The Possibilities with Good Data

Nancy Rockbrune
Head, Safety Management

ICAO SMM

- A19 Ch5

Data Sources

- Mandatory reporting systems
- Voluntary reporting systems

Data Sources

Note 1.— SDCPS refers to processing and reporting systems, safety databases, schemes for exchange of information, and recorded information including but not limited to:

a) data and information pertaining to accident and incident investigations;

b) data and information related to safety investigations by State authorities or aviation service providers;

c) mandatory safety reporting systems as indicated in 5.1.2;

d) voluntary safety reporting systems as indicated in 5.1.3; and

e) self-disclosure reporting systems, including automatic data capture systems, as described in Annex 6, Part I, Chapter 3, as well as manual data capture systems.

Annex 19, 2nd Ed.


"to measure is to know – if you cannot measure it, you cannot improve it"
– Lord Kelvin

Use of Data

- Conduct analysis on clean defensible data / information
  - Identify hazards and risks
  - Prioritize risks and subsequent actions to mitigate
  - Measures process performance
  - Identify and prioritize contributing factors to process performance
  - Measure and predict process performance improvements
- Communicate findings as appropriate

Data Management Principles

- Managing by averages leads to flawed decision making - not accounting for process variation
- If measurement system variation is too large there is an increased risk of:
  - Rejecting good data
  - Accepting bad data
- Important to know how much of the observed variation of a process is due to the actual process itself

Data Management Principles

- Operational definitions (includes taxonomies) help reduce subjectivity and variance in a measurement system (data)
- Operational definitions can be:
  - A written statement
  - Templates
  - Display of comparisons (colour chart)
- Operational definitions should be:
  - Something people can really use
  - Enables different people to reach the same conclusion (repeatability)
  - Enables the same person to reach the same correct conclusion at different times (reproducibility)

Taxonomy / Operational Definitions

- Controls data inputs
- Reduce subjectivity
- Reduce variation
- Means for integration (internal and external)

5.1.5 **Recommendation**.— *The safety database should use standardized taxonomy to facilitate safety information sharing and exchange.*

Annex 19, 2nd Ed.

Measuring Safety Performance ~ SPIs

- Set measureable (SMART) safety objectives
  - Verify safety performance
  - Validate effectiveness of safety risk controls
- Track performance
- Compare against targets
- Achievement of a target consequently represents an improvement in performance

Metrics

- Typically focused on number of serious accidents / incidents
- High profile
- Easy to measure
- Reactive
  - Does not expose systemic issues or hazards


ACCIDENT
FREE!

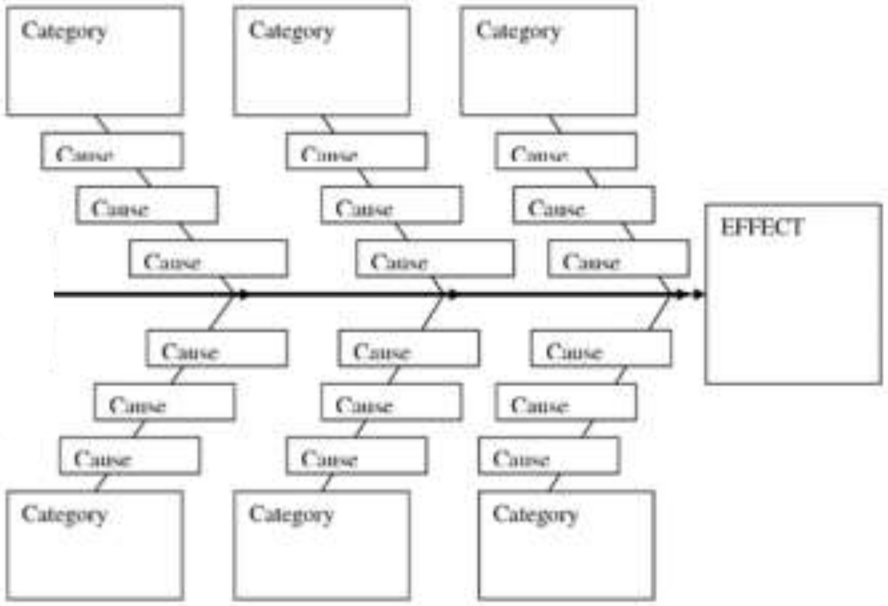

pilot
Miami
Fly
Moscow
Cairo
safety
Paris
Toronto
Seoul
Airplane
flight attendant
Dubai
IATA
runway
wings
Rome
ICAO
Sydney
dispatch
airport
London
Flight
Beijing
Oslo

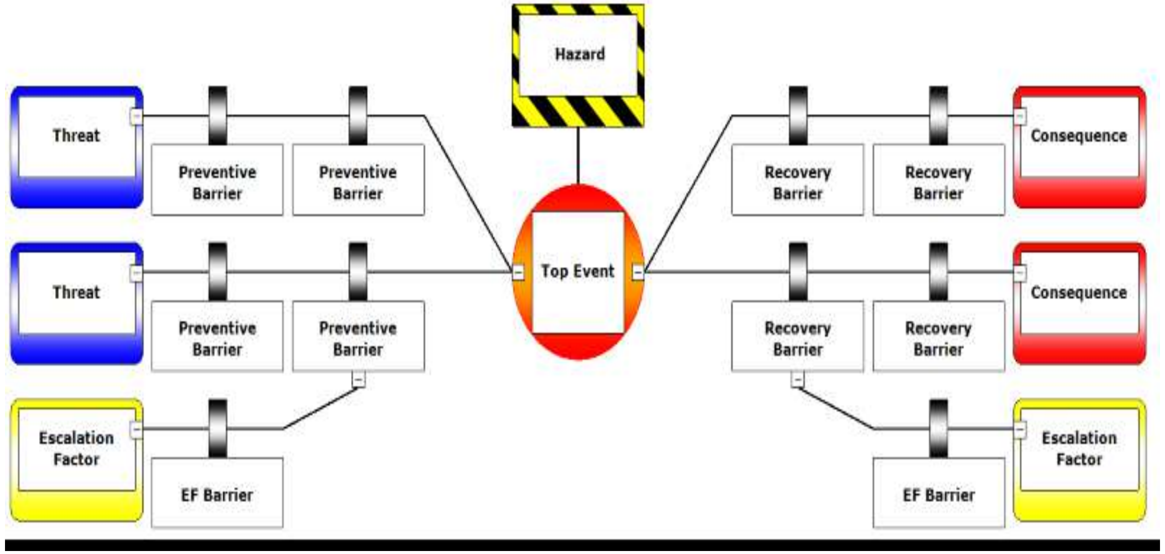
System Approach

- Managing at the process level is the basis of a “System” approach
- Considers all processes, their interrelationships and interactions

System Approach

- Direct relationship between inputs and outputs
- Therefore to improve the output, changes or improvements to the inputs are required

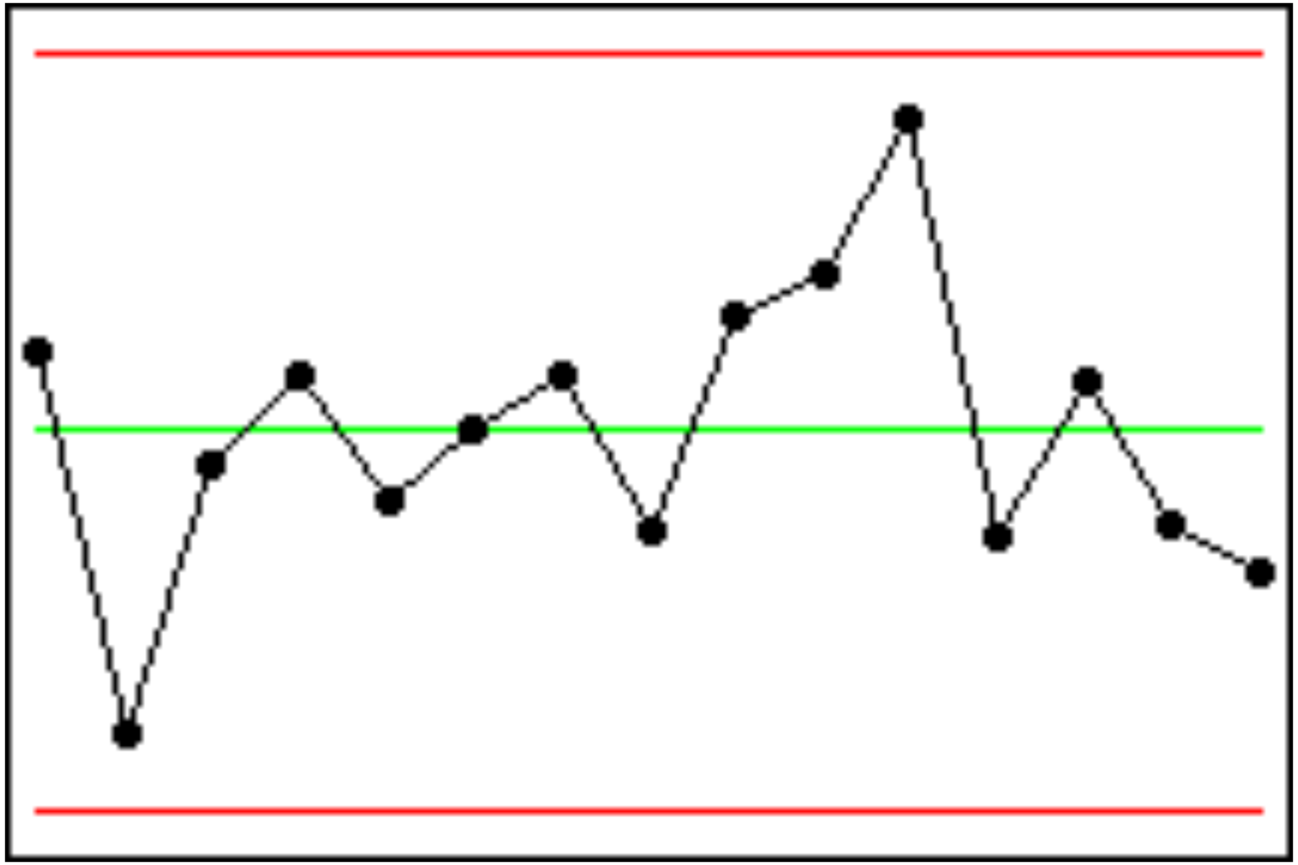




Control Charts

- Displays the control of a process
  - In control process shows random variation
  - Out of control process shows unusual variation due to special causes
- Help to determine where to focus problem-solving efforts by distinguishing between common and special-cause variation

Sample ~ Control Chart



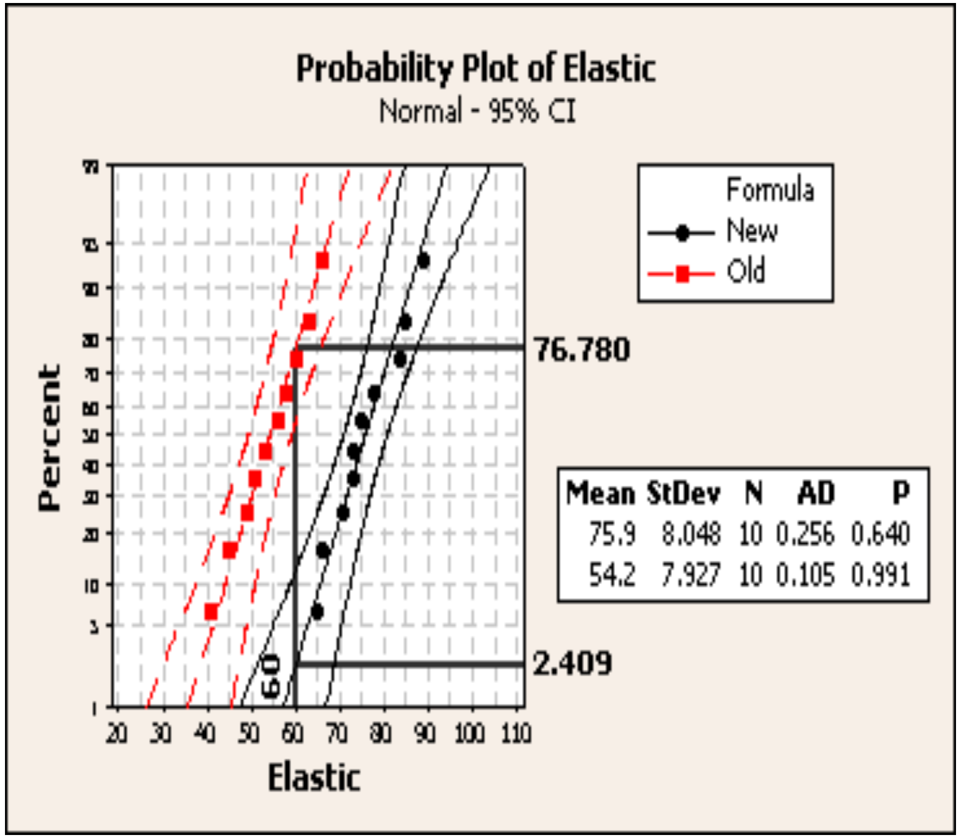
Upper Control Limit (UCL)

Centre Line

Lower Control Limit (LCL)

Sample ~ Probability Chart

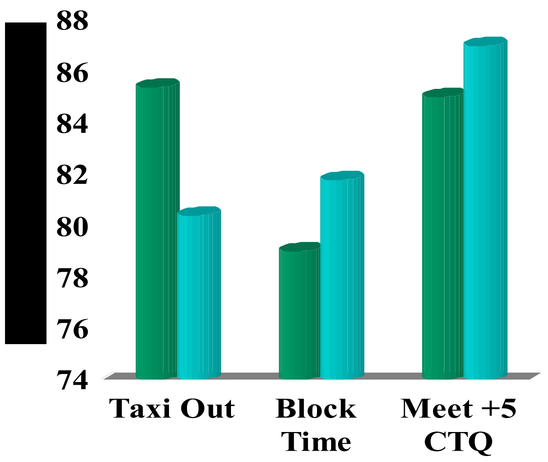
- Measure process improvements
- If distributions are normal can estimate the performance if new procedures are put in place

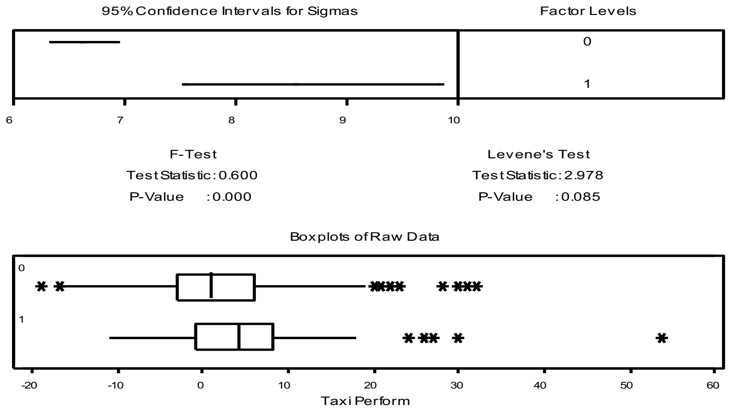


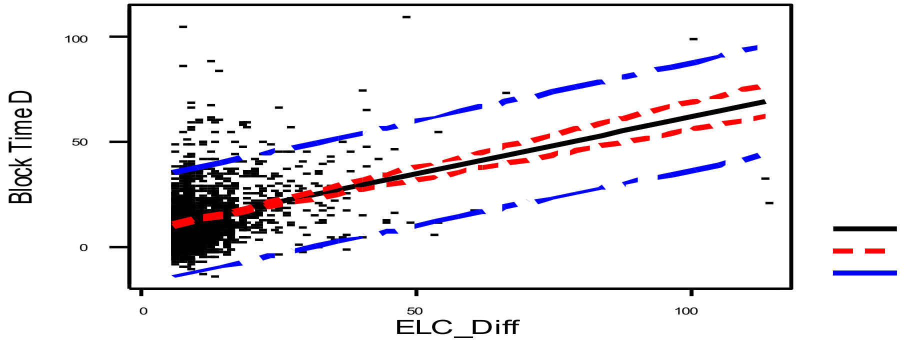
Why is Process Control Important?

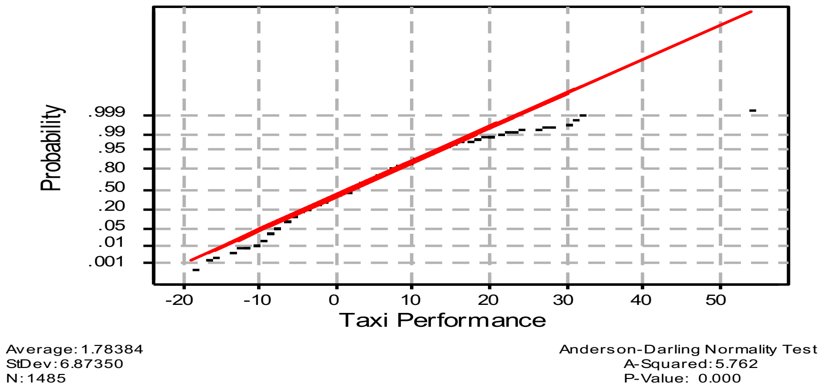
- Higher quality
- Increased efficiency
- Lower costs
- Fewer errors
- Leaner organization
- Sustained profitability
- Performance goals tied to business priorities
- Performance competencies ~ tools used to achieve goals

Process Control Example ~ ELC

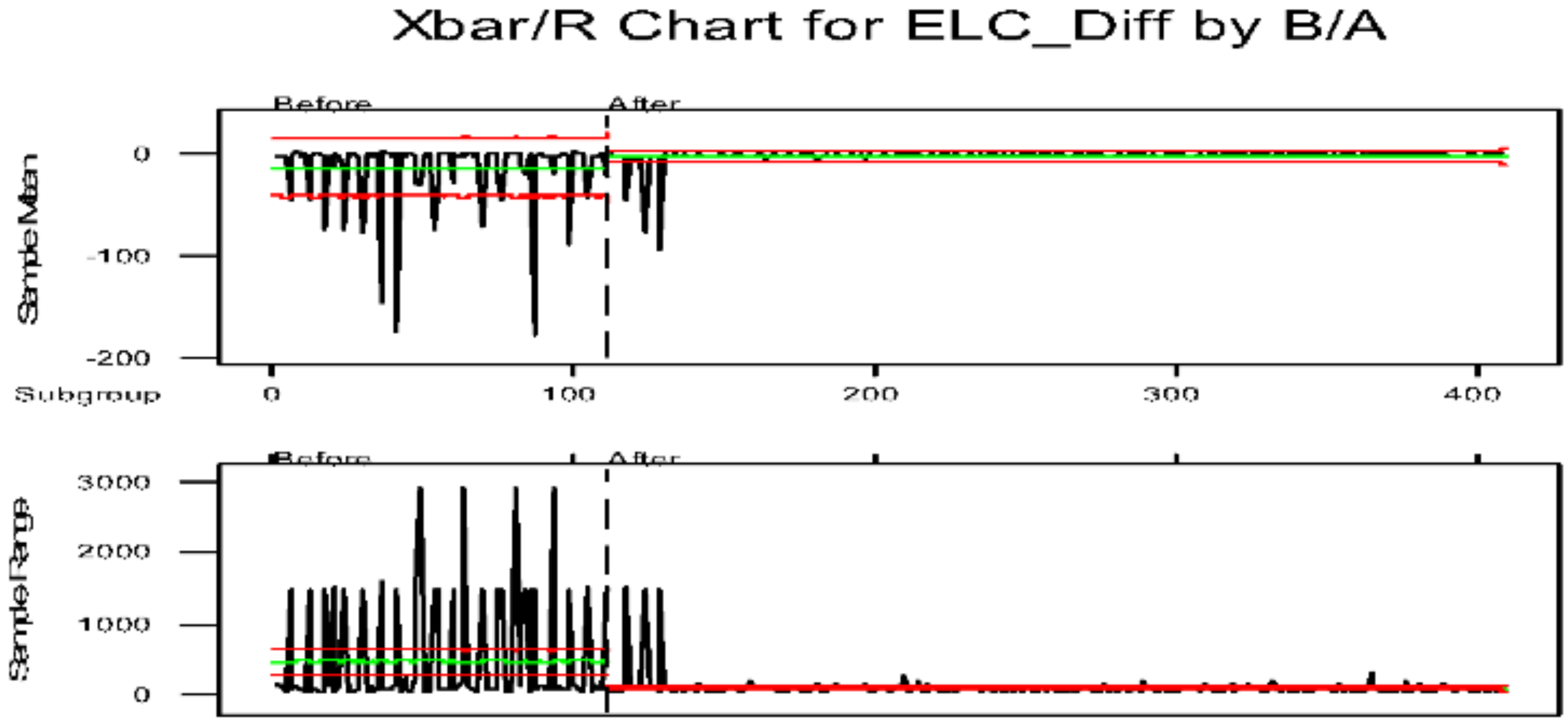








Process Control ~ Example



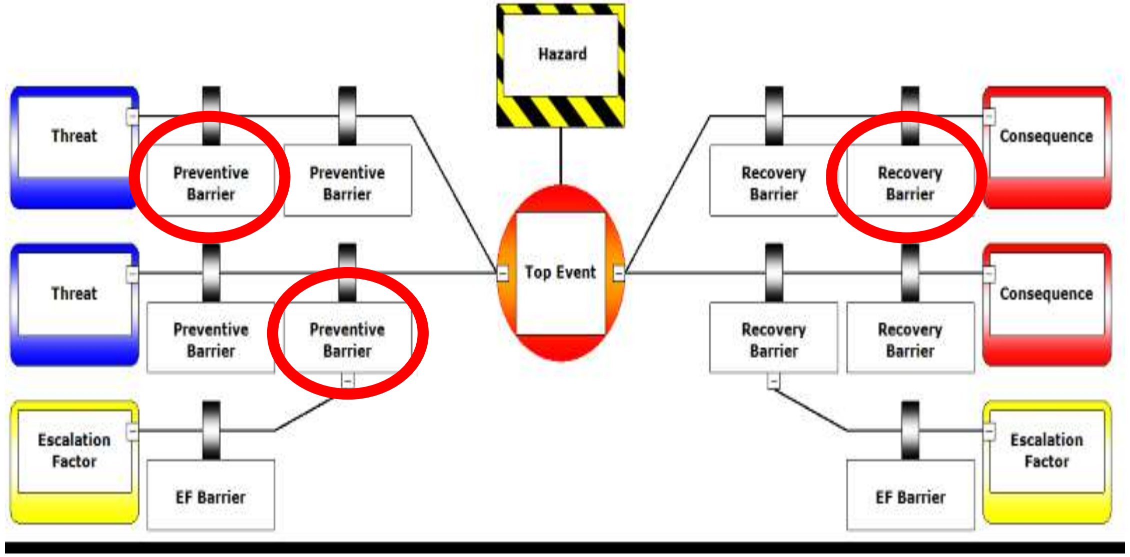
Other Examples

- Unstable approach criteria
  - Studies being made to evaluate the FSF initiative to reduce the height to 300ft before Go-Arounds
  - Data will identify if feasible or not
- RNAV vs Visual Approach
  - Comparing the approach tracks and monitor how many flights flying visual app vs RNAV results in Go-Arounds
  - Airline can then quantify the cost, review their processes

WHAT DATA AND INFORMATION

Proactive Shift

- SPIs measure performance of safety controls
  - Preventative
  - Recovery
- Shift focus to precursors

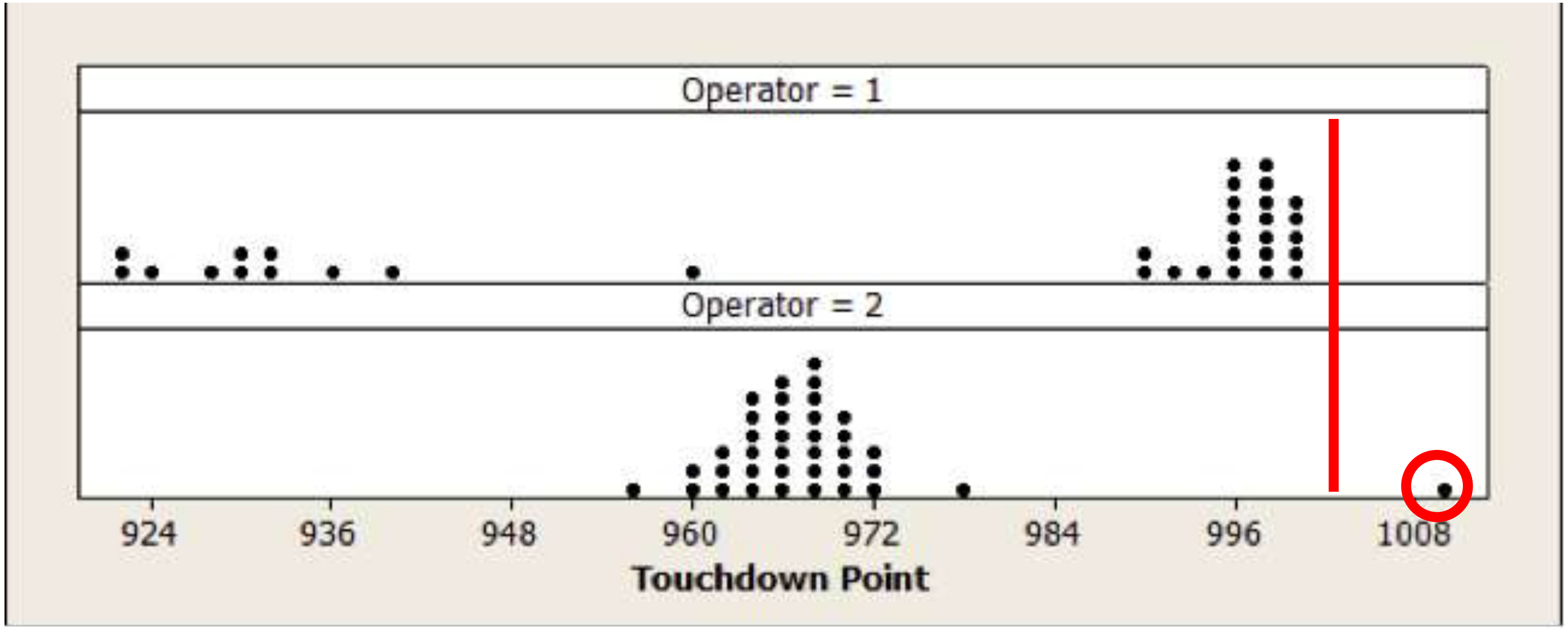


Sample SPI

IATA SPI GROUP: Draft SPI Candidate	
SPI / Safety Objective (SO)	Long Landing
Area of Safety Concern	Organizational
Safety Aim	Zero instances of long landings
Definition(s)	Threshold ~ touchdown >x m from runway threshold Distribution ~ distance from runway threshold at landing
Possible Data/Information Source(s) & (Expected Reliability for Source)	FDM (High) Touchdown point Length of Runway
SPI Data Source(s)	Distance from runway threshold at landing
Reporting Period and Interval	As determined by operator
Output format	As determined by operator
Alert Level	Each operator to determine their own alert level
Safety Performance Target	Each operator to determine their own target
Safety Action Plan(s)	Each operator to determine their own safety action plan.
Notes	Can do comparisons if carriers have same threshold limits

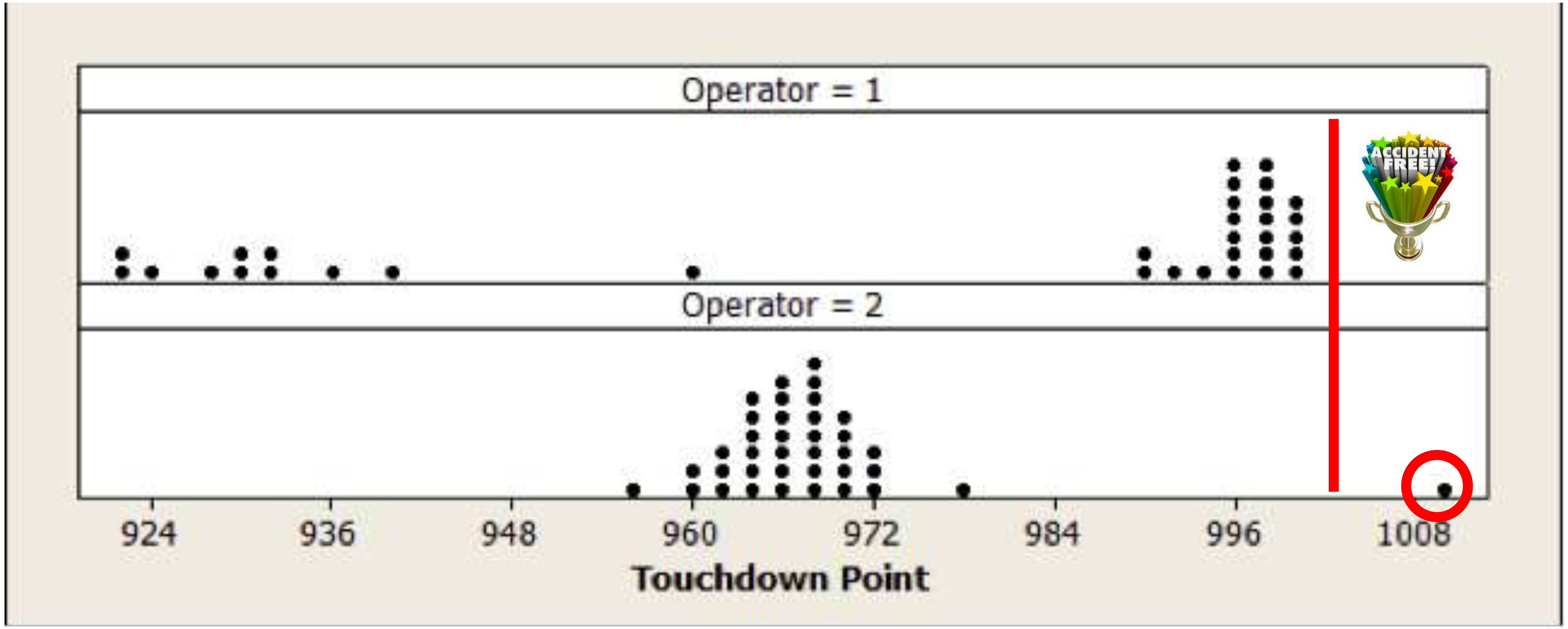
Sample SPI ~ Long Landing

- Identify touchdown points of ALL flights



Example ~ Long Landing

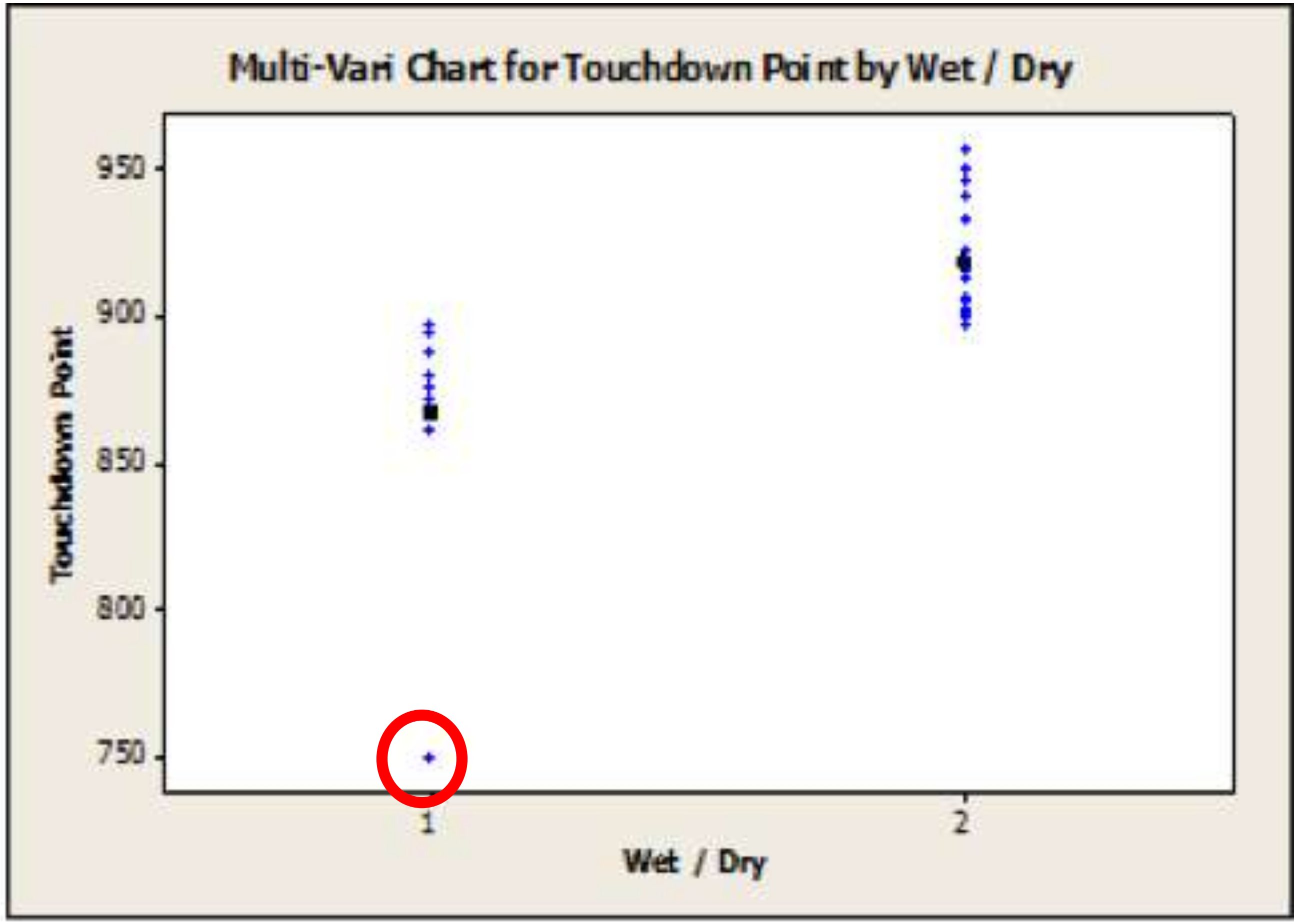
↗ Identify touchdown points of ALL flights



Sample FDM Parameters

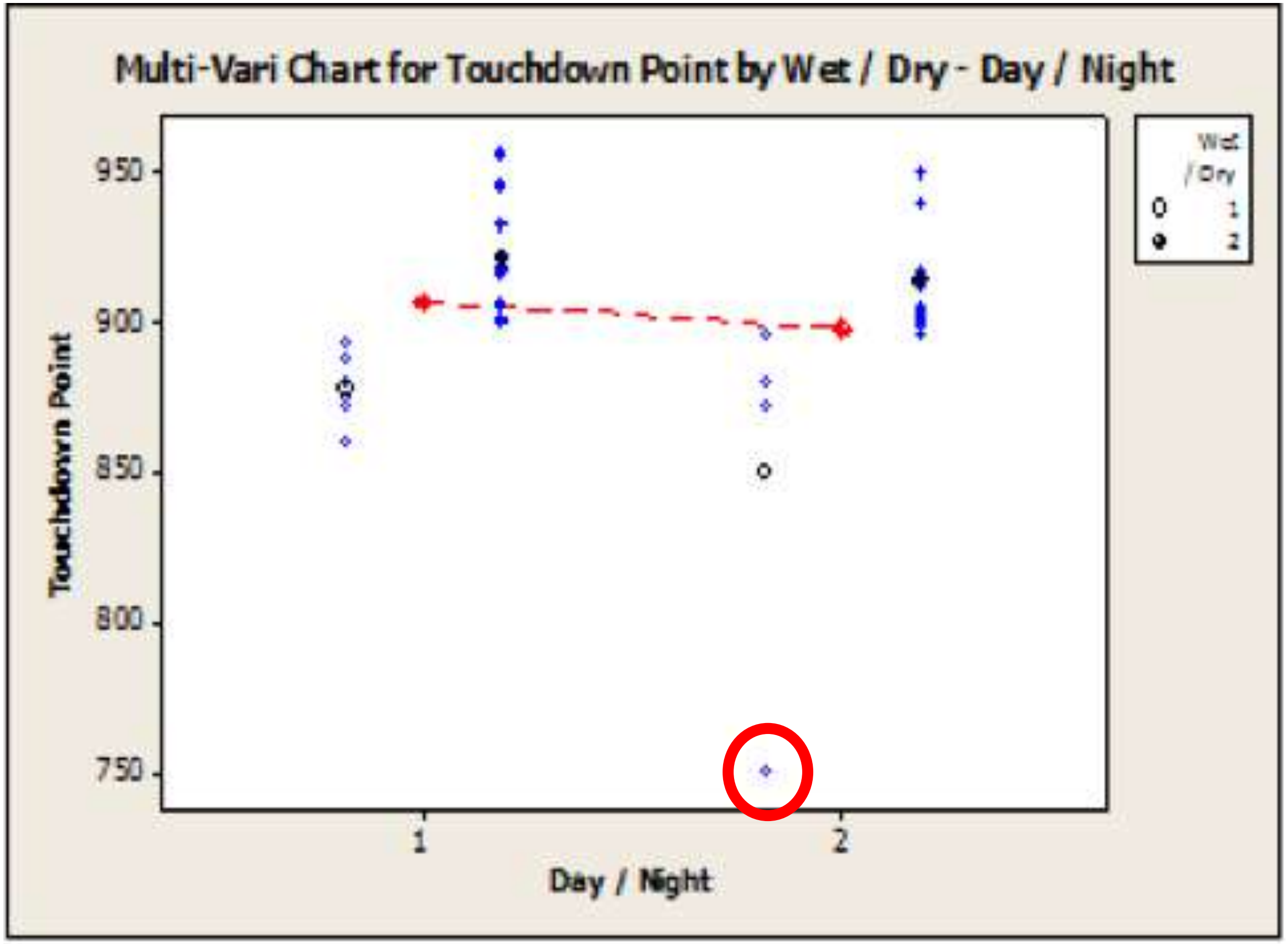
SPIs	FDM PARAMETERS																				
	Speed over the threshold	Speed on ground	Autopilot disengage	Altitude	AoA	Pitch	Bank angle	G forces	Flap settings	Landing gear	Spoiler position	Aircraft weight	Center of gravity	Touch-down point	Breaking action	General landing configuration (flap/gear/altimeter etc. settings)	Glidepath deviation (horizontal - altitude / vertical - azimuth)	Course deviation/correction	Proximity to another aircraft	EGT (exhaust gas temperature) or RPM	Application of reverse thrust
Long Landing	X			X		X			X			X	X	X		X	X				
Runway End Zone Ground Speed	X	X	X	X		X			X			X	X	X	X		X				X
Runway Turn-Off Speed		X									X				X			X			X
Sink Rate Before Touch Down	X				X	X			X		X	X	X				X				
Tail Clearance at Take-Off		X				X			X			X	X								
Tail Clearance on Landing	X			X	X	X			X		X	X	X				X				
Bank Angle During Landing				X			X				X							X			
EGPWS - Pull-Up	X			X					X	X	X						X				
Rejected Take Off (RTO)		X							X	X	X		X					X		X	X
a. Environmental Risk																					
b. Runway Side Excursion																					
c. Runway Over-Run																					
Taxi Speed Exceedance	X	X									X	X		X	X		X			X	X
TCAS RA			X	X		X													X	X	
Unstable Approach Continued	X			X	X	X	X	X	X	X	X			X		X	X	X		X	
Height that Stabilization Achieved	As above																				
Proximity to Alpha Max	X				X	X	X	X	X	X	X	X	X				X				
Unusual Attitude - Pitch						X			X												
Unusual Attitude - Bank Angle							X											X			
In-Flight Shut-Down (IFSD)																				X	
Landing Below Final Reserve Fuel																					

Sample SPI ~ Long Landing



This multi-vari chart shows condition of runway surface is a contributing factor

Sample SPI ~ Long Landing



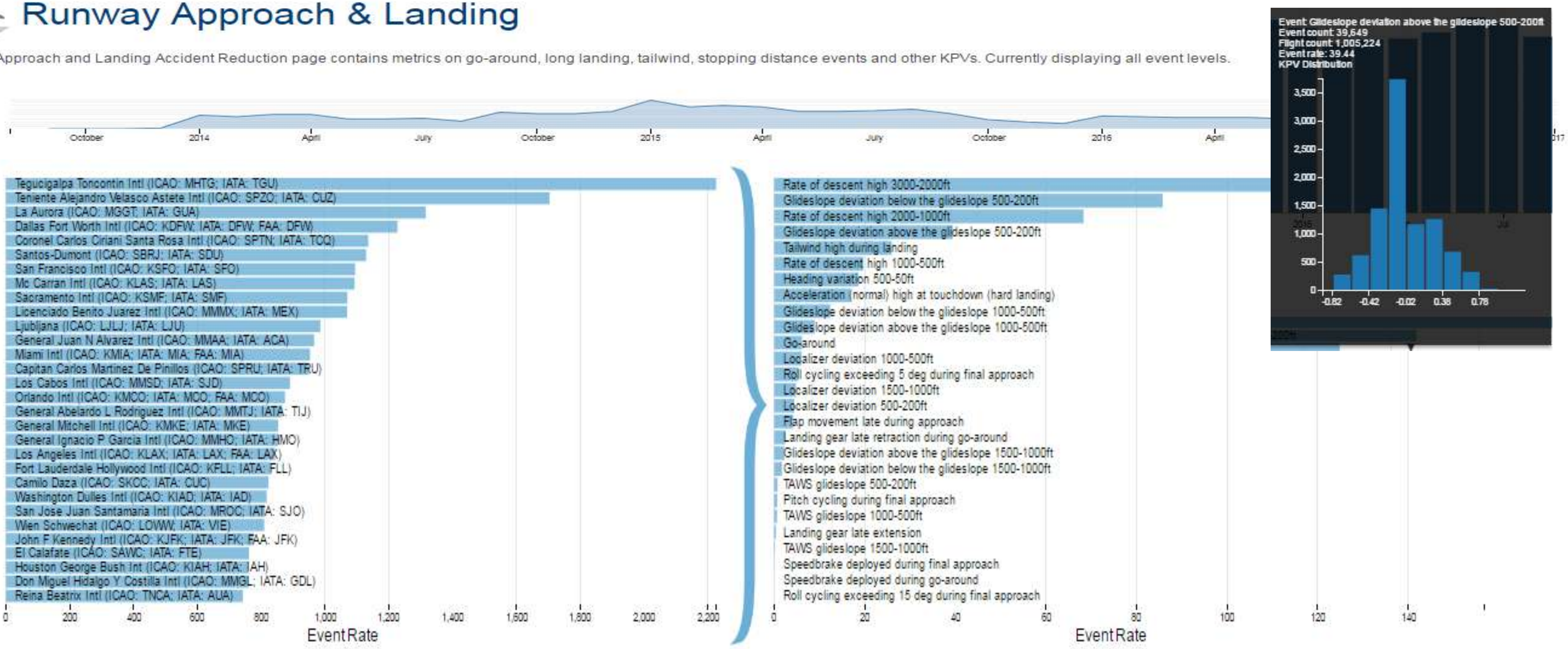
Outlier (750’) at night with a wet runway surface ~ only 1 instance

Analysis | GADM

Misconfigured Takeoff | TCAS | LOC-I | TAWS | Runway Approach & Landing

Runway Approach & Landing

The Approach and Landing Accident Reduction page contains metrics on go-around, long landing, tailwind, stopping distance events and other KPVs. Currently displaying all event levels.



ADS Flight Operations and Safety Track

- How data and information can be used to increase operational efficiency and improve safety performance
- Role of technology
  - “Intelligent Engines” and “Connected Aircraft”
- Dark Data
- Real-life examples of data and information usage

Thank you!

Big Data and Safety Indicators

Manoosh Valipour

Management Systems Analysis Officer

Air Navigation Bureau

International Civil Aviation Organization (ICAO)

IATA ADS Berlin

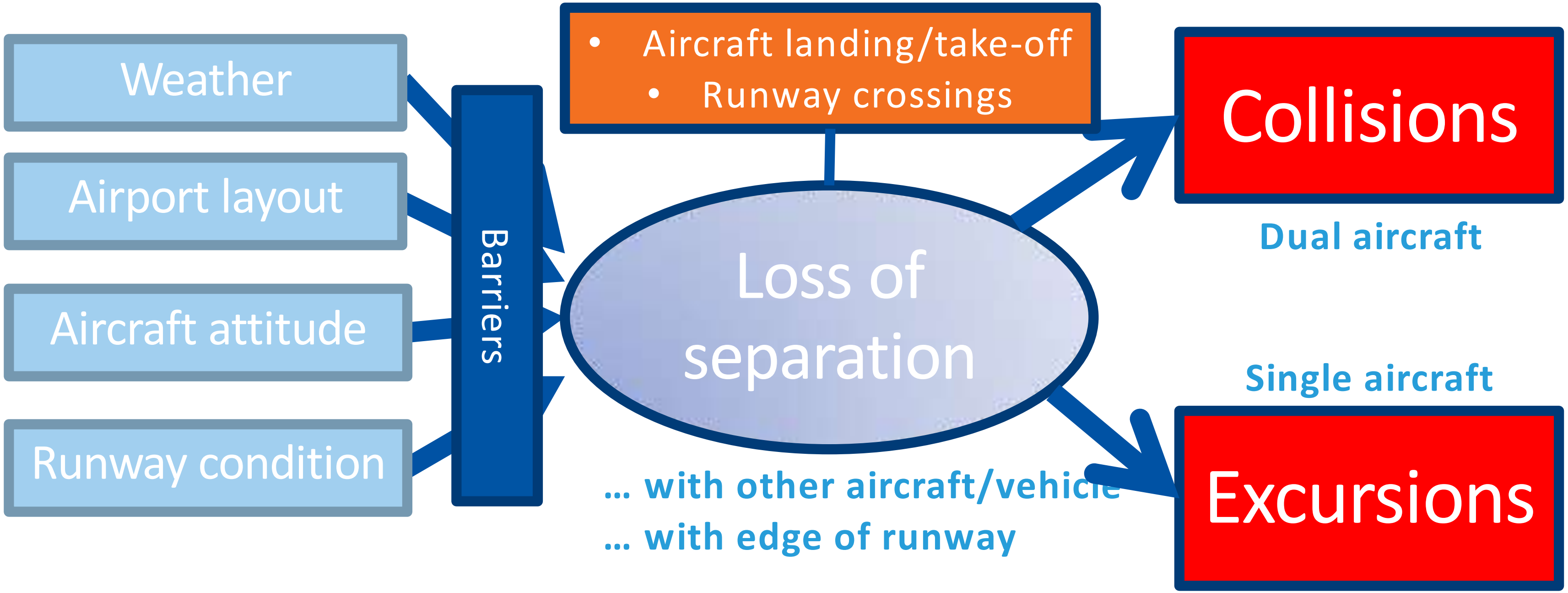
19-20 June 2018

Safety Performance Indicator (SPI)

- **A data-based parameter [metric] used for monitoring and assessing safety performance.**

Annex 19 – Safety Management

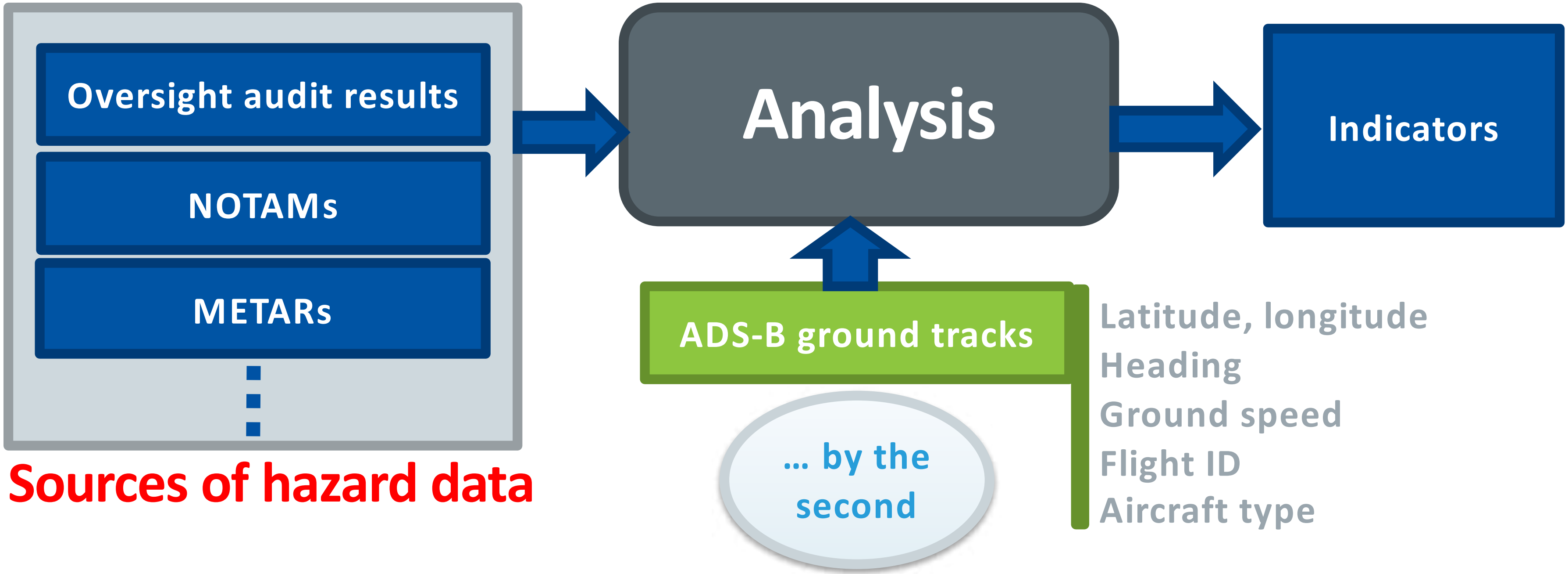
Runway Safety



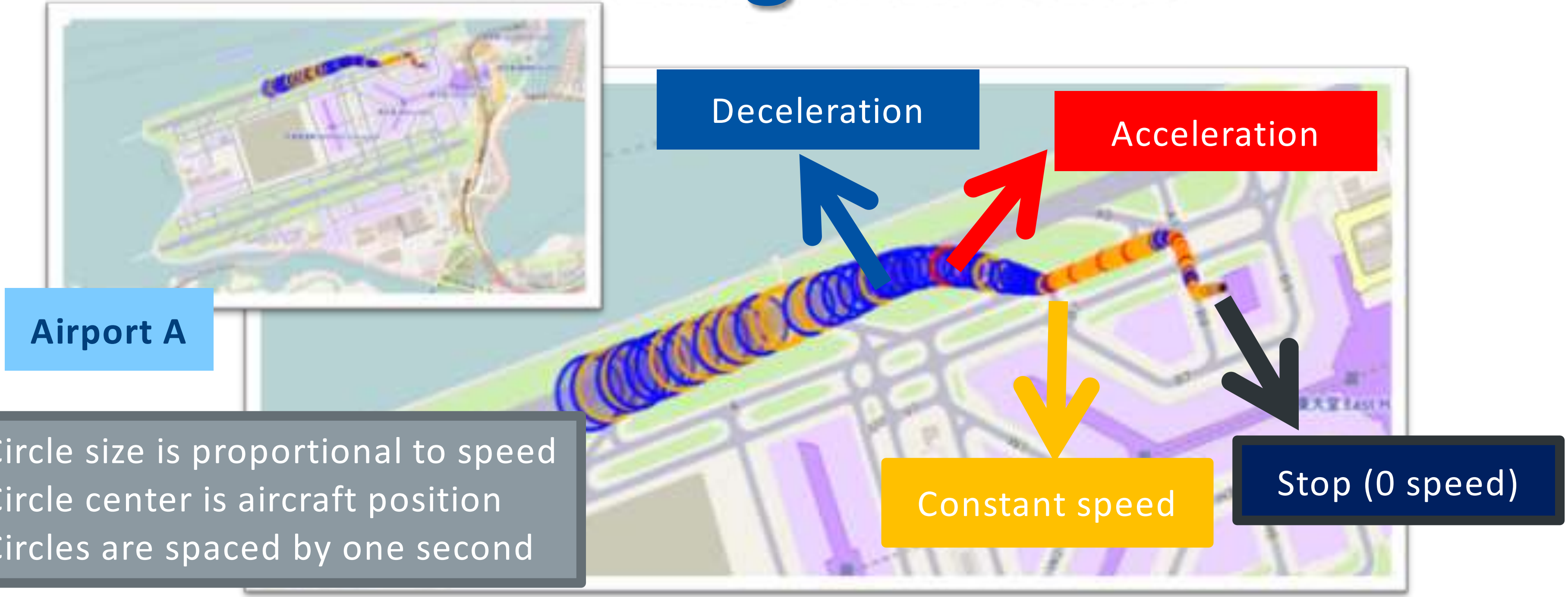
Gaining Insight

- Level 1
  - Reactive analysis and investigation of high consequence events (accidents, serious incidents)
- Level 2
  - Real-time monitoring of everyday operations and hazards in a proactive manner
  - Define separate and track normal vs abnormal operations

Level 2 Data Analysis Process

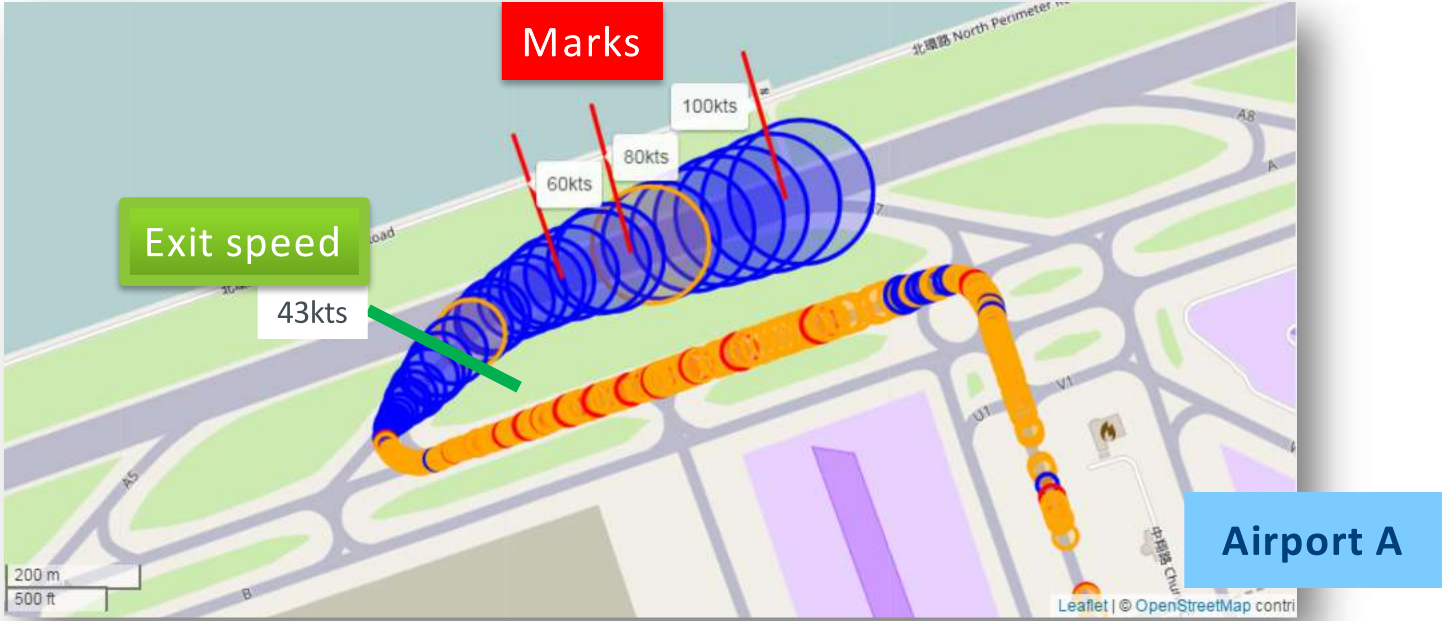


Visualizing the Data

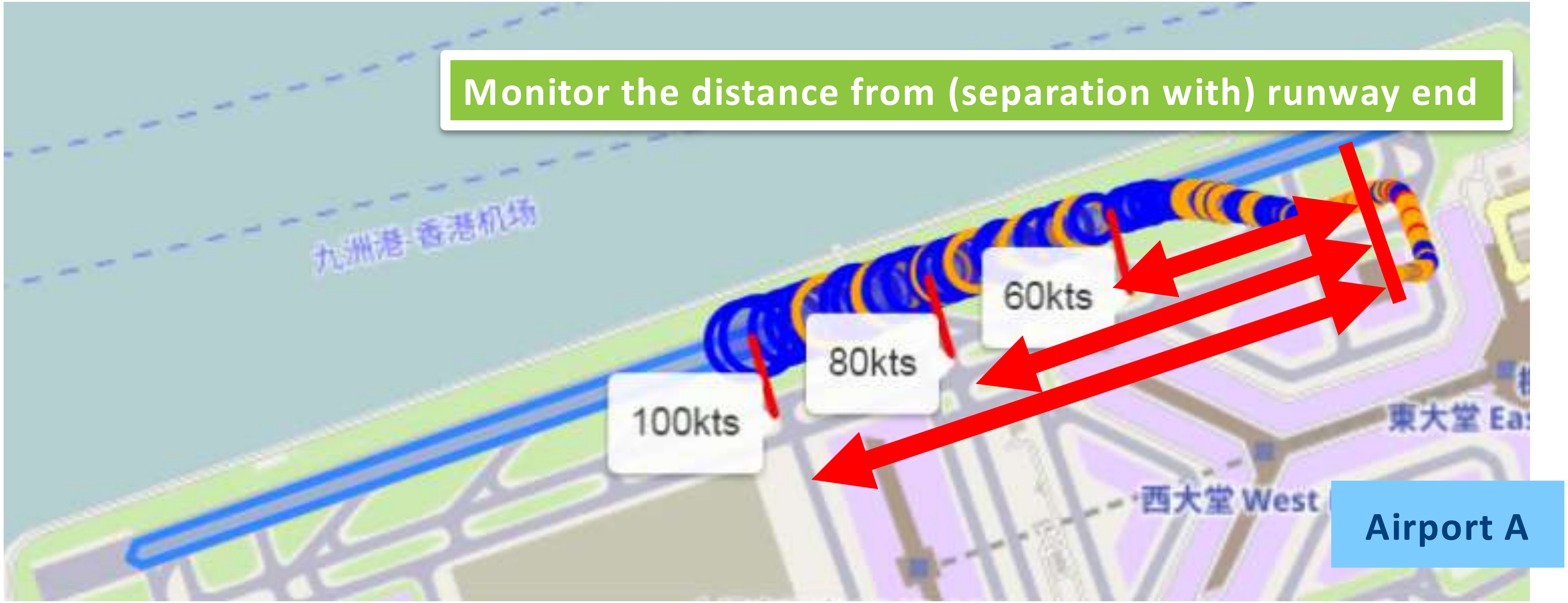


Circle size is proportional to speed
Circle center is aircraft position
Circles are spaced by one second

Speed Marks


Marks
100kts
80kts
60kts
Exit speed
43kts
Airport A
200 m
500 ft
Leaflet | © OpenStreetMap contri

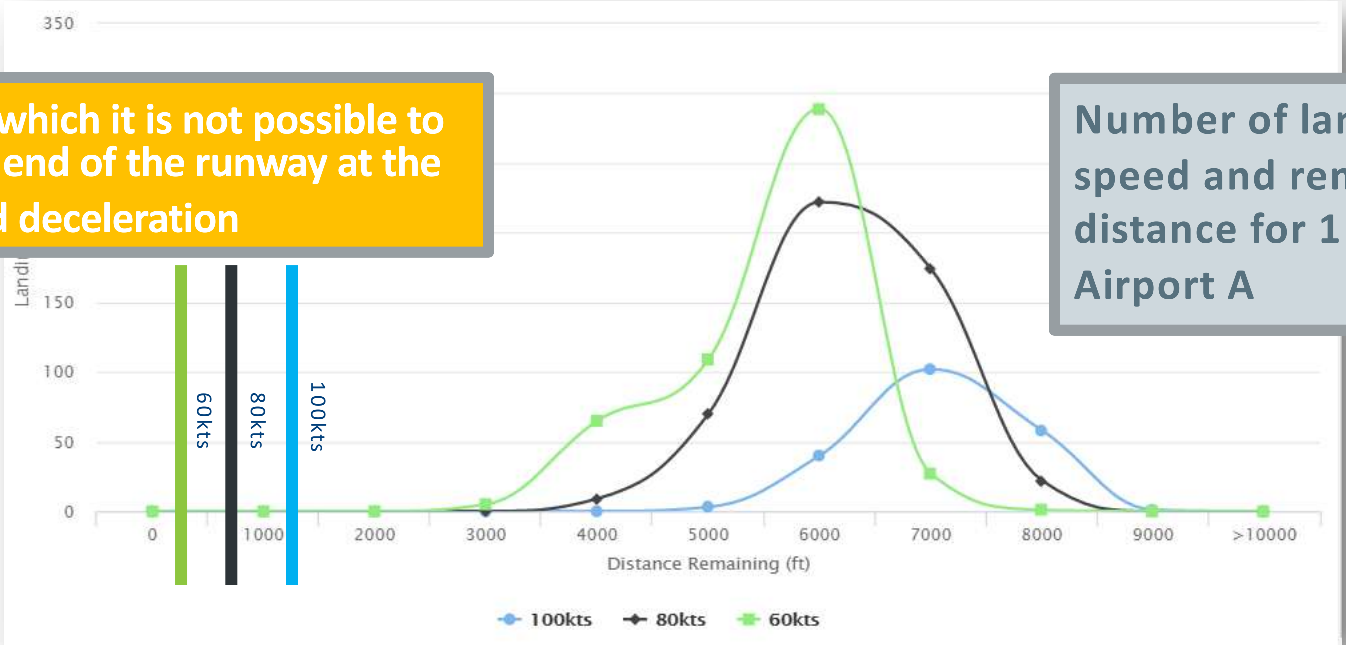
Runway Remaining



Runway Remaining

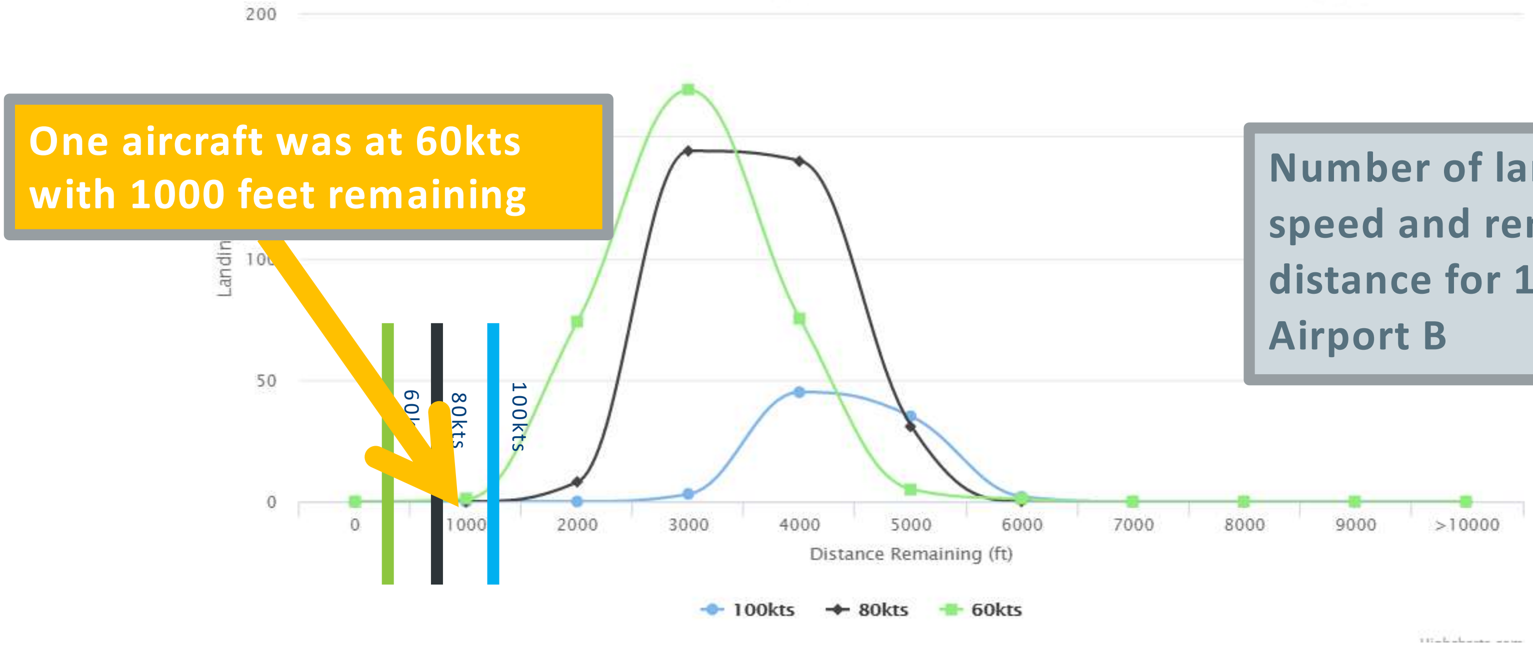
$$Distance = \frac{Speed^2}{2 * Deceleration}$$

Distances after which it is not possible to stop before the end of the runway at the given speed and deceleration



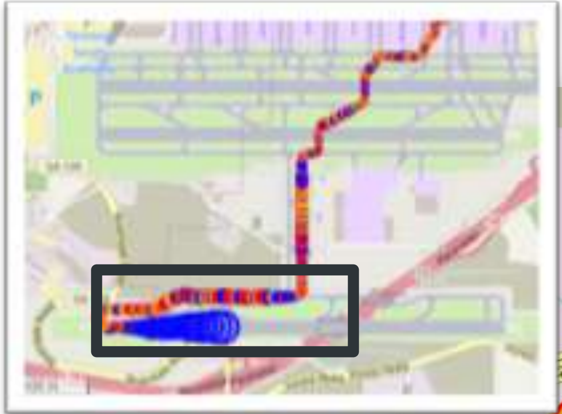
Number of landings vs speed and remaining distance for 1 day in Airport A

Runway Remaining



Number of landings vs speed and remaining distance for 1 day in Airport B

Reduced Separation with Runway End

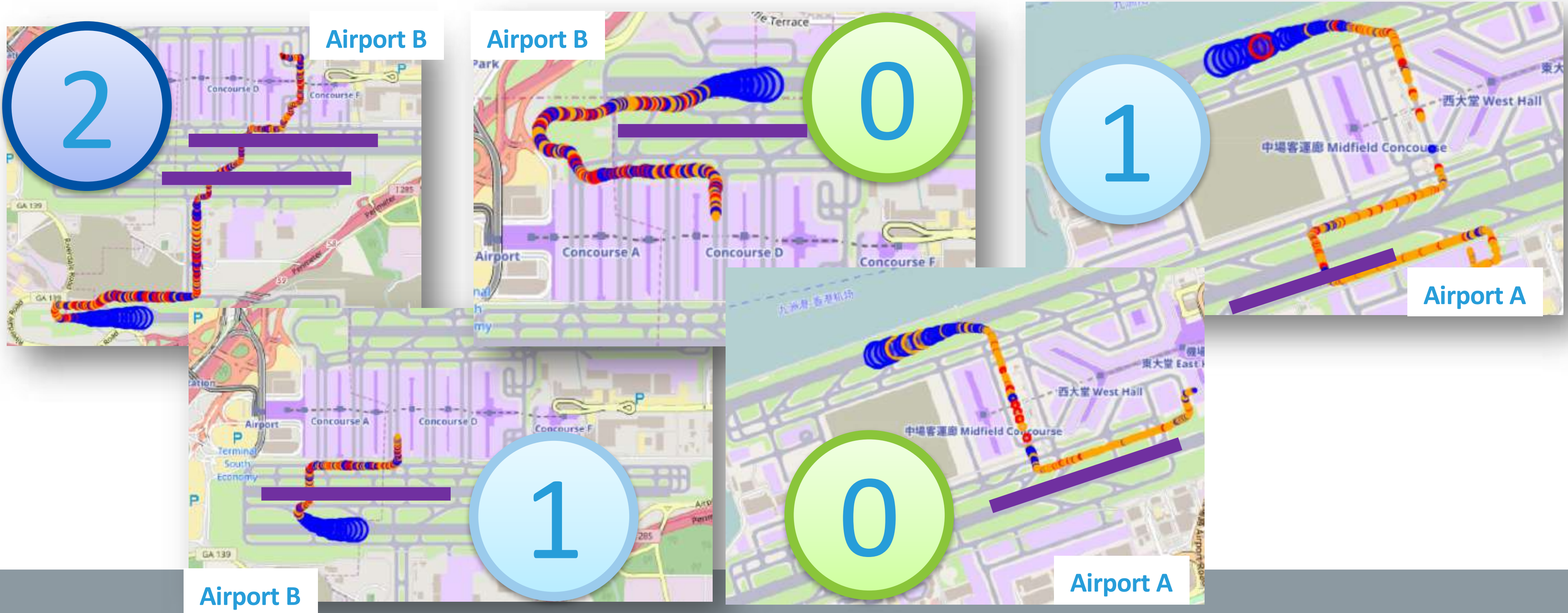


Exit speed

20kts

Airport B

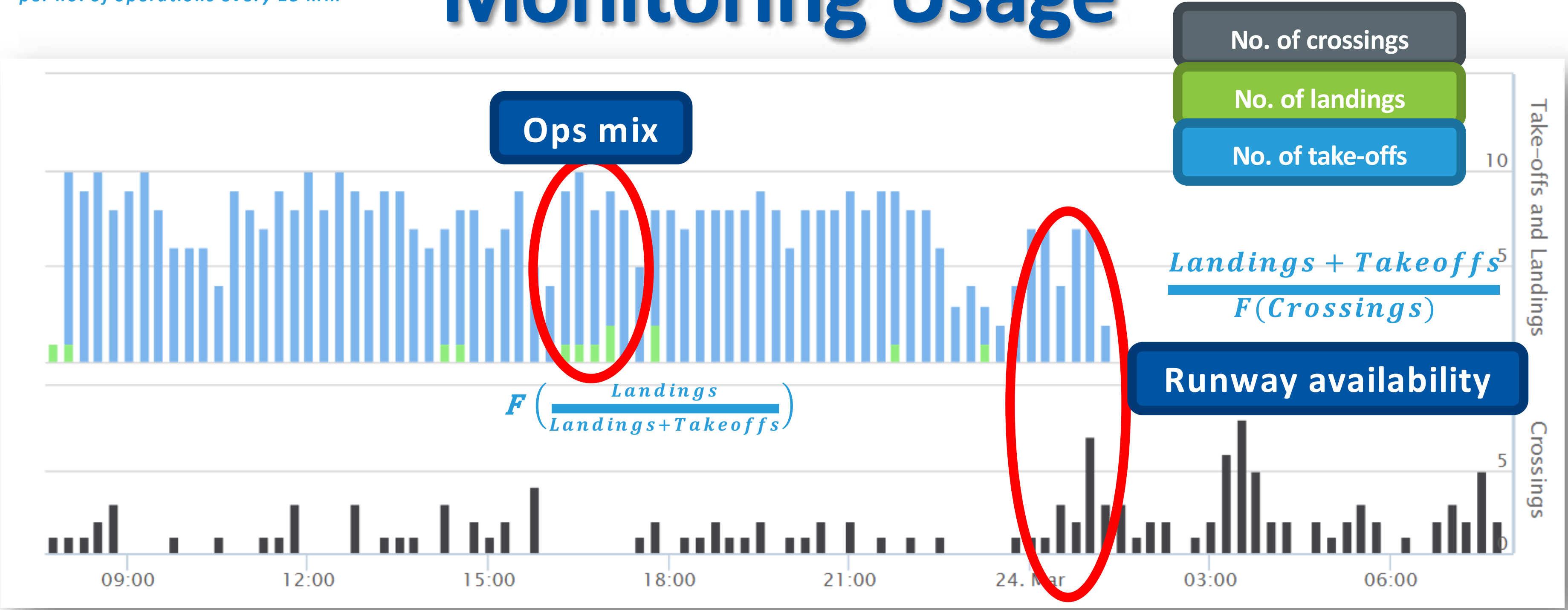
Runway Crossings



One day at Airport A RWY 1

per no. of operations every 15 min

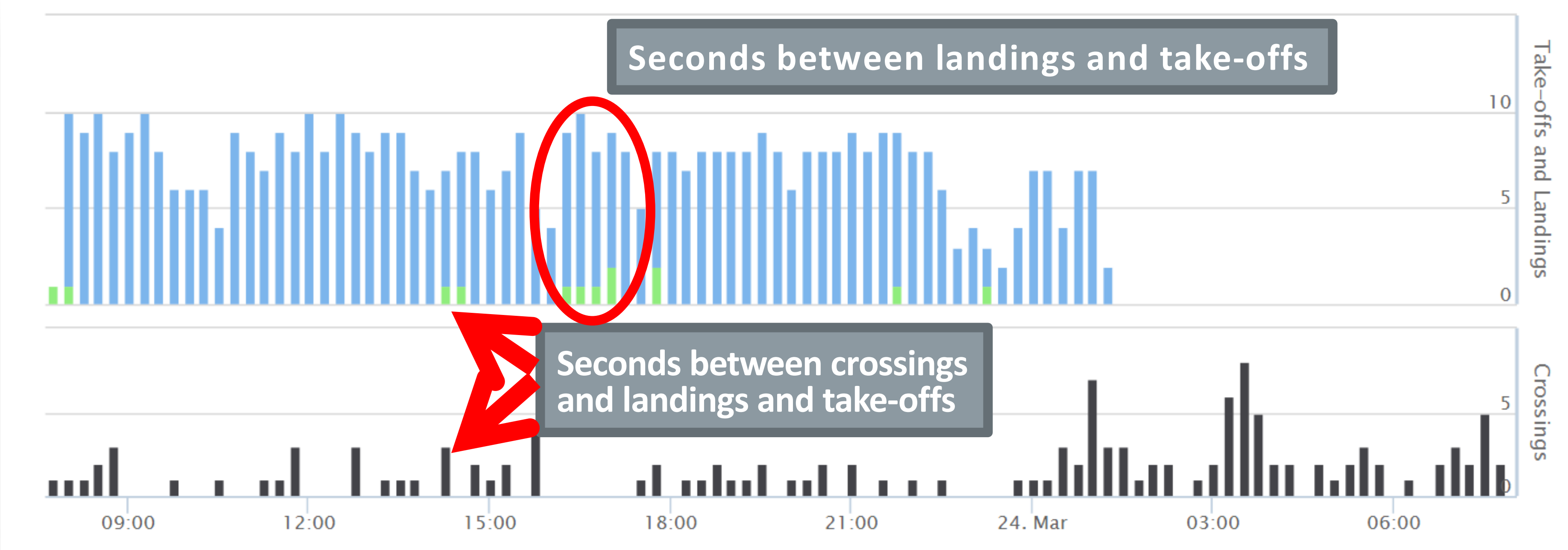
Monitoring Usage



One day at Airport A RWY 1

per no. of operations every 15 min

Monitoring Separation

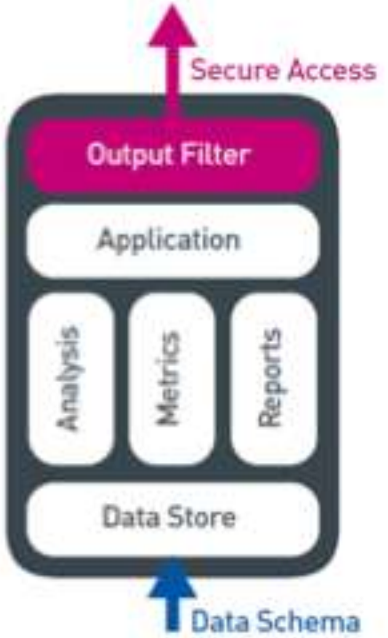


ICAO SAFETY

IATA ADS 2018

What is SIMS?

- A web-based information system
- Generates indicator analysis through various applications
- Supports implementation of State Safety Programmes (SSP) and Safety Management Systems (SMS)



ICAO


North American Central American and Caribbean (NACC) Office Mexico City
South American (SAM) Office Lima
ICAO Headquarters Montréal
Western and Central African (WACAF) Office Dakar
European and North Atlantic (EUR/NAT) Office Paris
Middle East (MID) Office Cairo
Eastern and Southern African (ESAF) Office Nairobi
Asia and Pacific (APAC) Sub-office Beijing
Asia and Pacific (APAC) Office Bangkok
THANK YOU

EASA
European Aviation Safety Agency

Aviation Data Symposium
The Data4Safety Programme

Erick Ferrandez
EASA Safety Intelligence and Performance

20 June 2018
Berlin

Your safety is our mission.

An agency of the European Union

Objective Deliverables

Expert Knowledge

Flight Data

Air Traffic data

Safety Reports (occurrences)

Weather,
and more…

Data Technologies

Collaborative Analysis Platform

Aviation Experts and Data Analysts

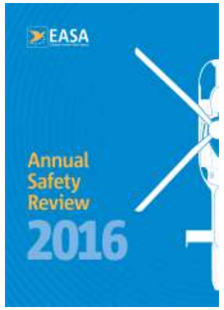
Big Data Platform

Connect Safety Intelligence with actions

Know where to look

See it coming

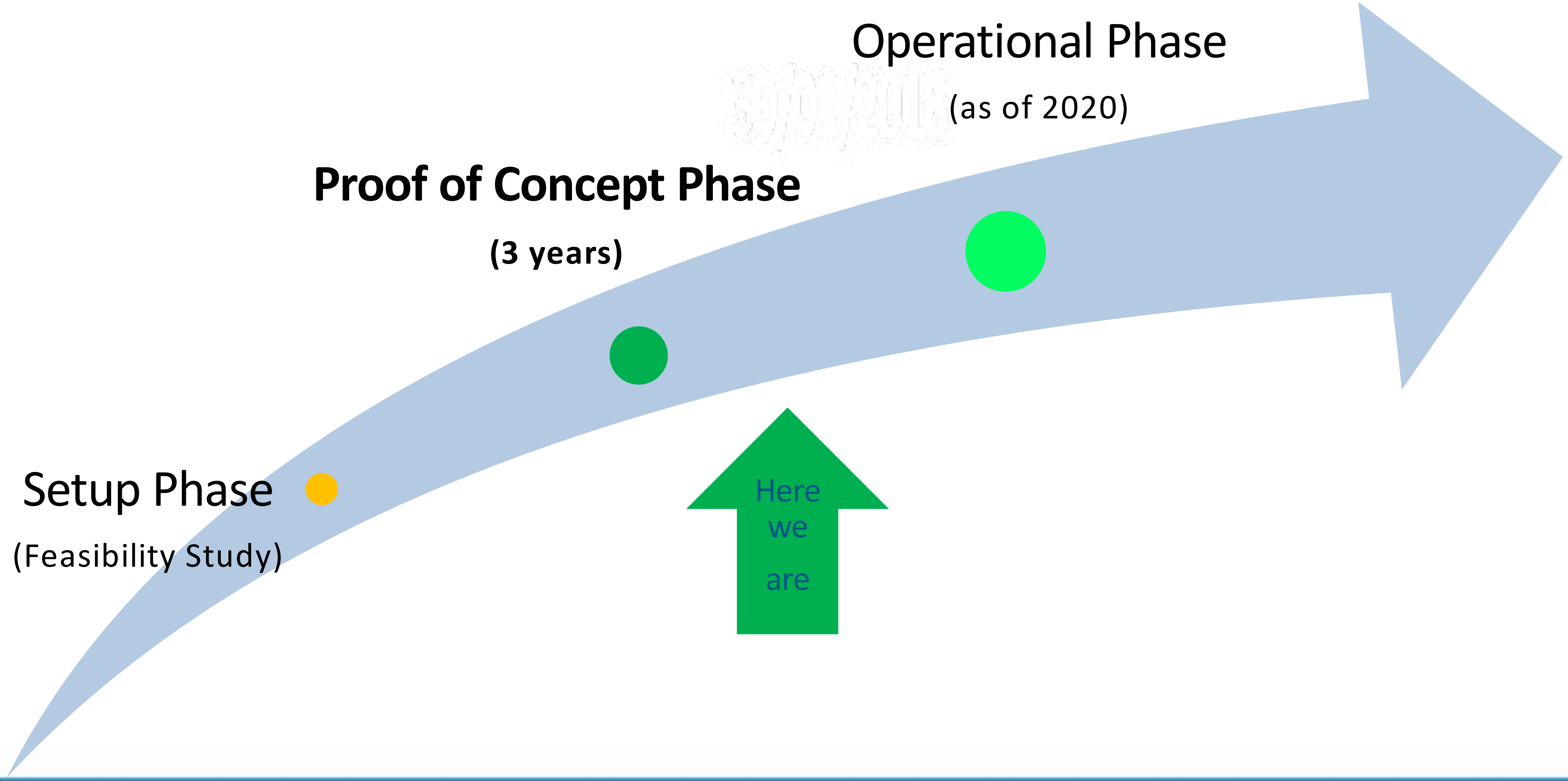
Act!



Support a performance-based environment

What is D4S implementation roadmap?

A step approach with a **P**roof **of C**oncept phase to **test** and **demonstrate**



D4S Founding Members

AESA, Airbus, Boeing, British Airways, DGAC France, EASA, easyJet, ECA (European Cockpit Association), IAA (Irish Aviation Authority), Iberia, Lufthansa, Ryanair, UK CAA

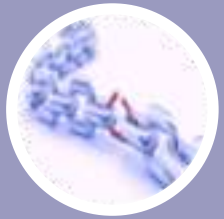
What do we want to deliver with D4S?

A set of outputs to produce **actionable safety intelligence**

Metrics

Blind Benchmarking

Directed Studies



Vulnerability Discoveries

Key elements of D4S

A **voluntary** and **collaborative** partnership amongst all stakeholders

Independent governance to reflect the partnership and collaborative approach (dual management authorities/industry)

Data Processing Organisation to manage the Big Data solution

Outcome shared for the benefit of the whole community

(Risk identification and analysis)

Linked with other international initiatives (ASIAS, FDX, …)

EASA
European Aviation Safety Agency

Thank you

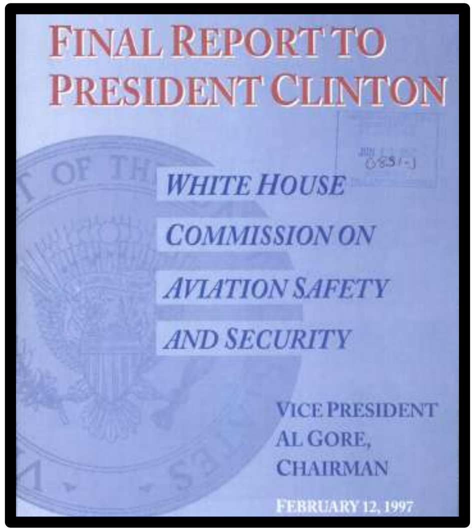
Advancing Safety Through Information Sharing

COMMERCIAL AVIATION SAFETY TEAM (CAST)

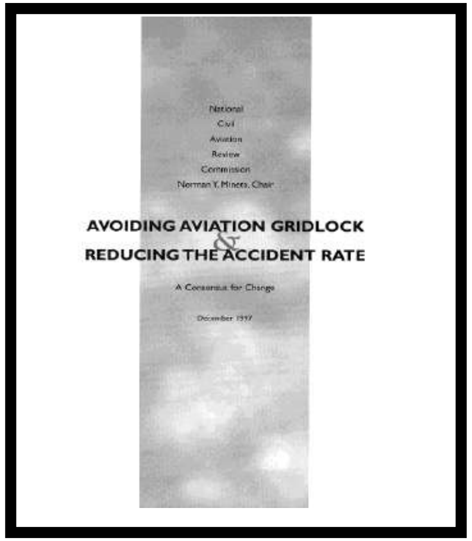
AVIATION SAFETY ANALYSIS AND SHARING (ASIAS)

Michael Quiello, Industry Co-Chair CAST
Vice President, Corporate Safety United Airlines

In the United States, our focus was set by the White House Commission on Aviation Safety, and The National Civil Aviation Review Commission (NCARC)



1.1 . . . Reduce Fatal Accident Rate . . .



- **. . . Strategic Plan to Improve Safety . . .**
- **. . . Improve Safety Worldwide . . .**

CAST brings together key stakeholders to cooperatively develop and implement a prioritized safety agenda.

Industry

- A4A
- AIA
- Airbus
- ALPA
- ACI-NA
- CAPA
- IATA**
- NACA
- Boeing
- GE*
- RAA
- FSF

Government

- DOD
- FAA
- NASA
- ICAO**
- TCCA
- NATCA
- NTSB**
- EASA**

Commercial Aviation Safety Team

* Representing P&W and RR

** Observer

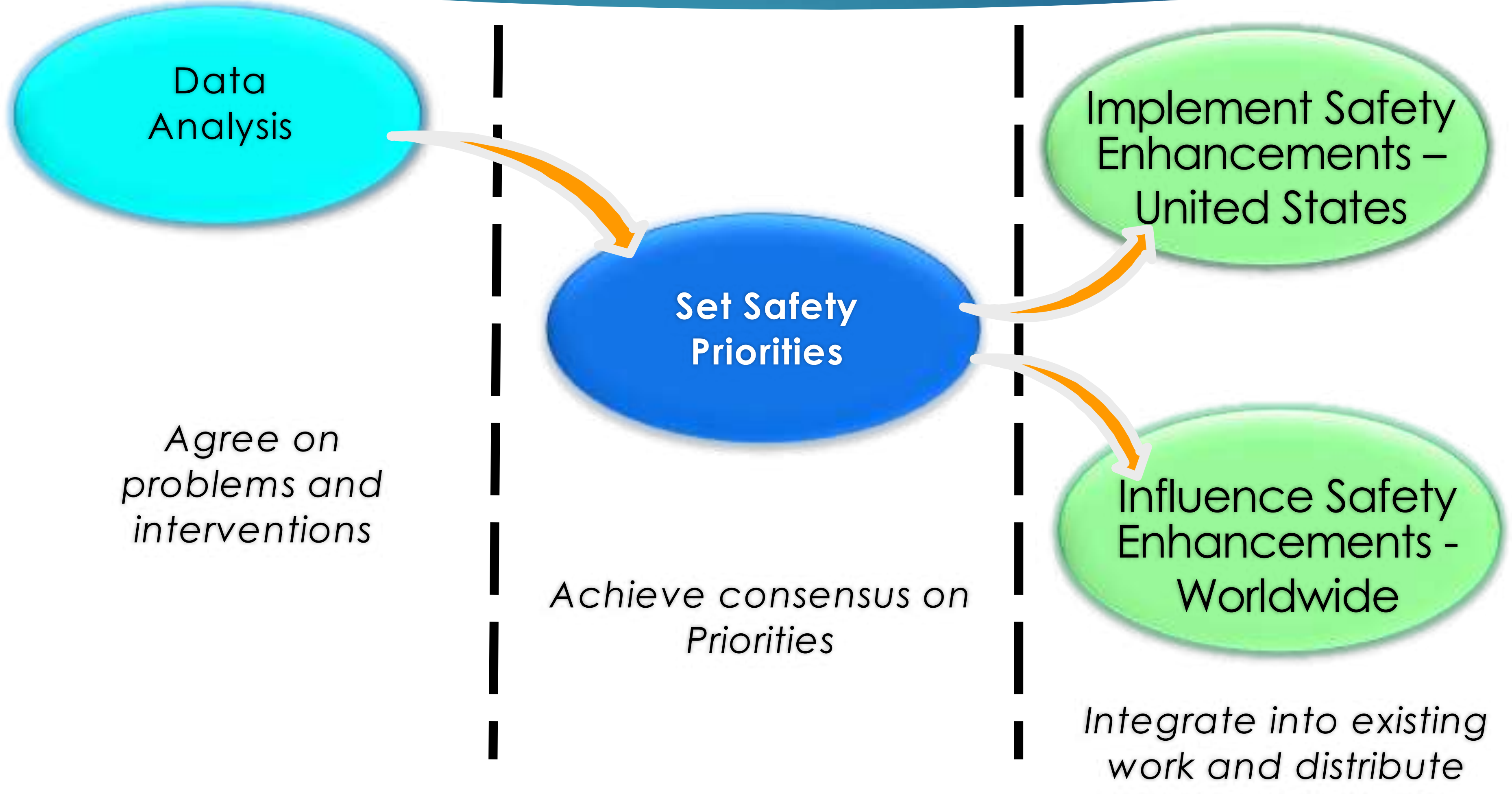
CAST Goal

- CAST came together in 1997 to form an unprecedented Industry-Government partnership…
  - Voluntary commitments, Consensus decision-making, Data-driven risk management, Implementation-focused.
  - Goal:

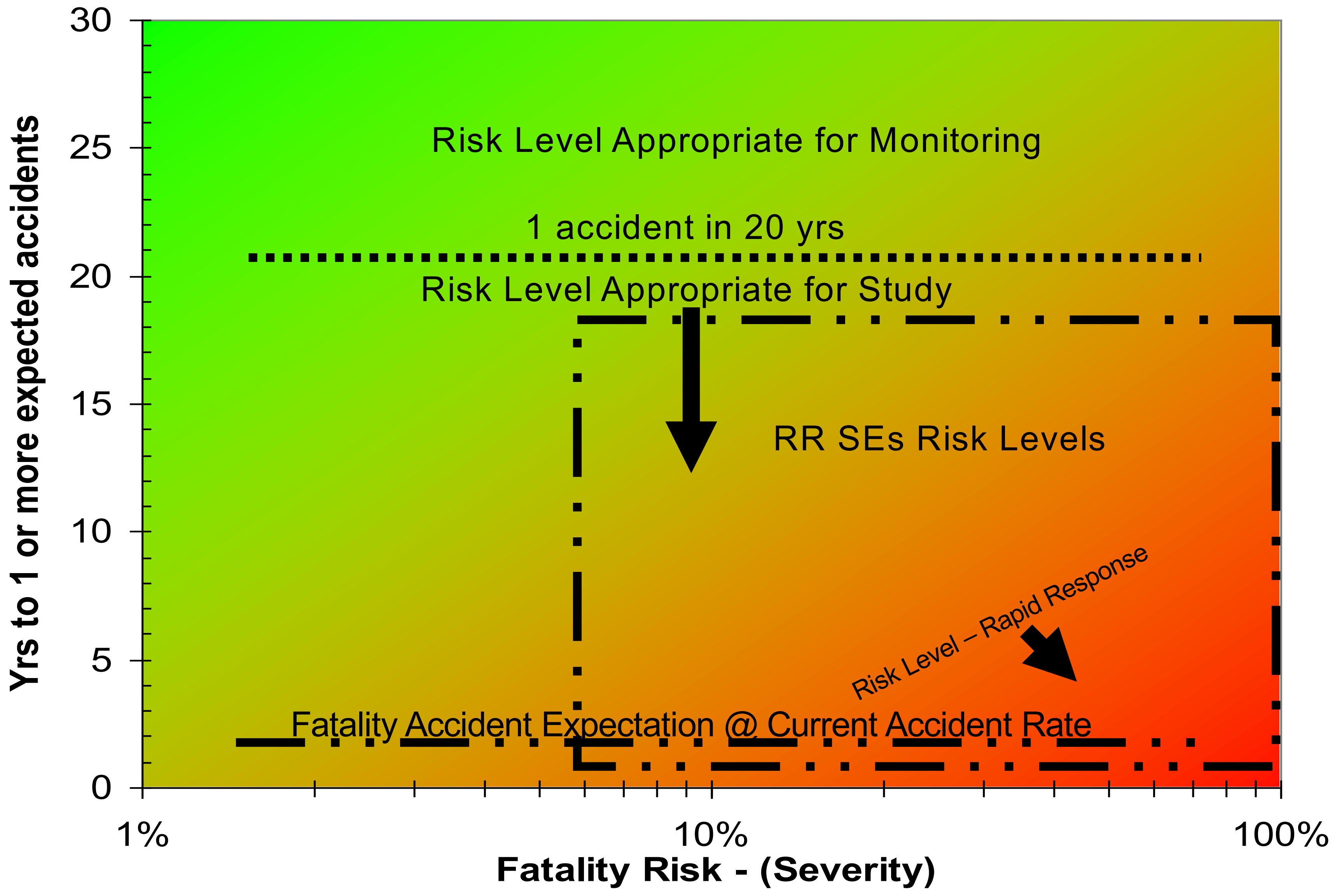
Original *Reduce the US commercial aviation fatal accident rate by 2007.* **83%**

New *Reduce the U.S. commercial aviation fatality risk by at least 50 percent from 2010 to 2025.*

CAST Safety Strategy



Study Prioritization
(Fleet Risk)



What is ASIAS?

- *A collaborative Government-Industry initiative on safety data analysis & sharing*

- *A risk-based approach to aviation safety, identifying & understanding risks before accidents or incidents occur*

- *Timely mitigation & prevention*

ASIAS Is Governed by Formal Principles

- Data used solely for advancement of safety
- Voluntary submission of safety-sensitive data
- Carrier/OEM/MRO data are de-identified
- Transparency – knowledge of how data are used
- Procedures & policies established through collaborative governance
- Analyses approved by an ASIAS Executive Board

CAST Recent Safety Studies

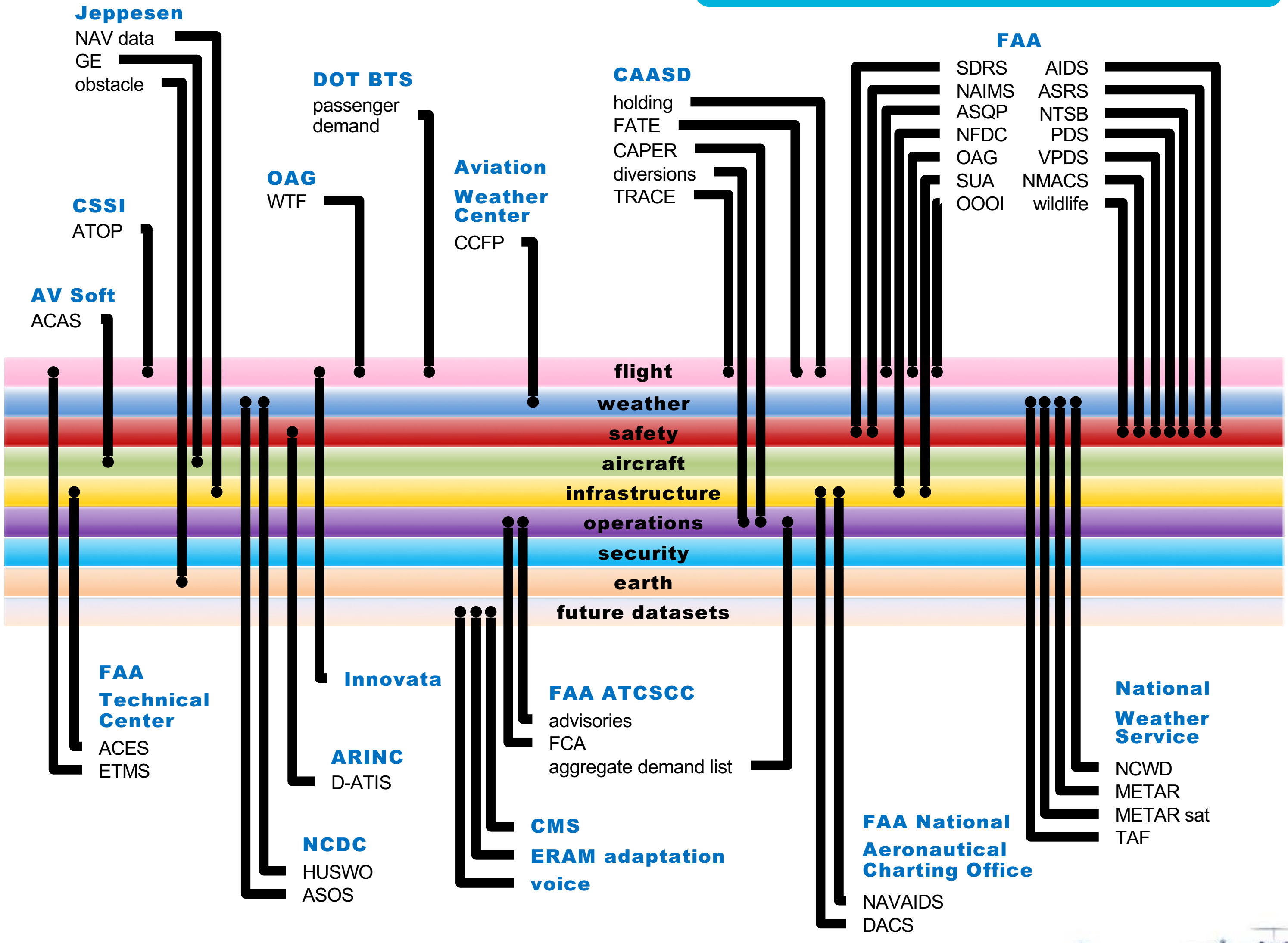
- Go-Around (underway)
- Takeoff Misconfiguration
- Runway Excursions (RE)
- RNAV Departures and STAR Operations
- Airplane State Awareness (ASA)
- Traffic Collision Avoidance System (TCAS)
- Terrain Awareness Warning System (TAWS)

data

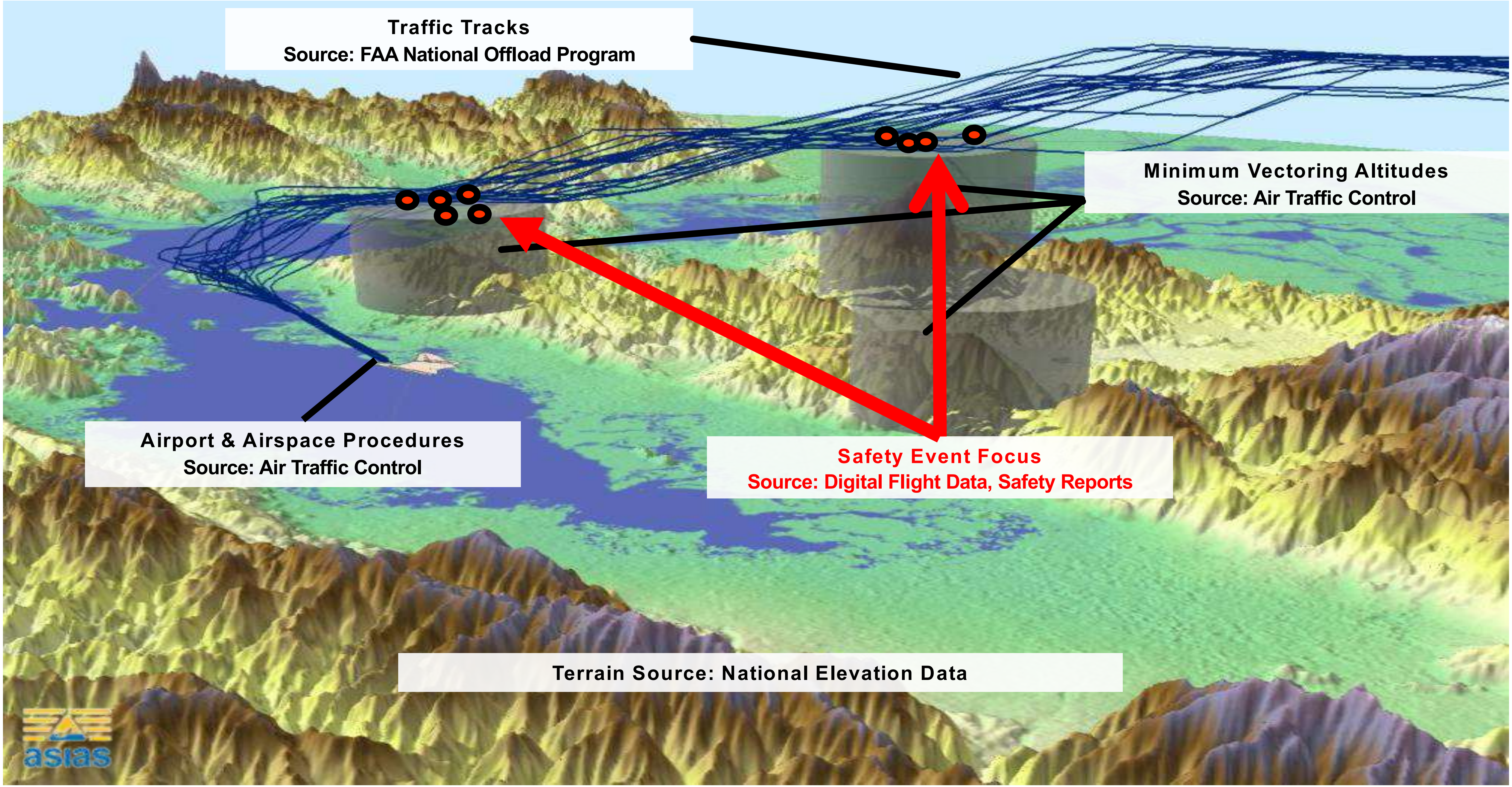
types

sources

Proprietary Data



LEVERAGING DATA FROM ACROSS THE INDUSTRY PROVIDES VALUABLE INSIGHTS



Impacts of Data Sharing

- Safety insight gained from ASIAS is invaluable, as it is not possible through other means and gives us the ability to—
  - Identify systemic risks
  - Detect the degradation of safety barriers
  - Monitor the effectiveness of deployed mitigation strategies
  - Understand the impact of changes in the aviation system

- CAST has adopted 22 safety enhancements to address systemic risks based on *non-accident* data from ASIAS

Summary

- Unprecedented partnership and positive impact
- Long-term industry and government commitment
- Committed to continue to drive future safety improvements through information sharing

skywise. The beating heart of aviation

Stephen Roebuck
Airbus Digital Transformation Office

Yuanbo Liu
Palantir Technologies

Community

Community

noun

1. a group of people living in the same place or having a particular characteristic in common
2. the condition of sharing or having certain attitudes and interests in common

FAL A350

FAL A350

4700 IT systems

FAL A350

4700 IT systems

40 non-conformity databases

FAL A350

4700 IT systems

40 non-conformity databases

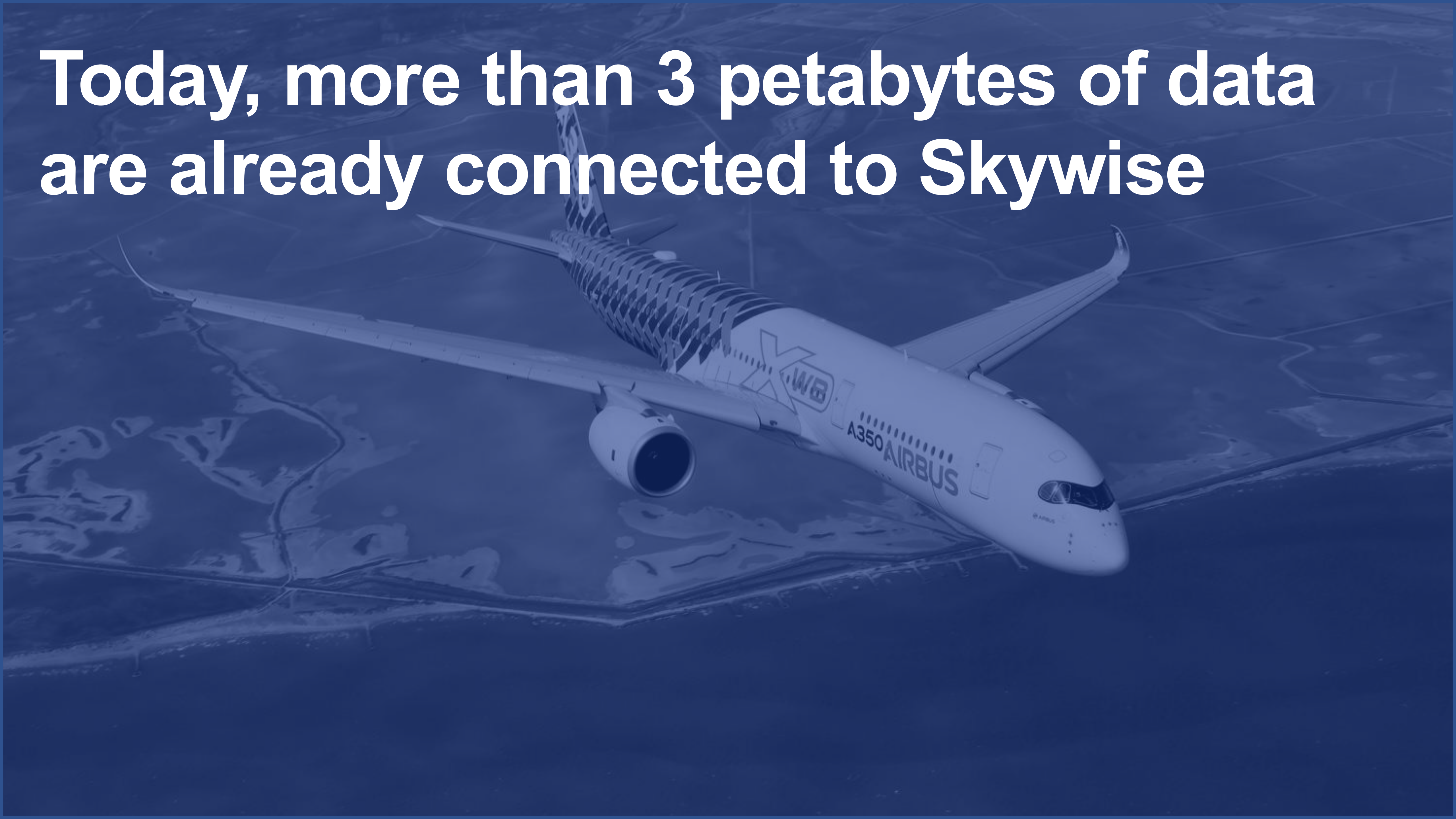
30 days to gather data required for 30 minute decision

Our journey to date

Exponential User Growth

Accelerating business transformation

Today, more than 3 petabytes of data are already connected to Skywise



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3,000+ aircraft

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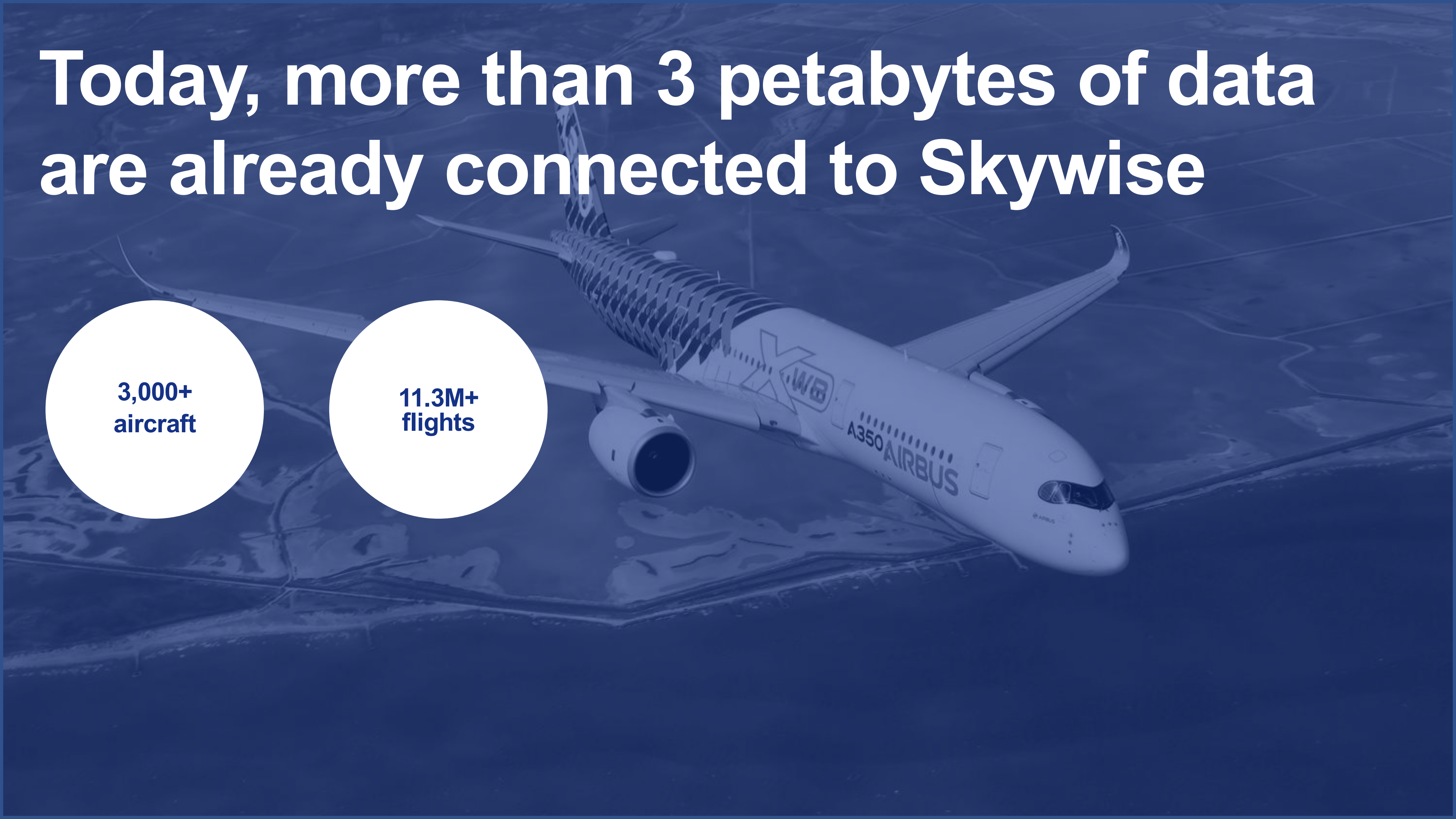

3,000+ aircraft

11.3M+ flights

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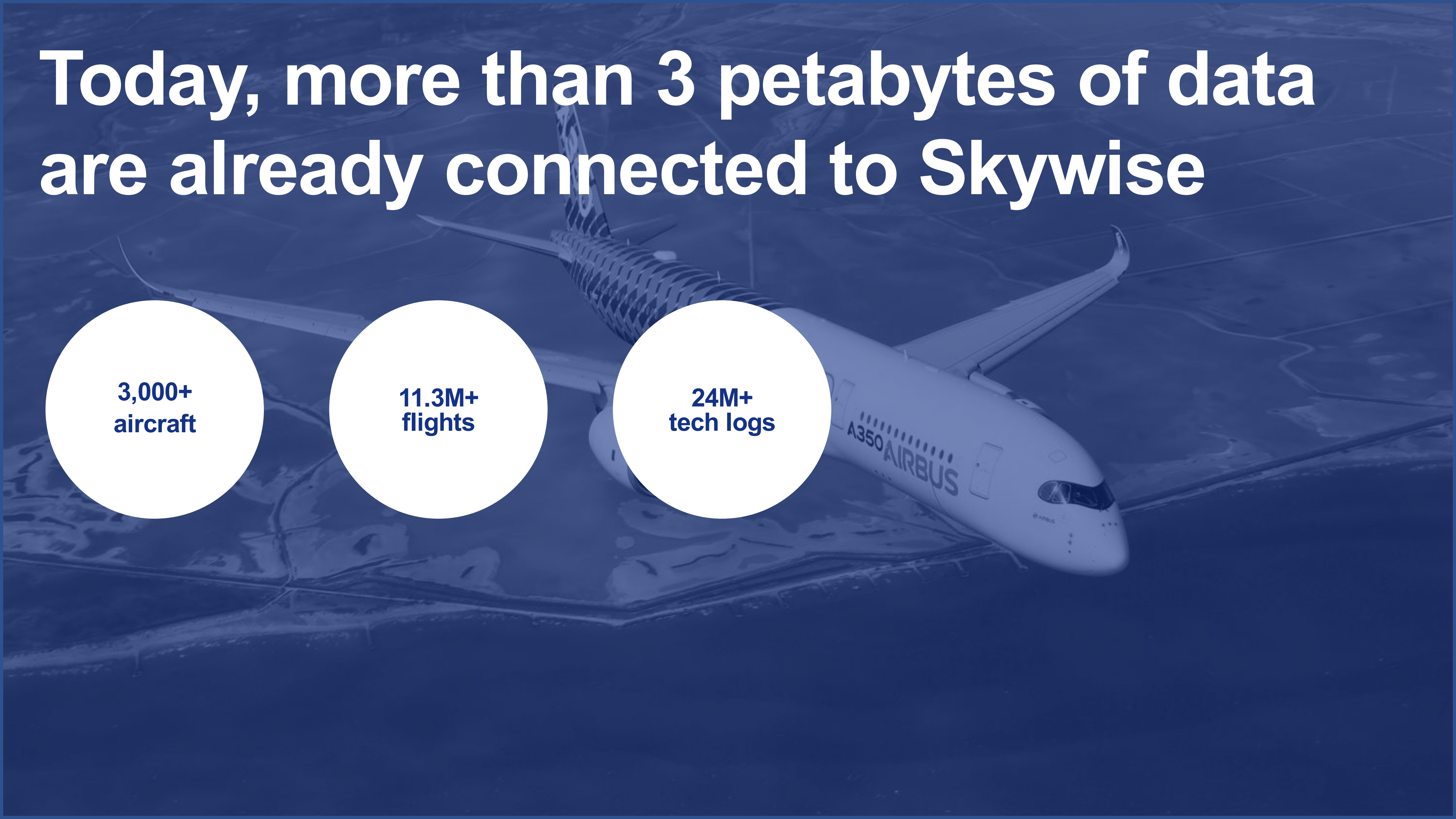

3,000+
aircraft

11.3M+
flights

24M+
tech logs

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- **3,000+** aircraft
- **11.3M+** flights
- **24M+** tech logs
- **70+** systems

Today, more than 3 petabytes of data are already connected to Skywise

3,000+
aircraft

11.3M+
flights

24M+
tech logs

70+
systems

5,000+
users

Connecting our industry

Connecting our industry

SUPPLIERS ········ **ENGINEERING & DESIGN** ········ **COMPONENT MANUFACTURING & ASSEMBLY** ········ **SERVICES** ········ **OPERATORS**

SUPPLIERS

Demand forecasting and reduce missing parts

ENGINEERING & DESIGN

Improving future aircraft design

Accelerating root cause analysis from months to days

COMPONENT MANUFACTURING & ASSEMBLY

Resource management and burndown rate monitoring

Improving logistics coordination and planning

Accelerating repair speed from weeks to hours

SERVICES

Preventative maintenance models

Reliability reporting

New route development

OPERATORS

Component reliability

Maintenance optimization

Connecting our industry

OPEN

Other OEM data is being hosted on Skywise

Operators are driving cross fleet workflows using Skywise

SECURE

Best in class technology from Palantir ensures secure handling of data

Robust permissions and access controls can be configured to operator requirements

COLLABORATIVE

Multi stakeholder workflows to connect operators, suppliers and major OEMs

Group collaboration and data sharing are possible

Airline spotlight

Over 2 trillion rows of sensor data for one national carrier alone
Enriched with faults and maintenance information
500+ users in the design office conducting root cause analysis and partnering with airline engineers
Unprecedented speed to investigate and resolve issues: from years to weeks

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Reduced NFF events from 13 per month to 3 per month

Diagnosed root cause of fuel pump that had been replaced 15+ times

sparkcognition™

Beyond Sensors & Big Data

How AI Drives Prediction and Optimization on Less Connected Aircraft

Mark Roboff
Vice President, Aerospace & Automotive

AI Systems Work Like A Human Brain

Process Information

Draw Conclusions

Codify Instincts and Experience Into Learning

AI systems

Significant benefits for the industrial world

Improved Accuracy

Scalability

External Factors

Adaptability

Security

In-Context Remediation

AI system for maintenance optimization

Prediction

Aircraft Sensor Data
(ACARS, DAR, QAR)

Diagnostic

Content from Hangers
(Maintenance logs)

Optimization

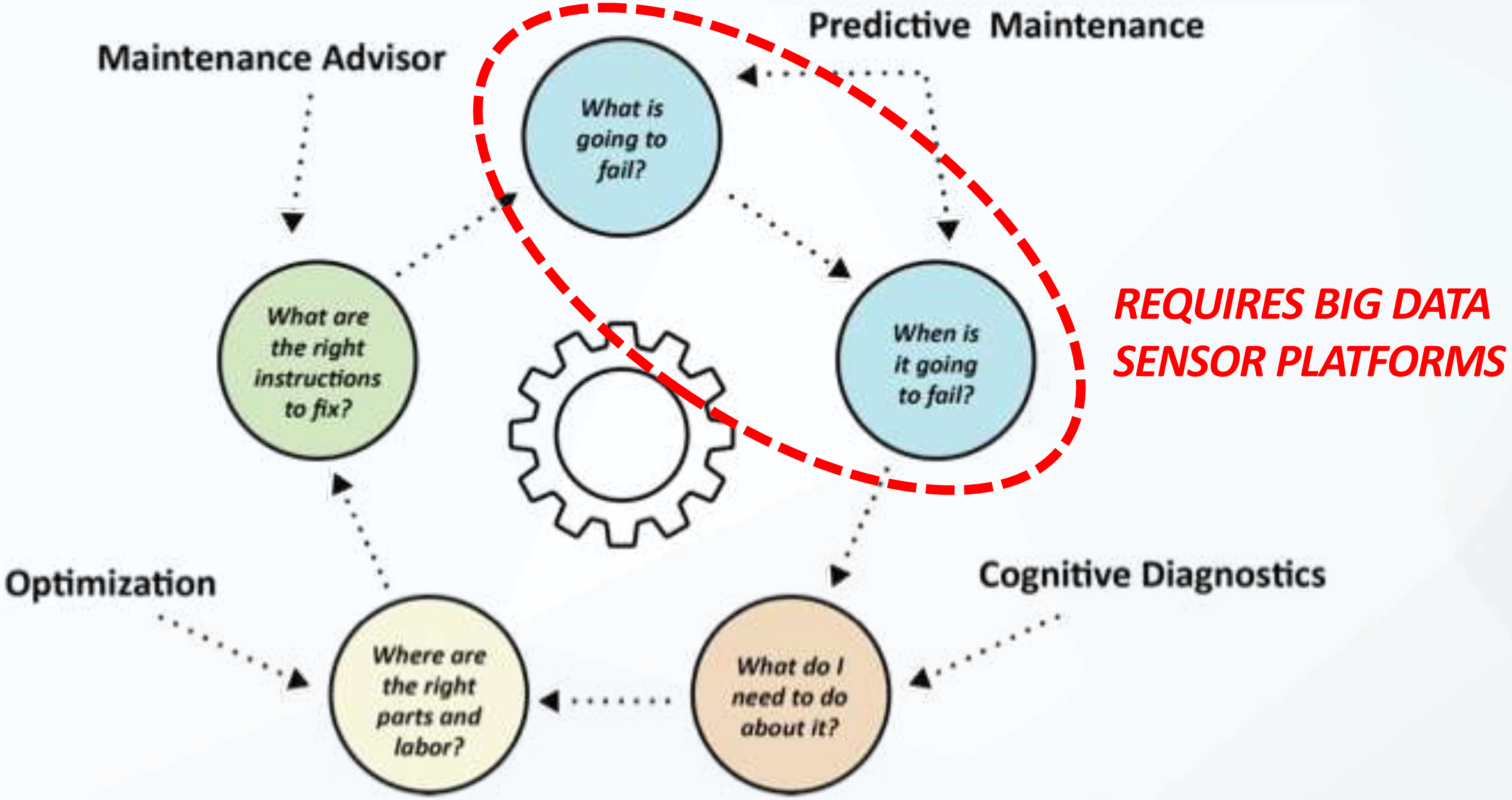
Content from Flight Ops
(Scheduling)

Advisory

Content from Hangers
(Service Manuals)

What is going to fail? How do I fix it? Where are the parts?
Where is the labor? What are the right instructions?

Addressing the maintenance life cycle



Today’s big data sensor platforms

This plane generates 1TB of data per flight

This plane generates over 24,000 parameters of data per flight

Problem: Only the newest aircraft have sensor platforms on the scale of big data

Prognostics and Health Management from MX Logs

Benefits of cognitive diagnostics

Compared to Traditional ACARS-Driven Aircraft Health Management, Cognitive Diagnostics Covers…

The Whole Fleet

- Covers all types in a mixed fleet with one deployment
- Provides the same high level of analytics for all aircraft types, regardless of age

The Whole Aircraft

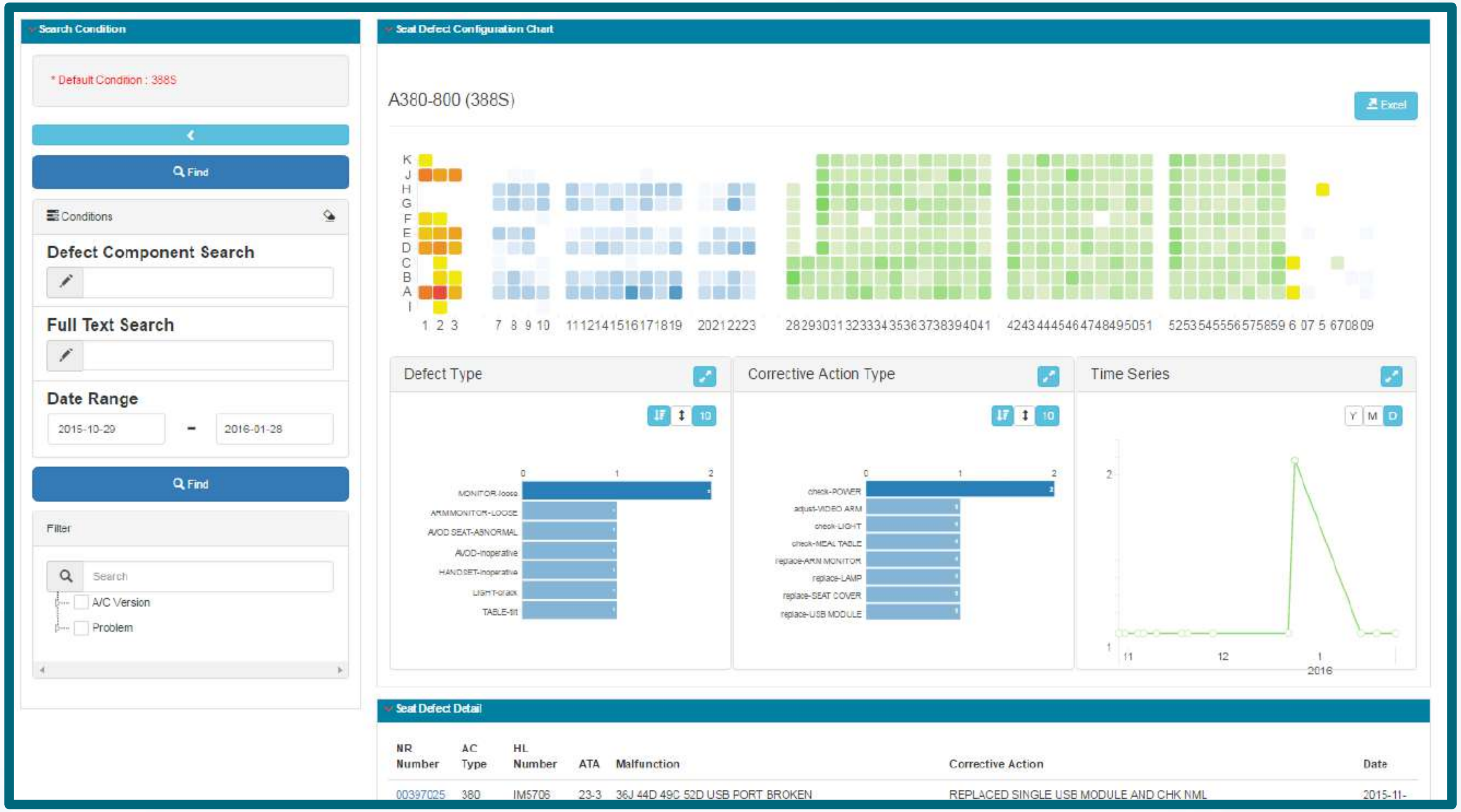
- Provides rich analytics and recommendations across all ATA chapters
- Identifies long term trends and patterns for quality in non-ACARs-reporting components, i.e. seats

Tribal Knowledge

- Delivers corrective actions across all ATA chapters from an airline's own maintenance history
- Embeds tribal knowledge for when reality differs from "by the book"

Example

Seat health management



Maintenance Advisor Leverages Maintenance Manuals to *Deliver the Right Instructions, to the Right Person, at the Right Time*

Advisor – Aiding the technician

1

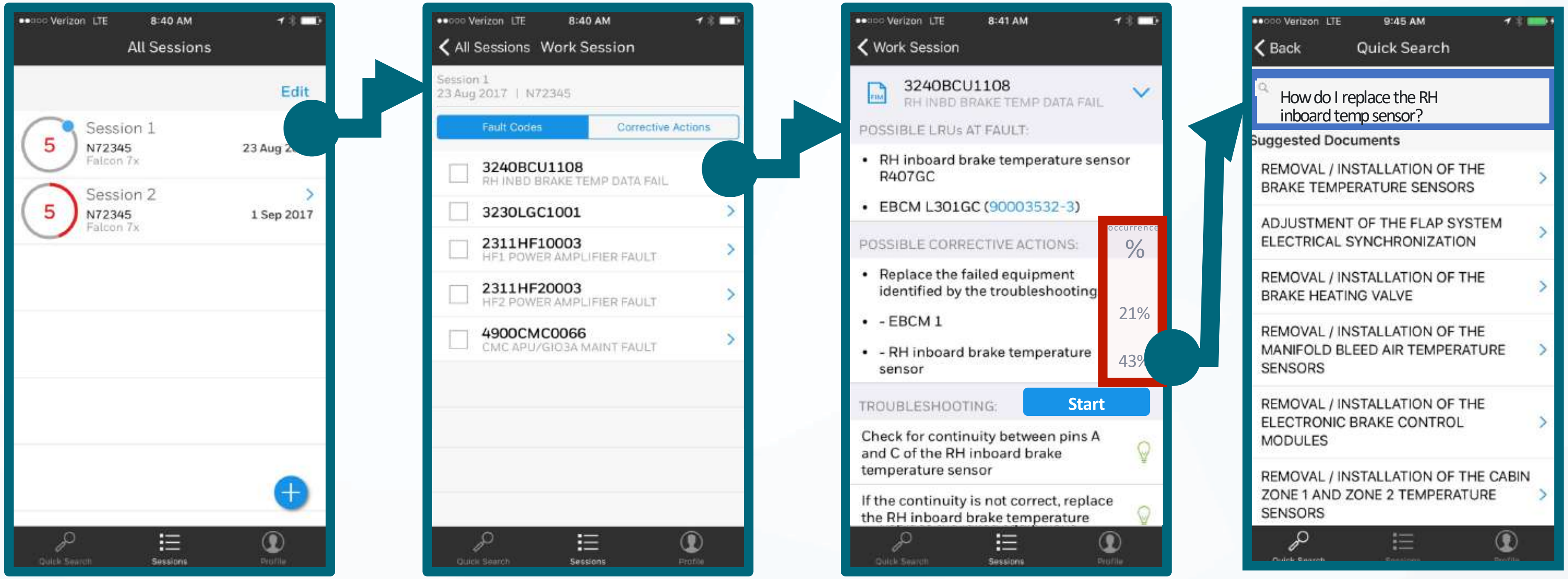
Guides the technician step-by-step on what to do to fix problems

2

Trusted solution with confidence ratings to provide a path toward resolution

3

Quick search allows natural language questions to find relevant tasks and information from anywhere in the manuals



Case inbox is split into sessions. Each session represents a chunk of work to be done for a given aircraft tail number

Technician selects a session and finds the faults or work that needs to be done for that aircraft

Technician selects a fault and finds historical information on which corrective actions have been successful most often in the past

A quick search using natural language returns the relevant AMM tasks for the top corrective action

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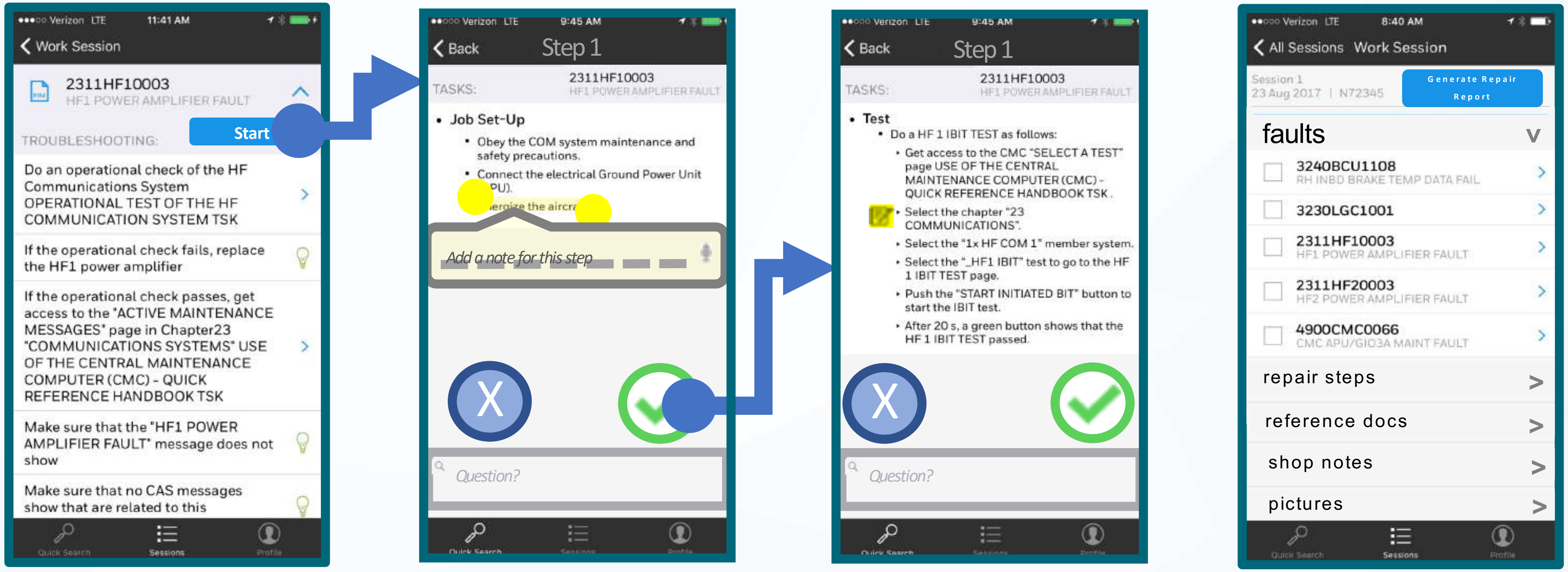

Starting a repair send the technician into a step by step process

Next steps are delivered in appropriate sections to the technician and feedback is collected

Connected devices become a powerful data collection and stakeholder communication device. Store notes to share learnings.

In Design: Automate Repair reports and store in the cloud

Who we are

SparkCognition is an enterprise AI company with software solutions that help customers

Analyze increasingly complex data stores

Reveal actionable insights

Identify and automate optimal responses

Closed Series B funding of $56.5M in venture capital in February 2018

Customers, partners, and awards

Customers

Invenergy
DOVER
DUKE ENERGY
Honeywell
BOEING
DEFENSE INNOVATION UNIT EXPERIMENTAL
FLOWSERVE
MHPS
ARMY BE THE BEST
U.S. DEPARTMENT OF ENERGY

Partners

IBM
Google
OSIsoft
ptc
GE
NATIONAL INSTRUMENTS
Deloitte.
relayr.

Awards

FROST & SULLIVAN
NOKIA Open Innovation Challenge 2015
CNBC DISRUPTOR 50 2017
THE AI 100
Gartner 2015 Cool Vendor
RED HERRING 100
2016 Fastest-Growing Companies in Central Texas
AUSTIN A-LIST

sparkcognition™

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