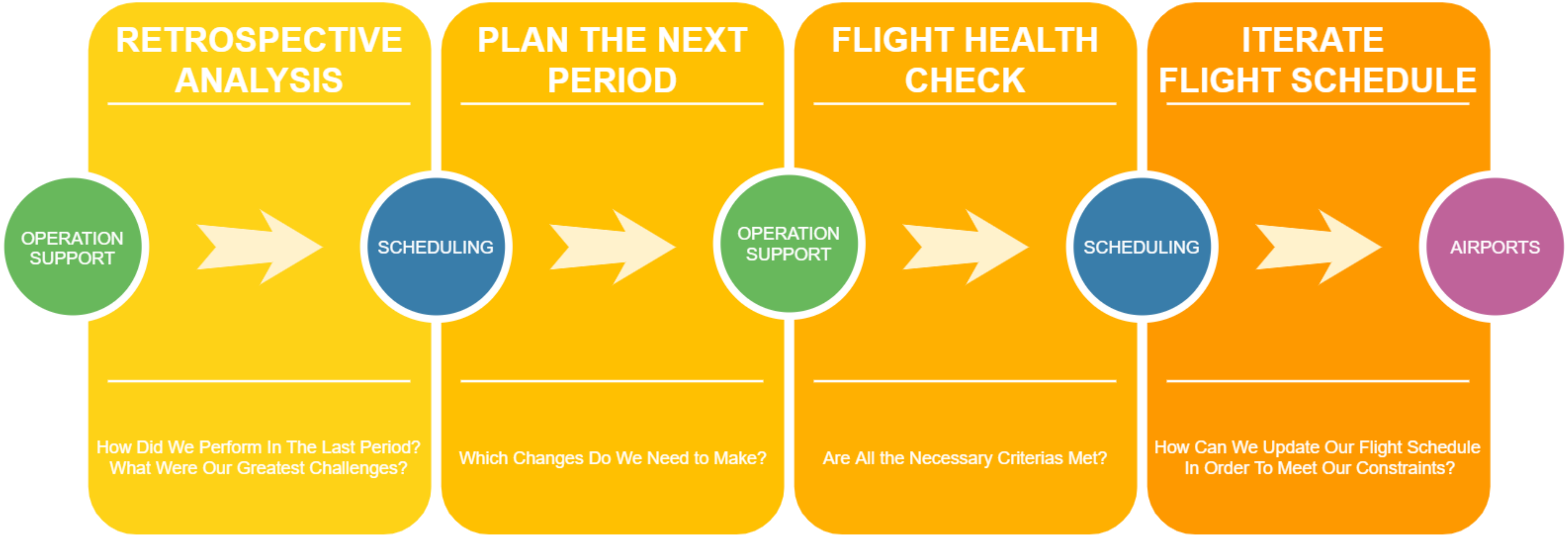


WHAT ARE THE GOALS?

- Optimize the entire business instead of individual units
- We are all pieces of the same puzzle
- Increase communication
- Centralize data flows
- Use data to eliminate doubt
- Fight Systematic Risk



IMPROVING LONG TERM PLANNING

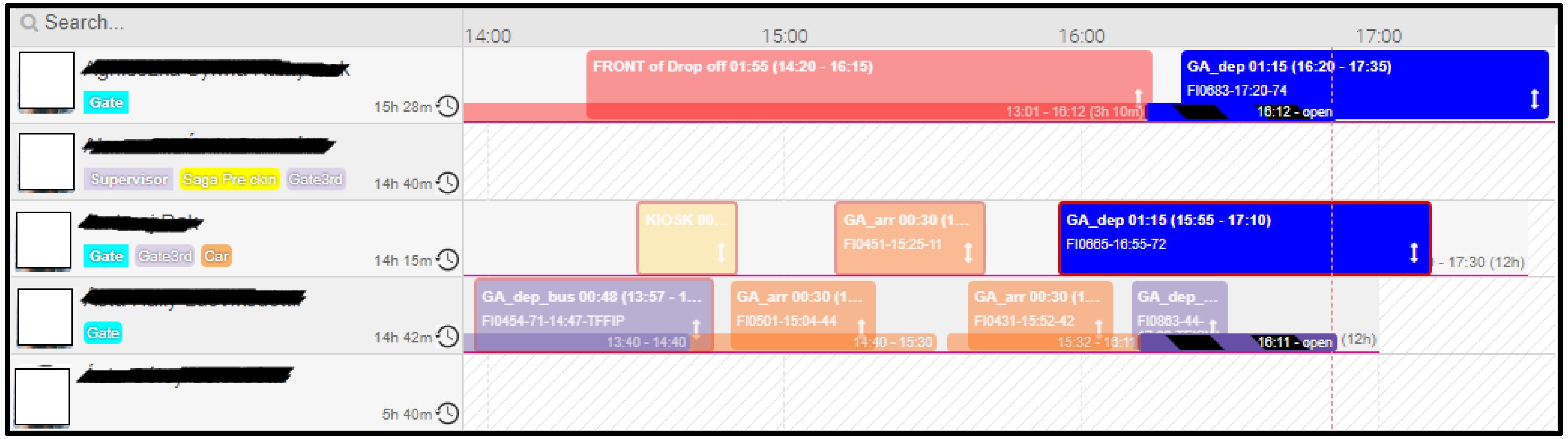


IMPROVING REAL TIME EXECUTION

IMPROVING REAL TIME EXECUTION

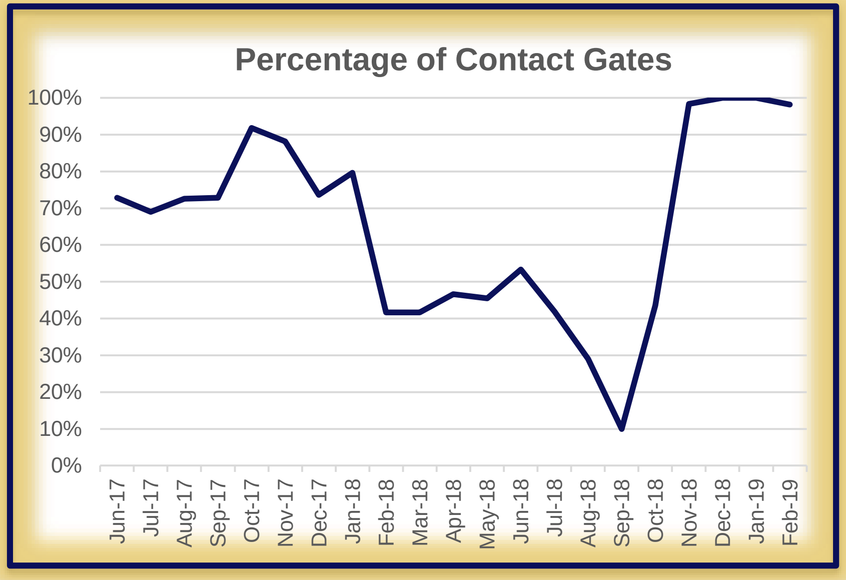
IMPROVING REAL TIME EXECUTION

Supervisor	Time			TEL	Radio
Employee no. 9	05:30-17:30		Reception // Assist with Crew check in	1	1
Employee no. 10	**05:00-17:00**		Check in	2	2
Employee no. 11	05:30-17:30		Check in	3	3
Employee no. 12	05:30-17:30		Zone A - C	4	4



IMPROVING REAL TIME EXECUTION

IMPROVING REAL TIME EXECUTION

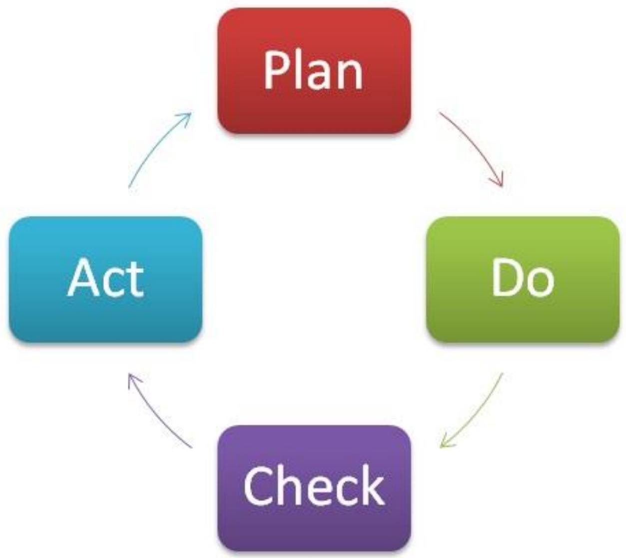


FINDING THE RIGHT MOTIVATION

- Greater company performance awareness
- Positive feedback
- Gamification
- Performance bonuses
- Consensus regarding our main KPI´s - what counts as success?

GOING FORWARD

- Digitalization
- Data-Driven Decision Making
- Clearer Business Processes
- Increased Cost Awareness
- Focus on Continuous Improvements



Any Questions?

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Avoiding turbulence and disruptions: a new collaborative approach

Martin Gerber, Technical Pilot Airbus A320, Swiss International Air Lines

Avoiding turbulence and disruptions
A new collaborative approach

Martin Gerber

Technical Pilot

Swiss International Airlines

Flight Operations Engineering, ZRH AO/PB-E

Lufthansa Group

Presented to IATA Aviation Data Symposium
26 June 2019, Athens, Greece

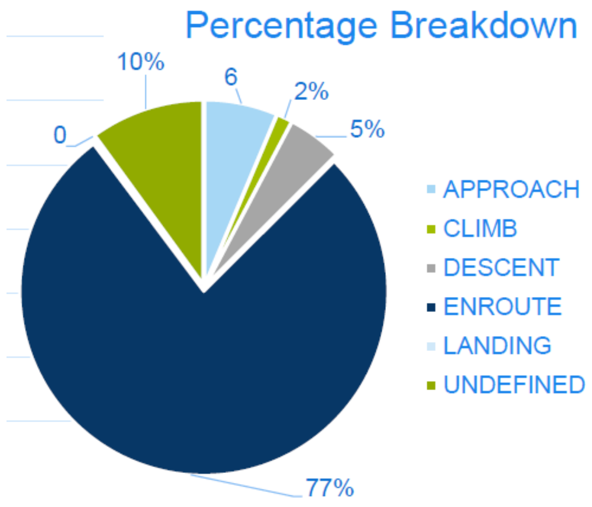
Avoiding turbulence – a new collaborative approach
Agenda

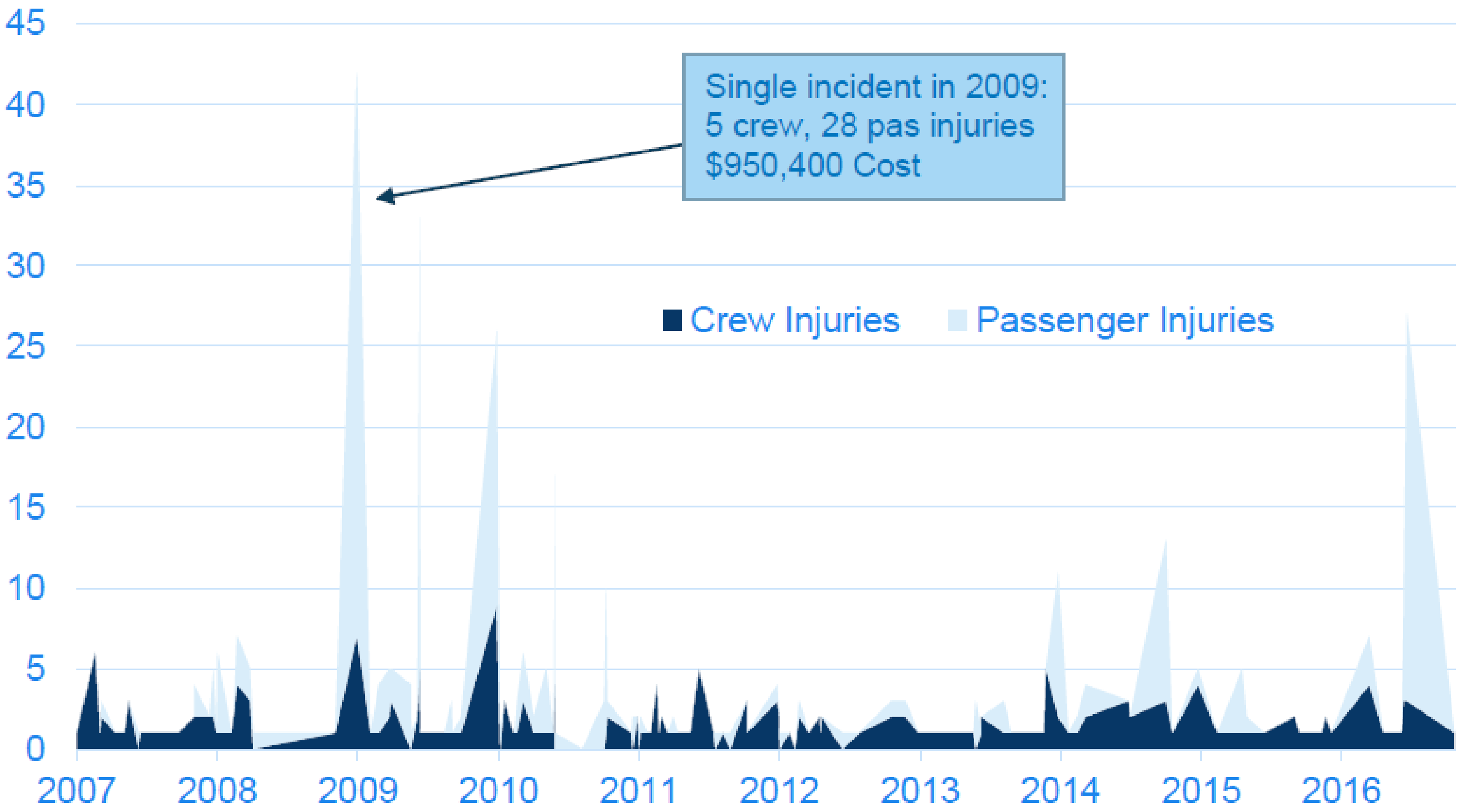
1) Motivation – Turbulence impact on operation
2) Stakeholders affected by aviation turbulence
3) Turbulence reporting yesterday and tomorrow
   - Energy Dissipation Rate (EDR)
4) The IATA Turbulence Aware Project
5) Application for objective EDR data sharing
6) Extension of EDR measurement capability to more airlines

Avoiding turbulence – a new collaborative approach
Motivation - Turbulence impact on operation

Turbulence Injury Count

2007 – 2016	**Crew**	**Passenger**
Serious	82	20
Minor	126	212
Total	208	232
Grand Total	**440**	





Source: IATA, Search only included FAR Part 121 Operators (U. S. airlines)

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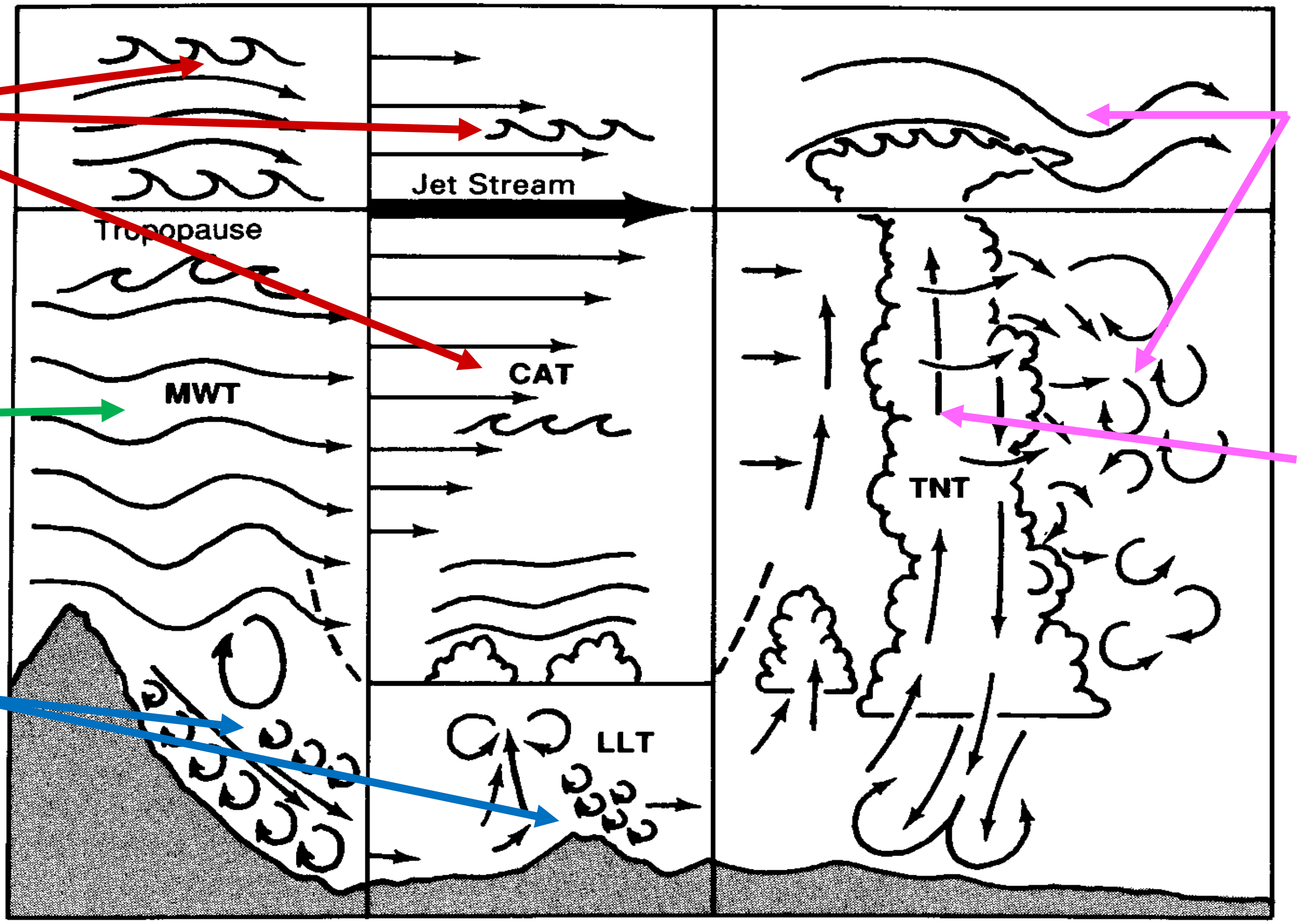
Avoiding turbulence – a new collaborative approach
Motivation - Turbulence impact on operation

Clear Air Turbulence (CAT)

Mountain Wave Turbulence (MWT)

Low level Terrain-induced Turbulence (LLT)



Cloud-induced or Convectively-induced Turbulence (CIT)

In-cloud Turbulence

Source: P. Lester, "Turbulence – A new perspective for pilots," Jeppesen, 1994

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Avoiding turbulence – a new collaborative approach

Stakeholders affected by aviation turbulence

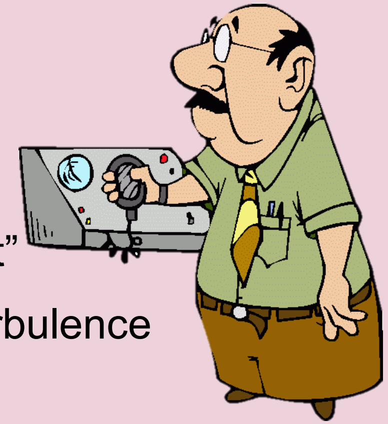
Flight Crews

- Multiple data sources (ATC “chat” room, dispatchers, company-specific forecast products, on-board radar)
- Reporting subjectivity, inaccuracy
- Cabin management, tolerance for risk

Cabin Crews

- Cabin management
- Insufficient info from flight crews
- Obligation to continue duties when seatbelt sign is on
- Uncooperative passengers

ATC



- No access to real-time turbulence data at work area
- PIREPs communicated via “sneaker net”
- Altitudes “blocked” out with repeated turbulence reports, can persist for hours

Research / Forecaster / Dispatcher

- Deterministic forecast models, not validated in real-time
- Limited access to turbulence information
- Limited communication with crew

Source: Tammy Farrar, FAA NextGen, Aviation Weather Division

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Avoiding turbulence – a new collaborative approach
Turbulence reporting yesterday and tomorrow

Yesterday: PIREP

“If you can still drink your coffee, it’s light turbulence.”

→ **subjective, aircraft dependent**

Tomorrow: Automated EDR Reports

→ **objective, aircraft independent**

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Avoiding turbulence – a new collaborative approach
Energy Dissipation Rate (EDR)

Energy Dissipation Rate (EDR)

- ICAO Annex 3 metrics for turbulence
- Measuring the state of the atmosphere around the aircraft in flight
- Aircraft independent absolute value
- Simple software installation

Source: IATA

Source: Ships on a Stormy Sea by Johannes Christiaan Schotel, 1826

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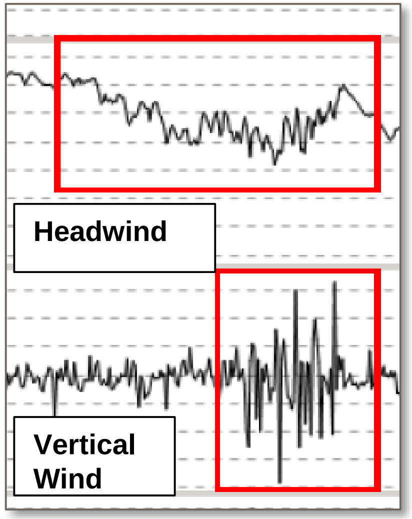
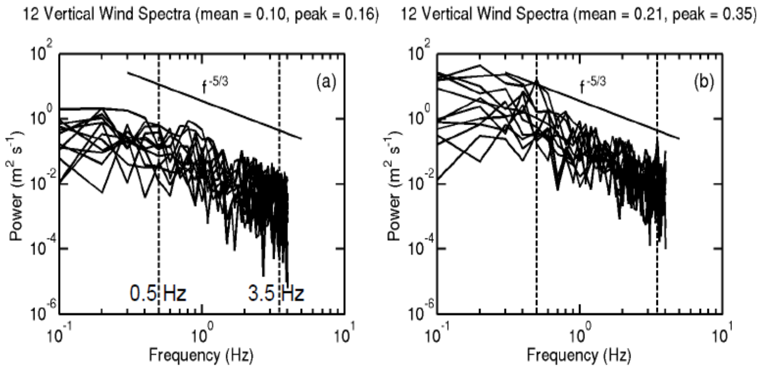
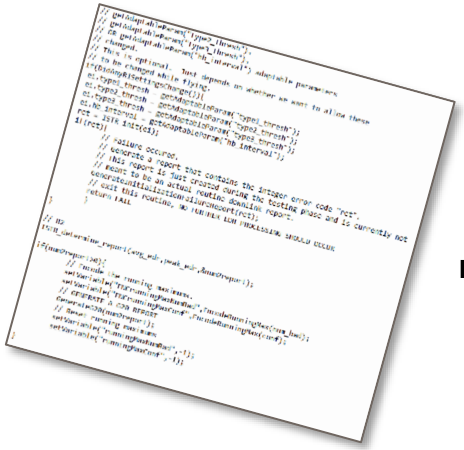
Avoiding turbulence – a new collaborative approach

How to calculate EDR





 +  +  +  → 

Angle of Attack	True Airspeed	Algorithm	**ACMS**, or	Connectivity
(min. 8 Hz)	(min. 8 Hz)	(NCAR, DLR)	**EFB with AID**	(ACARS, …)

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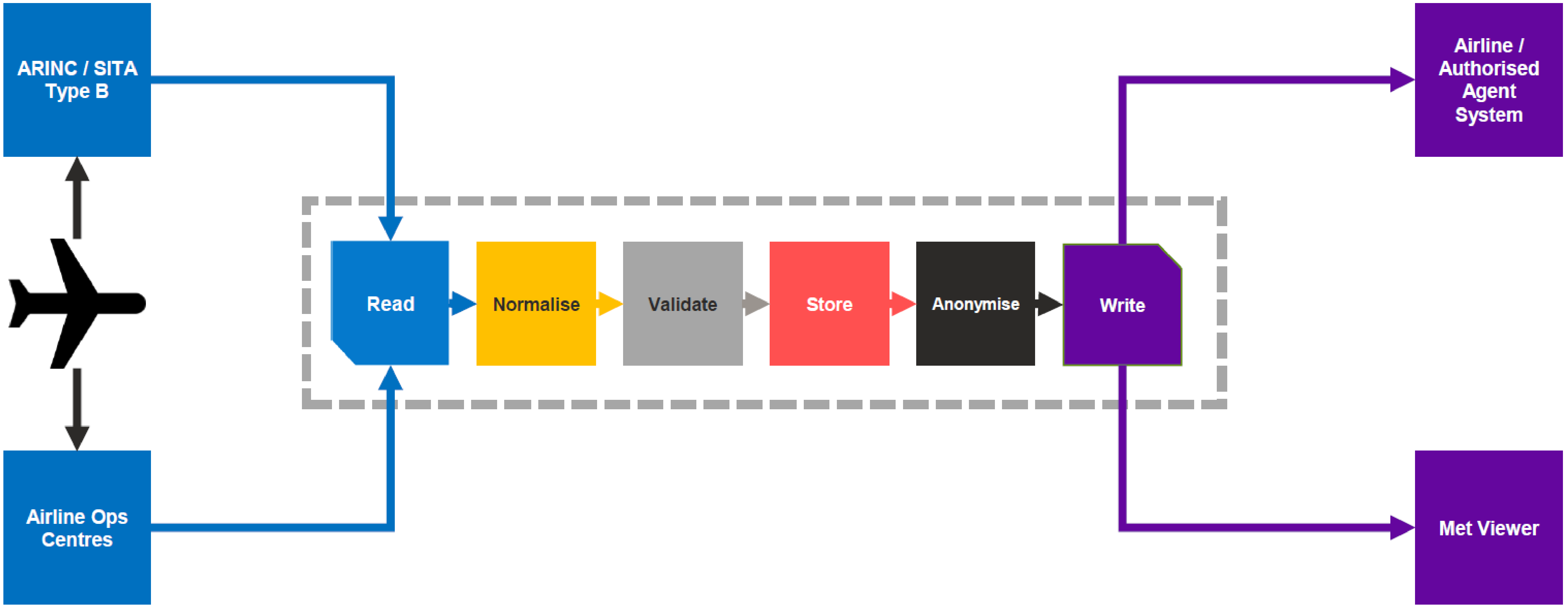
Avoiding turbulence – a new collaborative approach
The IATA Turbulence Aware Project



Source: IATA, Turbulence Data Sharing Project, K. Vashchankova, 2019

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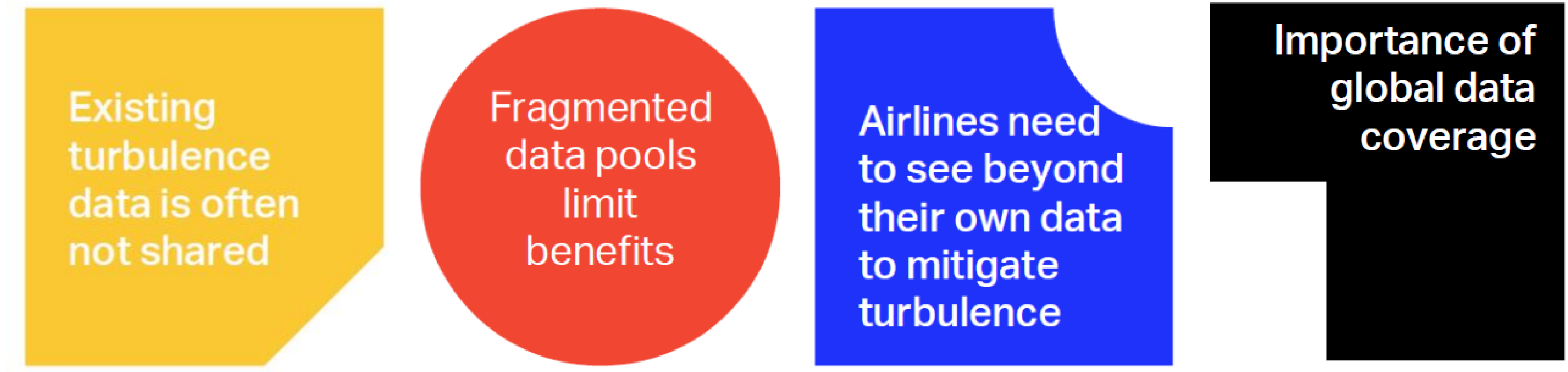
Avoiding turbulence – a new collaborative approach
The IATA Turbulence Aware Project

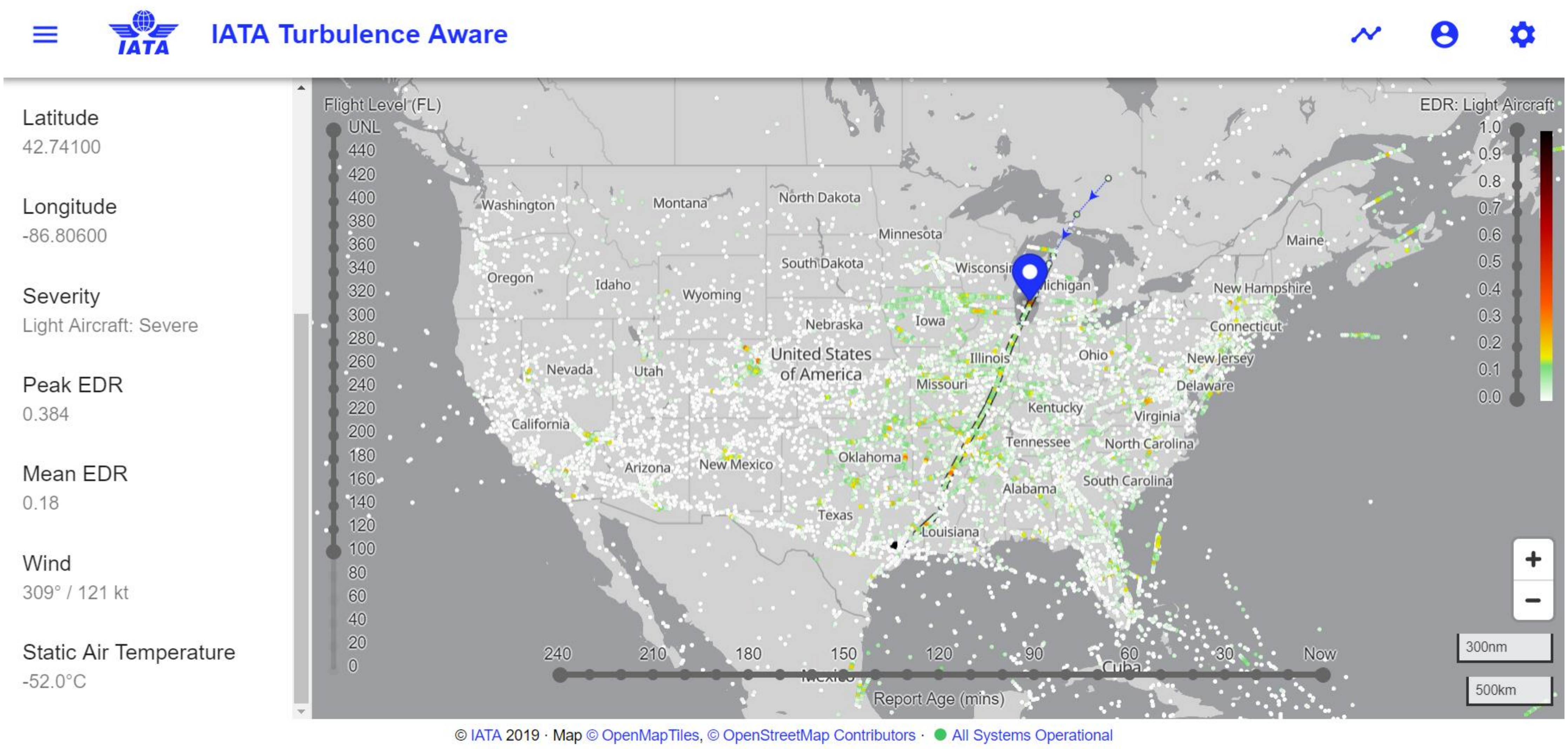


Source: IATA, Turbulence Data Sharing Project, K. Vashchankova, 2019

Avoiding turbulence – a new collaborative approach
The IATA Turbulence Aware Project

CHINA SOUTHERN AIRLINES
UNITED
ATLAS AIR WORLDWIDE
Southwest
QANTAS
AIRFRANCE
American Airlines
CATHAY PACIFIC
Aer Lingus
JAPAN AIRLINES
DELTA
easyJet
Lufthansa
SWISS
WESTJET

Avoiding turbulence – a new collaborative approach
The IATA Turbulence Aware Project: Web Viewer



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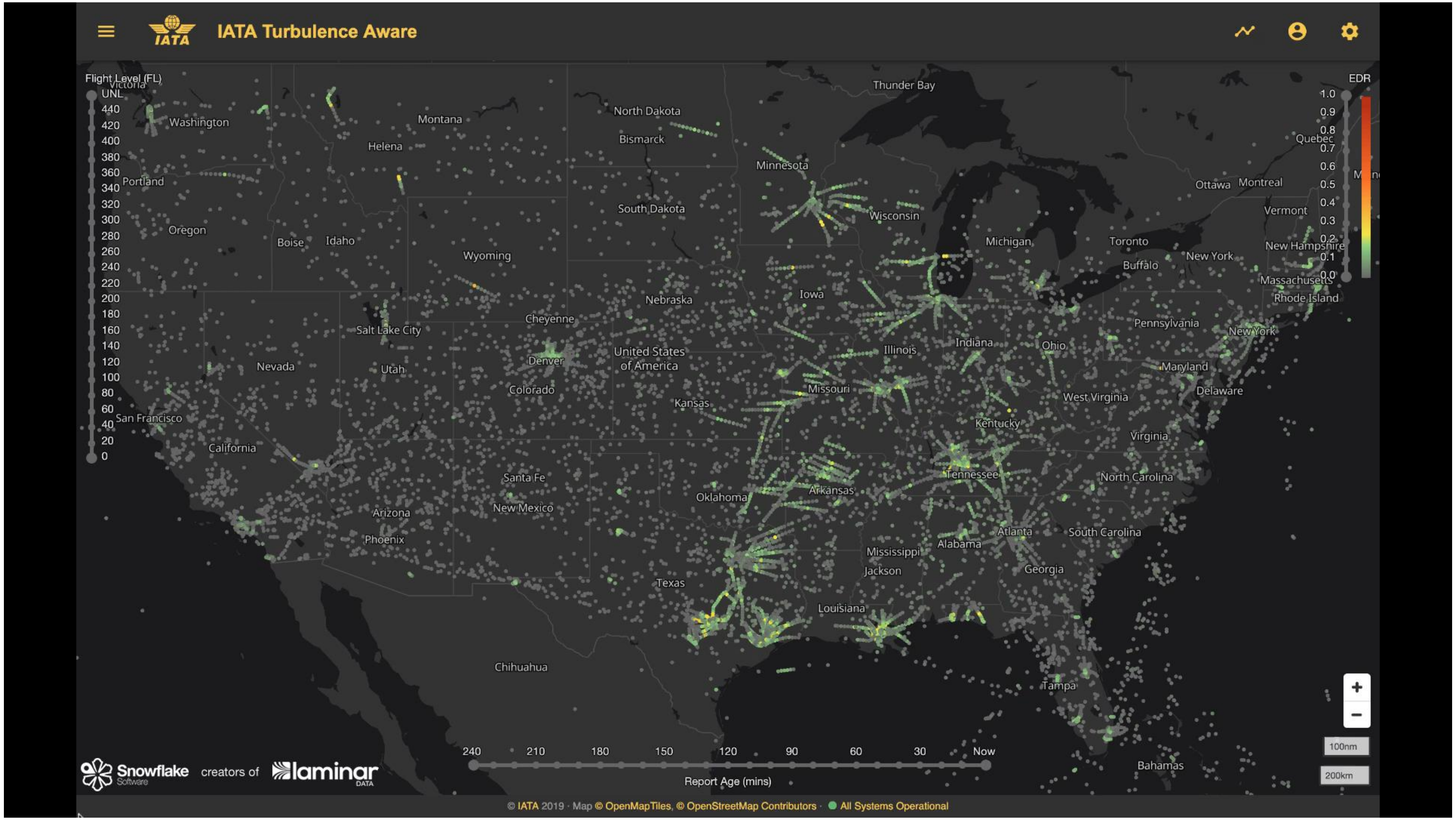
Avoiding turbulence – a new collaborative approach
The IATA Turbulence Aware Project: Data Visualization



Source: Ian Painter – Snowflake Software

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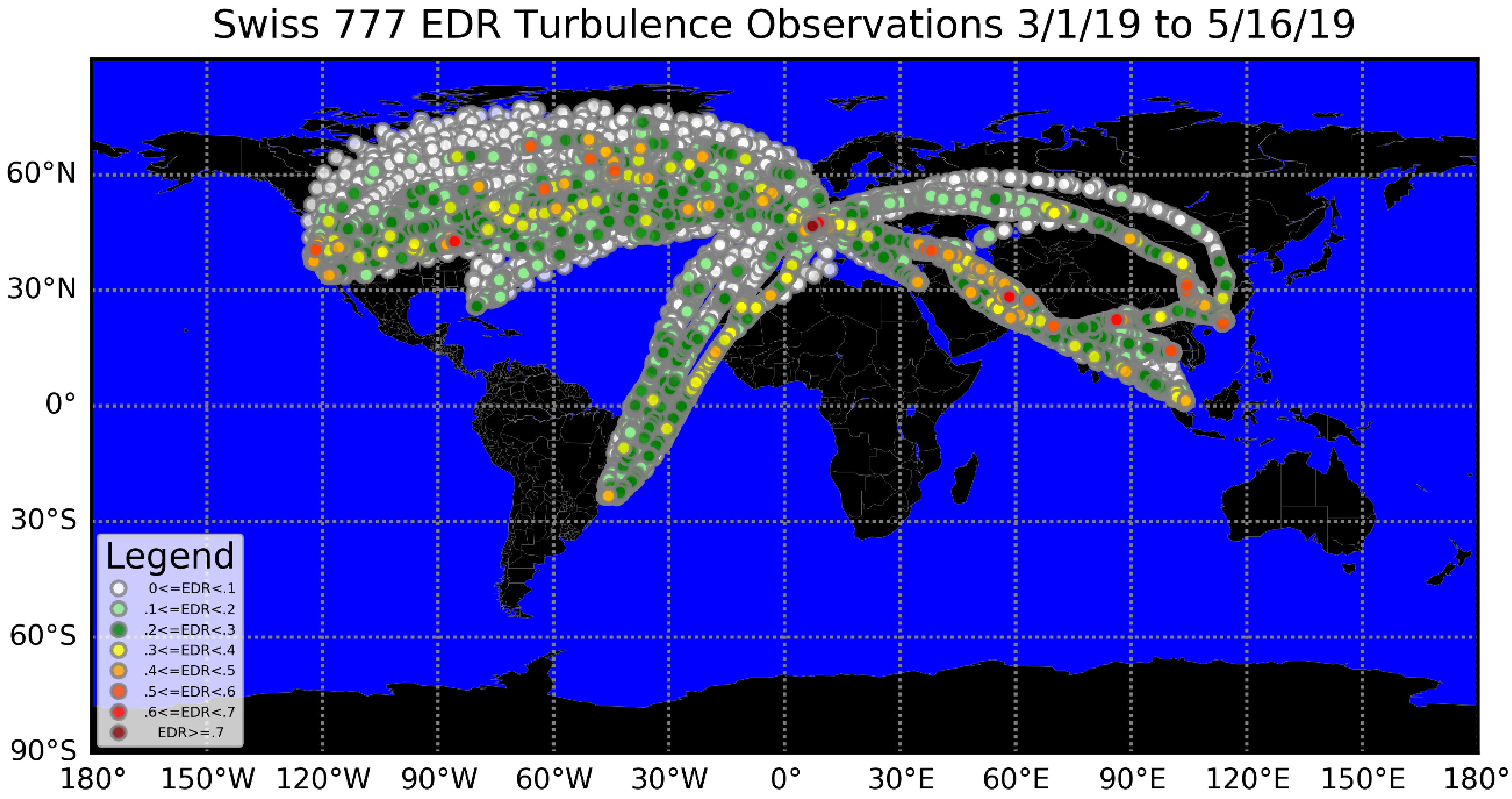
Avoiding turbulence – a new collaborative approach
The IATA Turbulence Aware Project



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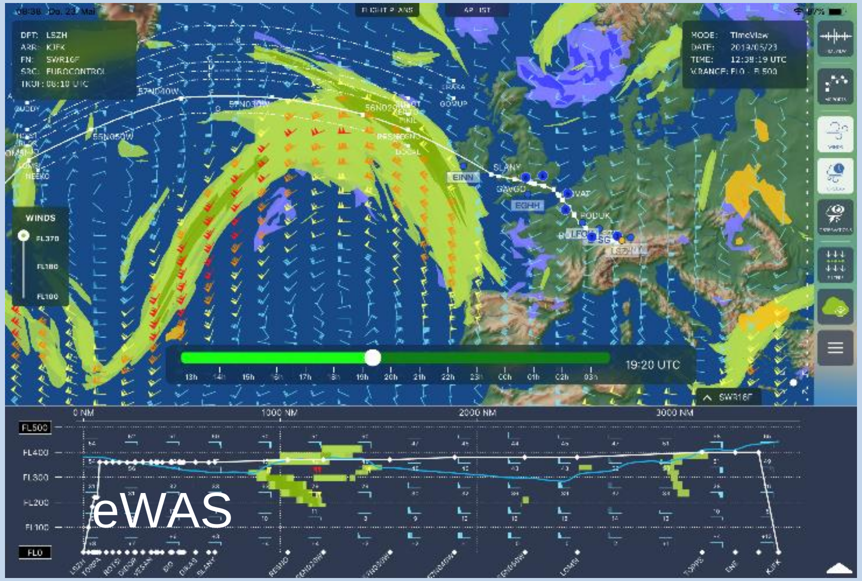
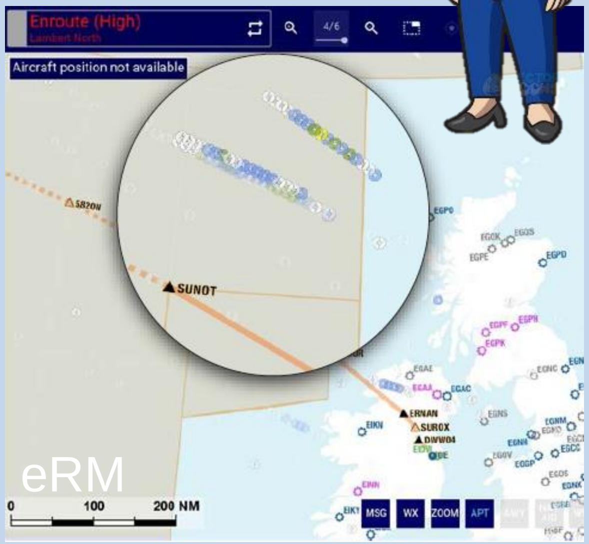
Avoiding turbulence – a new collaborative approach

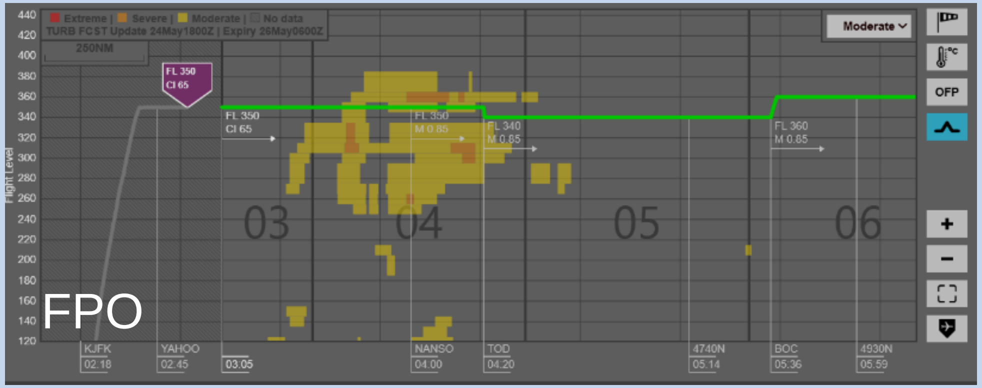
Application for objective EDR data sharing

Flight Crews

- Display of nowcast turbulence forecast
- Enhances pilot's ability to anticipate and react to possible turbulent conditions
- Better decisions based on not only cabin safety, but ride comfort and fuel-burn efficiency (reduced emissions)







Sources: GTD (top left)
LSY, AerLingus (top right)
PACE (right)

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Avoiding turbulence – a new collaborative approach
Application for objective EDR data sharing

Cabin Crew

- The cabin crew and passengers are warned and secured in time
- The service can be scheduled around the time of increased turbulence activity
- Less injuries
- Airline reputation

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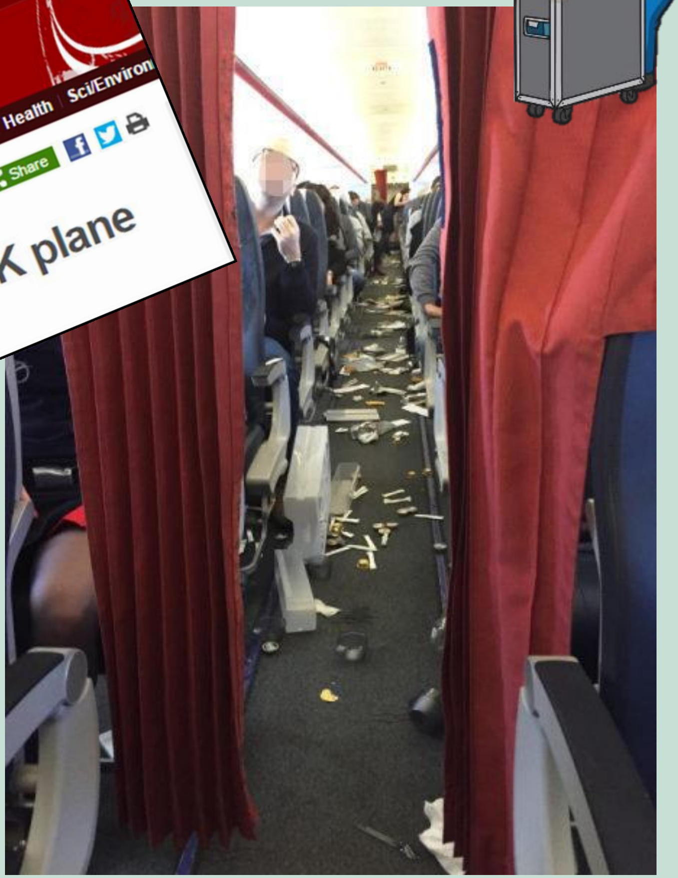
16 July 2014 Last updated at 10:23 GMT

Twenty injured when S Africa to HK plane hits turbulence



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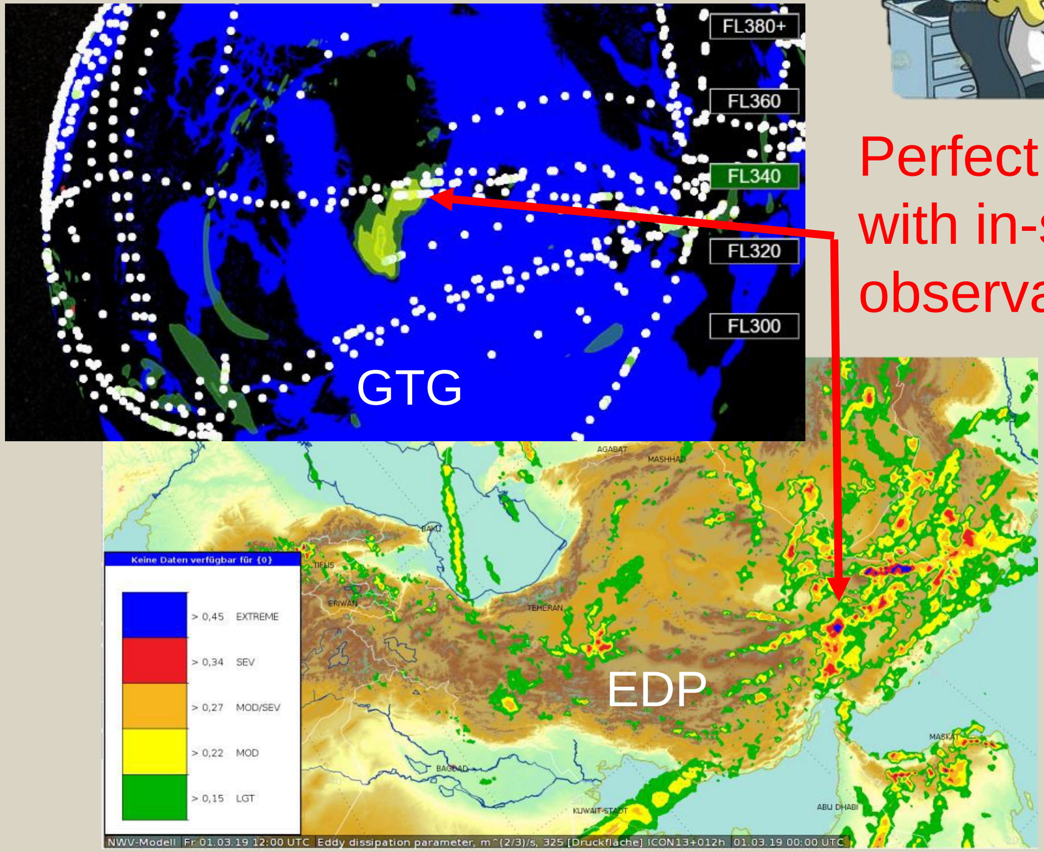
Avoiding turbulence – a new collaborative approach
Application for objective EDR data sharing

Researcher and Forecaster

- *«Turbulence Forecasting remains one of the last great challenges of numerical weather prediction.»* 1)
- Roadmap for WAFS calls for the WAFC to implement turbulence forecasts utilizing EDR during the Aviation System Block Upgrades (ASBU) time frame (2019-2024). 2)
- Improve numerical weather prediction models



Perfect match with in-situ EDR observation

1) Robert Sharman (NCAR, Geophys, Res, Lett. 39, 2012

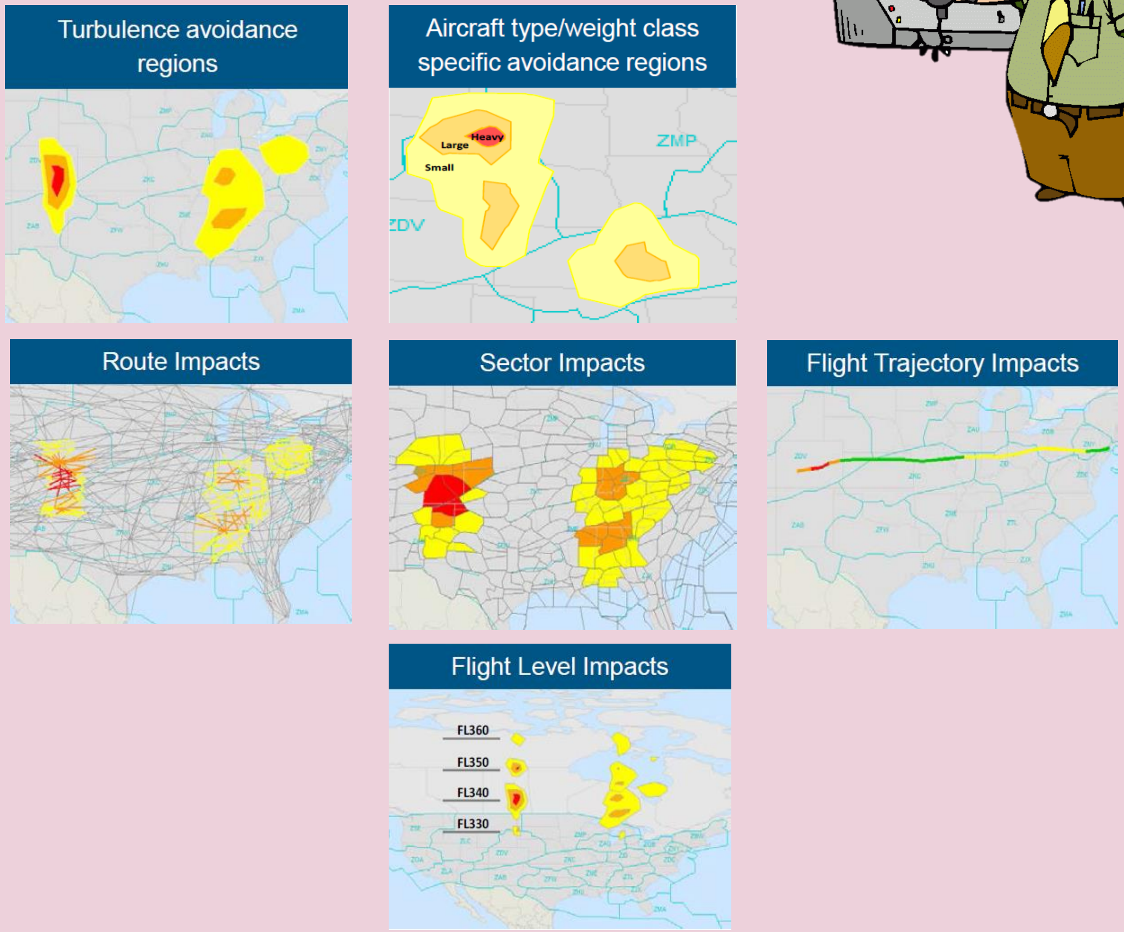
2) 4th Meeting of the Meteorological Panel (METP), Montréal, 10 to 14 September 2018

Sources: T. Rahmes, Boeing – B.Sharman, NCAR
A. Barleben, Deutscher Wetterdienst DWD

Avoiding turbulence – a new collaborative approach
Application for objective EDR data sharing

ATC

- Reduction in ATC workload: Less requests for altitude changes
- Improved airspace capacity
- Less reroutes, delays, diversions, cancellations
- Turbulence Avoidance Modeling (TAM): Developing predictive models of pilot behavior in response to turbulence encounters



Source: Rafal Kicinger and Christina Bittle, Metron Aviation, Turbulence Impact Mitigation Workshop 3, 5-6 September 2018, Mclean, VA.

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Avoiding turbulence – a new collaborative approach
Extension of EDR measurement to more airlines

IATA Turbulence Aware

- A global platform for sharing automated EDR turbulence reports in real-time
- Data is collected from airlines, business aviation or third party ground servers in real-time
- Data processing through the platform is max. 30 sec
- Airlines can use their own flight planning and in-flight tools to display the data, or use IATA Turbulence Aware viewer in-flight via Wi-Fi

→ Global collaboration is the key to success!

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Thank you

The adoption of network-centric data sharing in Air Traffic Management: The case of SWIM

Marina Efthymiou, PhD, Course Director for M.Sc. in Aviation Leadership, Assistant Professor in Aviation Management, DCU Business School

Agenda

- Problem statement
- SWIM fundamentals
- What do the different parties think about SWIM?
- The case study of A-CDM at Dublin airport

15 mins Arrival Punctuality

75.8%

-3.9%pts vs. 2017

Flights arriving > 15 minutes ahead of schedule

Early Arrivals

9.5% -0.2%pts

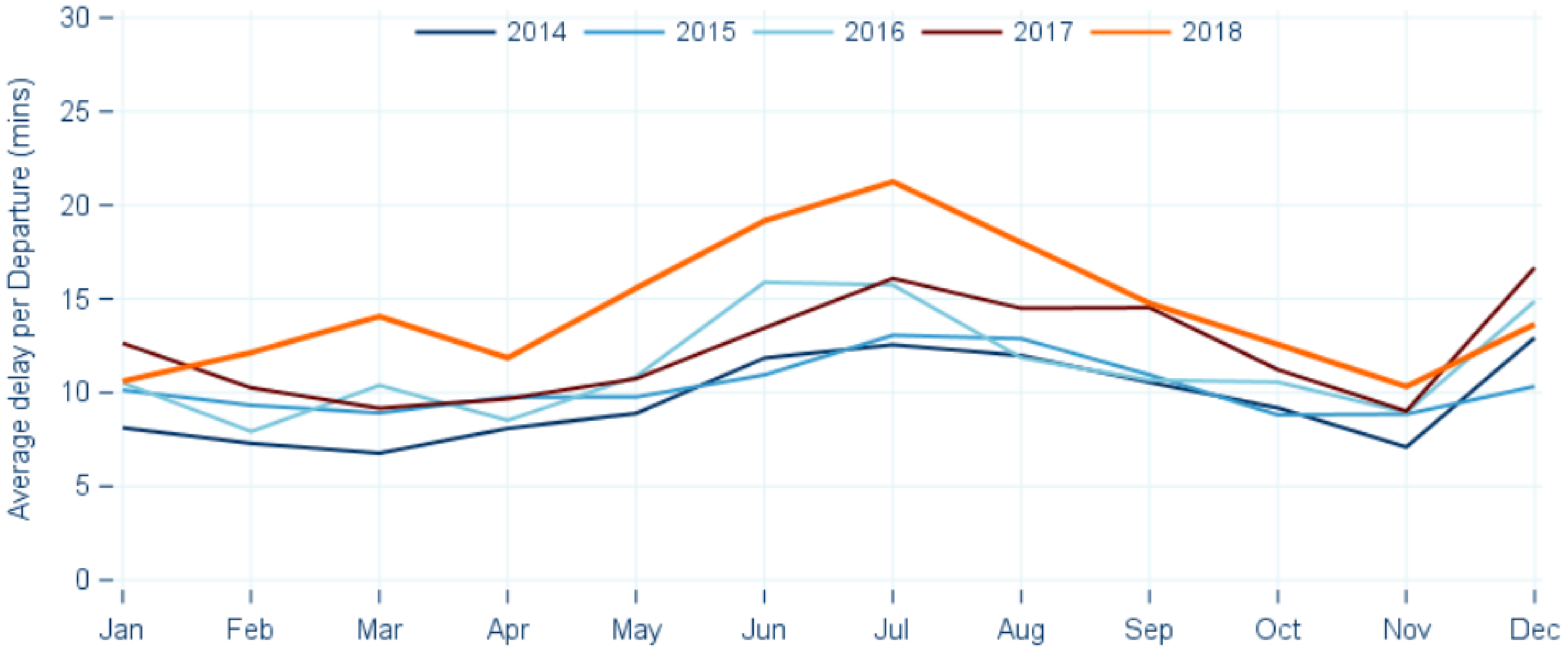
Main Delay Causes 2018 in mins/flight

Reactionary	**6.7**
Airline	**3.6**
ATFM En-Route	**1.7**

2018 Departure Delay (from all causes)

14.7 mins/flight

+2.3 mins vs. 2017

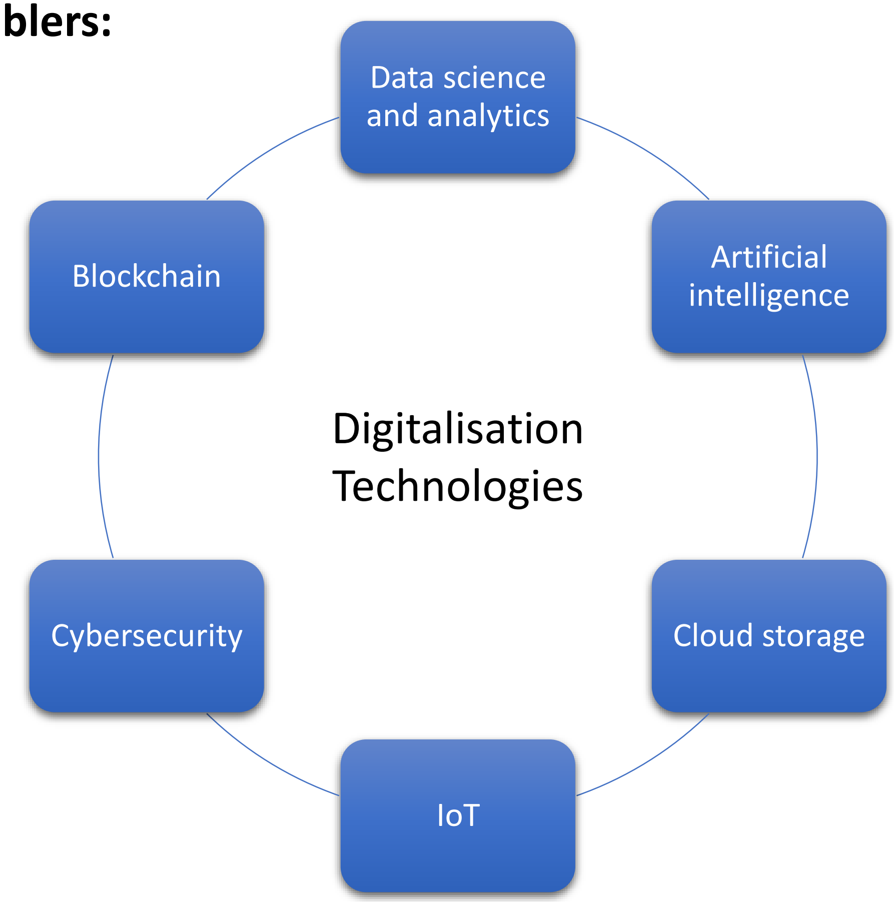


EUROCONTROL, 2019

Need for new (or optimised) technologies to improve the overall performance of the network

- Evident possibilities:
  - Optimized aircraft separation
  - Real-time airborne fleet adjustment
  - Congestion prediction and holding pattern elimination

Enablers:



System Wide Information Management concept (SWIM)

- **GOAL:** provide a platform for open sharing of all information between operators, airports, ANSPs and meteorology services.

- **Major drivers/factors:**
  - Availability and penetration of the required level of technology within the airborne fleet and ground infrastructure; and
  - Willingness and possibility of actors to share their operational data with potential competitors.

What do the different parties think about SWIM?

Exploratory study and In-depth interviews with 14 senior experts working for :

- Airbus
- Boeing
- COOPANS
- ANSPs
- Airports

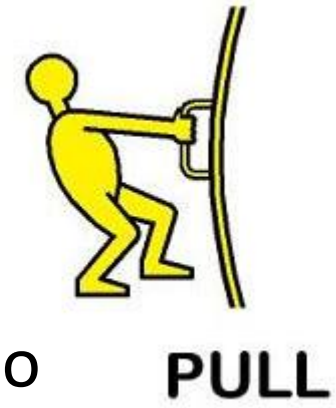
Themes of research:

- SWIM status
- Data analysis
- Barriers to implementation
- Drivers to change

Analysis:

- 411 data points
- 125 excerpts

Barriers to implementation



- **Difficulty to negotiate agreements with the pilots' trade unions** to allow data gathering.
- **Cost** and the **lack of a positive business case evidence**.
- The need to upgrade the ground and airborne systems to fix a problem that does not exist today – they can quite effectively communicate and operate with the existing technology.
- The **maturity of the concept** with concerns on data validity and cyber security as a potential blocking point to stakeholders.
- **Natural resistance to change** safety and operational perspective.

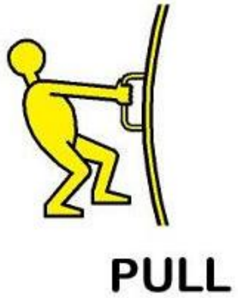
Drivers of change

- Clarity of communications
- Transparency
- Ability to be more agile and to quickly and economically integrate new functionalities and stakeholders
- Obsolescence of technology
- Regulations

A-CDM: Dublin Airport

- A-CDM requires organisational culture changes, handling of sensitive data, procedural changes and understanding of all A-CDM partners.
- The concept relies on improved messaging between the airport, airlines, ground service providers, ANSP, and the network manager, ensuring improved awareness for all these stakeholders.
- **Local benefits:**
  - improved efficiency of stand allocation;
  - improved aircraft sequencing and shorter taxi times yielding fuel economy;
  - improved availability of ground handling services.

A-CDM: Barriers to success



- **Ability to re-sequence** aircraft on ATC request: DUB however has a primarily single taxiway infrastructure = no re-sequencing is possible for aircraft that have been pushed back from the stand
- substantial **cultural** issue with A-CDM: All respondents claiming that the main beneficiary of A-CDM is one of the other stakeholders
- **Different needs** are not aligned: No cost burden sharing with the other stakeholders.
- **Stakeholders questioning the validity of the A-CDM model mandate:** only airports exceeding 77K movements are required (and subsidized) to implement A-CDM; Compatibility of the concept with the operational reality of ATC

A-CDM: Drivers of change

- Benefits of **network predictability**
- Benefits on capacity optimization
- **EU mandate and** availability of funding

Conclusions and Recommendations

- The potential of data sharing in aviation is substantial.

- Command and Control regulations vs Performance Regulation
- Effective stakeholder management to gain buy-in from all participants.
- One of the biggest constrains of SWIM is the cost of investment.
  - R&D investment in the area of airspace harmonisation, technological innovations and especially IoT
  - Subsidisation of technology adoption for airlines, airports and ANSPs

Thank you for your attention!

Dr Marina Efthymiou

marina.Efthymiou@dcu.ie

Based on: *Lootens, K. and Efthymiou, M. (2019). The adoption of network-centric data sharing in Air Traffic Management. Information Resources Management Journal, 32 (3), 48-69. DOI: 10.4018/IRMJ.2019070103*

Networking Lunch

IBM