Aviation Data Symposium
15–16 November 2017
Miami, USA
Safety and Operations

Thank you to our Sponsor

Deloitte.
Opening Remarks & Objectives
The Benefits and Challenges of Global Information Sharing and Exchange Networks

Moderator
- Olena Vasylchenko, Head, Centers of Excellence ITS, IATA

Panelists
- Al Madar, Managing Director, Operation Safety, American Airlines
- Rodolfo Quevedo, Director, Safety, IATA
Partnership for Safety

Al Madar
Managing Director, Operation Safety
American Airlines
Partnership for Safety

COMMERCIAL AVIATION SAFETY TEAM (CAST)

AVIATION SAFETY ANALYSIS AND SHARING (ASIAS)
Safety Life Cycle

Modeling & Simulation

NextGen

Mitigations

Safety Analysis

Monitoring

Information Sharing

Aviation Safety INFOSHARE
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.

New Reduce the U.S. commercial aviation fatality risk by at least 50 percent from 2010 to 2025.
Predicted vs. Actual Part 121 Onboard Fatalities

- Lives Lost: 0, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500


- CAST Safety Enhancements
- Voluntary Safety Reporting Programs
- Six-Axis Simulator FDR
- Safety Management Systems
- ASIAS Established

Net reduction of
A history of continuous improvement

- From 1997 to 2007, CAST leveraged accident data

- With so few accidents and no “common causes,” we needed more data points in order to move from a reactive to a predictive approach.

- Led to the establishment of ASIAS in 2007
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
- Procedures & policies established through collaborative governance
- Transparency – knowledge of how data are used
- Analyses approved by an ASIAS Executive Board
**ASIAS Participation: FOQA & ASAP**

**FOQA**
- 44% of NAS Commercial Ops have approved FOQA programs
- 99% participate in ASIAS
- FOQA Records in ASIAS: 16.1 M Commercial + 35 K General Aviation (3 years of data)

**ASAP**
- 81% of NAS Commercial Ops have approved ASAP programs
- 97% participate in ASIAS
- ASAP Records in ASIAS: 188 K Commercial + 18 K General Aviation (3 years of data)
CAST / ASIAS Safety Studies

- Takeoff Misconfiguration
- Runway Excursions (RE)
- RNAV Departures and STAR Operations
- Airplane State Awareness (ASA)
- Traffic Collision Avoidance System (TCAS)
- Terrain Awareness Warning System (TAWS)
2017 and beyond--Fusion is the next step in continuous improvement of the CAST / ASIAS process

numerous data sources = greater insight into the safety issue
deeper understanding of underlying contributing factors
better informed = develop more effective mitigations
rigorous identity protections are applied

irreversible de-identification of data conducted within 24 hours

all processing & analysis conducted in secure environment per ASIAS governance

results de-identified & aggregated per ASIAS governance

irreversible hashing

ASIAS Proprietary - Do Not Distribute
fusio provides enhanced insight – runway excursion example

<table>
<thead>
<tr>
<th>FLIGHT PARAMETERS FROM FOQA</th>
</tr>
</thead>
<tbody>
<tr>
<td>runway remaining @ 50 knots</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>EXAMPLE FLIGHT</strong></td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
</tr>
</tbody>
</table>

“"I did not sense a significant braking action taking place"”

“"We touched down beyond the landing area"”

“"by 500 ft AGL I believe I was stabilized on speed, on glideslope and on course"”

WEATHER INFORMATION FROM ASOS

<table>
<thead>
<tr>
<th>ASOS report offset</th>
<th>headwind (knots)</th>
<th>crosswind (knots)</th>
<th>wind gust (knots)</th>
<th>precip. within 1 hour (in)</th>
<th>visibility (Mi)</th>
<th>ceiling (ft)</th>
<th>sigweather</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>-6.6</td>
<td>-14.6</td>
<td>24</td>
<td>0.04</td>
<td>7</td>
<td>9500</td>
<td>-RA</td>
</tr>
</tbody>
</table>

ASIAS Proprietary - Do Not Distribute
Success is the result of 20 years of an unprecedented Government / Industry partnership.

Leverage “big data” to reduce risk within the National Airspace System.

Drive future safety improvements through further data enhancements/analysis and even greater collaboration/trust.
IATA Safety Information Exchange Program

Rodolfo Quevedo
Director, Safety
IATA
IATA Safety Information Exchange Program

Supported by IATA Safety/GADM
Goal

- To support a proactive data-driven approach leading to the identification, analysis and mitigation of aviation risks
## GADM Portfolio

### Global Data Exchange Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FDX</strong></td>
<td>Database of FDA and FOQA type events</td>
</tr>
<tr>
<td><strong>GDDDB</strong></td>
<td>Database of ground damage incident reports</td>
</tr>
<tr>
<td><strong>STEADES</strong></td>
<td>Database of airline incident reports</td>
</tr>
</tbody>
</table>

### Individualized Airline Service

- **Flight Data Analysis Service**
  - Database of commercial aviation accidents
    - Data used to create the IATA Safety Report

### Audit Data

- **Audit Data**
  - Database of audit findings from IOSA and ISAGO audits
How has GADM been used?

Support to National and International Safety Teams

- **CAST**
  - ASIAS data sharing program
  - MoU since 2013
  - Share the INFORMATION not DATA
  - Alignment of metrics

- **ICAO**
  - Regional Aviation Safety Groups

- **BAST**
  - Brazilian Aviation Safety Team
  - Data provided for quarterly meetings
Challenges

- Data collection – harmonization across global community
- Data de-identification vs information analysis and sharing
- Safety information protection – application of governance protocols to avoid misuse
- Industry concerns regarding the scope and use of Safety Information
  - Mandatory versus Voluntary
  - Use of highly sensitive data
  - Safety versus Compliance
Safety Information Exchange Program

- States must manage the safety performance of its aviation system
  - Requires safety management inputs by both the State and Service Providers

- States have recognized the value of using this aggregated, de-identified Operator information to support State safety activities
  - All safety data and safety information deemed relevant by a State is in scope for a IATA Safety Information Exchange Program
IATA Program

Industry / State collaboration to develop Safety Information Exchange and analysis
- ICAO Assembly A39-WP/117

Models would:
- Meet the needs of an SSP to manage safety at the State level
- Address Industry concerns
- Adhere to Annex 19 protection principles
- Streamline global safety-sharing channels for and harmonize metrics
Collaborative Approach to Safety Management

IATA Safety Information Exchange Program

• Enables States access to de-identified aggregate Safety information collected by IATA

• Supports both State and Regional Safety Oversight Organization (RSOOSs) Safety Management activities

• Also supports the ICAO Global Aviation Safety Plan (GASP) objectives and the work of the Regional Aviation Safety Groups (RASGs)
Safety Information Exchange Model
Establishment of a “Collaborative Safety Team”

- Mechanism for safety information sharing and exchange to identify top safety risks, and develop mitigation strategies to improve the safety performance of the respective State aviation system
- Team includes representation from the State and aviation system Service Providers
- Team establishes the protocols for the Safety Information Exchange (SIE)
- Frequency of the meeting based on the need and desire of the State and participating Service Providers
Collaborative Approach to Safety Management

IATA as Custodian

- Assures the protections of the safety data and safety information from Operators are applied consistently and in accordance with A19 provisions and the respective program governance
- Integrates the various safety data sources
- Provides de-identified aggregate information to the respective State or RSOO
Overview

The FDX analysis pages enable querying of event occurrences through a much larger database than that of your own. Contributors' data is processed using a single platform into a single database to ensure consistency of analysis. FDX members benefit from free access to this innovative tool to identify systemic issues and benchmarking. Data is always de-identified and updated on a regular basis. Users can drill down several layers of data from flights to event categories, regions, and airports.

For more information on how to participate, access the GADM Site.

Latest update

2017-03-30: Updates and improvements.
2017-03-16: Initial release.

Definitions

- Rule of Three
- Event Rates
- IATA Region of Operator
- Flight Date

Reminder: Access to IATA FDX is limited to users authorized by IATA under specific individual license and FDX member agreements. Users are not authorized to re-distribute FDX information in any form without prior written consent from IATA. In the event of wrongful disclosure IATA reserves all its rights including (but not limited to) termination of the present access.
Runway Approach & Landing

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

Event rate by month

STATE
Runway Approach & Landing

The Approach and Landing Accident Reduction page contains metrics on go-around, long landing, tailwind, stopping distance events and other KPIs at various airports.

- Event Rate for various metrics over time.
- Graphs and charts showing trends and data analysis.

November 2017
In-Depth Studies

Rate of Descent 1000-500ft (Max)

Touchdown Distance to RWY Start

ADS November 2017
COLLABORATION

That's why it's important
Information Sharing and Exchange Networks - A Participants View

Pablo Hernández-Coronado Quintero
Director of Safety Analysis & QM, Spanish Aviation Safety and Security Agency (AESA)
case study

Pablo Hernández-Coronado Quintero
Director of Safety Analysis and Quality Management
AESA
STATE SAFETY PROGRAMME

Input

Data
✓ Operational
✓ Compliance
✓ Performance
✓ Enforcement
✓ Financial...

SRM
rules

policy

Cost/benefit

Evaluation

Output

Execution programs

Programs
✓ Safety Action Plan
✓ Safety Oversight Plan
✓ Regulations
✓ Safety Campaigns...

SA
OCCURRENCE REPORTING

PRELIMINARY ANALYSIS

HIGH SEVERITY

• Information gathering
• Deeper analysis
• Formal Investigation?

ECCAIRS: UPDATED WITH RESULTS

Safety risk assessment methodology for aggregate data

Safety Risk assessment for an event
RAT << ARMS << Bow-Tie

SPECIAL EVENTS

MAJOR RISK CONCERN
SAFETY PERFORMANCE INDICATORS

Parameters to monitor SMS safety performance

Agreed with service providers

Although, mandatory by Law 1/2011 of 4th March 2011

Monthly provided via Internet secure access (login & password required)

And, service providers take advantage of AESA’s safety data
Código de Plantilla: F-DEA-CDO-08 2.0

© AESA
Queda terminantemente prohibida la reproducción total o parcial de este documento, así como su uso indebido y/o su exhibición o comunicación a terceros.

Exposure Data
• Flight hours per air fleet & month
• Nº of take-offs per air fleet & month
• Daily use per air fleet (flight hours)

Maintenance Data
• PIREPs per 100 TOs
• Deferred Maintenance Items per month & aircraft
• In Flight Shut Downs (IFSD) per 1000 engine operating hours
• IFTB (In-Flight Turn Back) & Diversions due to Technical Reasons per 100 TOs
• Delays or Cancelled flights due to Technical Reasons per 100 TOs
• Rejected take offs due to Technical Reasons per 100 TOs

Operational Data
• Unstable approaches per every 100 reviewed flights
• GPWS & EGPWS warnings per 100 TOs
• Missed approaches or “GO-AROUNDs” per 100 TOs
• Technical crew duty period exceeded per month

CAT OPERATORS’ SPIs
SAFETY RISK ANALYSIS

Aviation System

Sector

Corporate

Safety Cloud
RISK BASED OVERSIGHT

SAFETY INFORMATION AND DATA SOURCES

Risk Exposure
- Category A and B operators
- ANSPs and industry: i.e. No. of operations, flight hours, passengers
- Registered air fleet

Compliance
- AESA’s safety oversight findings: OPS, AIW
- SAFA & SANA reports: ramp inspections
- Enforcement procedures (qualitative analysis)
- Pax. claims (qualitative analysis)

Performance
- Occurrence Reporting System; MOR & VOR
- Financial information
- SPIs
- SMS
RISK BASED OVERSIGHT

- CORPORATE LEVEL: SAFETY DNA

![Diagram](image)
# Financial Indicators

<table>
<thead>
<tr>
<th>Financial Indicators</th>
<th>Index</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquidity</td>
<td>0-100</td>
<td>Estimated Bank Liquidity</td>
</tr>
<tr>
<td>Long Term Debt</td>
<td>0-150</td>
<td>Estimated Long Term Debt</td>
</tr>
<tr>
<td>Profitability and Cash Flow</td>
<td>0-100</td>
<td>Profitability and Cash Flow</td>
</tr>
<tr>
<td>Decapitalization</td>
<td>0-100</td>
<td>Decapitalization Index</td>
</tr>
<tr>
<td>Short Term Debt</td>
<td>0-100</td>
<td>Short Term Debt Index</td>
</tr>
<tr>
<td>Mean Values</td>
<td></td>
<td>Sector Mean Values</td>
</tr>
<tr>
<td>TOP Ten Index</td>
<td></td>
<td>Top 10 Financial Indicators</td>
</tr>
</tbody>
</table>

### Risk Based Oversight

<table>
<thead>
<tr>
<th>Risk Based Oversight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QT/Annual Trend</td>
<td>Quarterly Trend/Annual Trend</td>
</tr>
<tr>
<td>0-100 Index</td>
<td>0-100 Financial Indicators</td>
</tr>
<tr>
<td>0-150 Index</td>
<td>0-150 Financial Indicators</td>
</tr>
</tbody>
</table>
RISK BASED OVERSIGHT

- SECTOR LEVEL

![Graph showing risk level assessment](image)
RISK BASED OVERSIGHT
RISK BASED OVERSIGHT

**ANÁLISIS DE LA FLOTA DE OPERADORES TAC**

<table>
<thead>
<tr>
<th>CATEGORÍA</th>
<th>NS AERONAVES SMA</th>
<th>NS AERONAVES AOC</th>
<th>NS AERONAVES ARC</th>
<th>ANTIGÜEDAD MEDIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>737-700</td>
<td>38</td>
<td>35</td>
<td>38</td>
<td>6.97</td>
</tr>
</tbody>
</table>

**PERIODO ANÁLISIS**

24/10/2013 - 23/10/2017

---

**SUcesos de la Flota - Grupo**

**SUcesos de la Flota - Aeronavegabilidad**

**SUcesos - Sistemas ATA**

© AESA. Queda terminantemente prohibida la reproducción total o parcial de este documento, así como su uso indebido y/o su exhibición o comunicación a terceros.
RESULTADO INSPECCIONES EN RAMPA

ÁREA SANA

ÍNDICADOR SANA

ÁREA SAFA

ÍNDICADOR SAFA

RISK BASED OVERSIGHT
RISK BASED OVERSIGHT
RIMAS
- Aviation System Level -
A comprehensive coherent methodology for aviation safety risk management at state level

Beyond risk matrices towards coherent development of SSPs

Key issues/steps:
1. Meaningfully exploring aviation safety databases
2. Building forecasting models for: operations, occurrences, severities
3. Assessing multiple consequences: deaths, injuries, delays, cancellations, maintenance and repair operations, image loss,...
5. Optimal assessment of aviation safety resources
RIMAS: RISK MANAGEMENT IN AVIATION SAFETY

- MOR. 88 types of occurrences. Registered in ECCAIRS.

- Other databases: ASN, Eurocontrol (CFMU), ESTOP, ...

- 5 severity degrees (ICAO and EUROCONTROL): Minor, Significant, Major, Serious, Accident

- 4 types of aircrafts T1, T2, T3, T4 (No. of passengers)

  ✓ Flight operations
    • Hard landing, ...

  ✓ Navigation services
    • ACAS warnings, ...

  ✓ Airworthiness
    • Engine failure, ...

  ✓ Airport
    • Impact with vehicle, ...

  ✓ External factors
    • Bird strikes, ...

Código de Plantilla: F-DEA-CDO-08 2.0
© AESA
Queda terminantemente prohibida la reproducción total o parcial de este documento, así como su uso indebido y/o su exhibición o comunicación a terceros.
RESOURCE ALLOCATION

Influence Diagram
PREDICTING THE NUMBER OF OCCURRENCES

### Model

\[
\begin{align*}
\{ n_i = H_i \theta_i + z_i, z_i \sim N(0, \Sigma_i) \\
\theta_i = J_i \theta_{i-1} + \xi_i, \xi_i \sim N(0, S_i) \\
\theta_0 \sim N(\eta_0, S_0) \\
x_i | \lambda_i, n_i \sim Po(\lambda_i n_i) \\
\lambda_i = \exp(u_i) \\
u_i = F_i \theta_i + v_i, v_i \sim N(0, V_i) \\
\theta_i = G_i \theta_{i-1} + w_i, w_i \sim N(0, W_i) \\
\theta_0 \sim N(\mu_0, W_0),
\end{align*}
\]
FEATURES FACED IN (POISSON) INCIDENT RATES

(a) Stress

(b) Seasonal

(c) Linear

(d) Group

(e) Underreporting
We must also predict the corresponding occurrence classes (severities)

Model

assuming that the data $D_t$ available until the beginning of the $t$-th period are $((s_{1,1}, s_{2,1}, \ldots, s_{5,1}), \ldots, (s_{1,t-1}, s_{2,t-1}, \ldots, s_{5,t-1}))$, and where $s_{i,j}$ represents the number of occurrences of class $i$, $i \in \{1, 2, 3, 4, 5\}$, in period $j$, $j \in \{1, \ldots, t-1\}$:

$$
p|D_t \sim Dir \left( \alpha_1 + \sum_{i=1}^{t-1} s_{i,1}, \ldots, \alpha_5 + \sum_{i=1}^{t-1} s_{i,t-1} \right)
$$
PREDICTING INCIDENT CONSEQUENCES

- Multiattribute utility function

```
Optimize AS

Min. Operational impact
- Min. Delays
  # hours delay
- Min. Cancellations
  # cancellations

Min. Material damage
- Min. Repairs
  # repairs
- Min. Destroy
  # destroys

Min. Image loss
  # accidents

Min. Health Impact
- Min. Fatalities
  # fatalities
- Min. Injuries
  # severe injuries
  # minor injuries
```
## RISK MAPPING

- Mapping (forecasted) incident numbers vs (forecasted) incident costs (expected, boxplots)

<table>
<thead>
<tr>
<th>Less but more expensive</th>
<th>More and more expensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less and less expensive</td>
<td>More but less expensive</td>
</tr>
</tbody>
</table>

---

### (a) Año 2015

- **Incident rate**: \( \lambda \sim \text{Gamma}(a, p) \)
- **Class probabilities**: \( p_k \sim \text{Dir}(\alpha_1, \ldots, \alpha_{15}) \)
- **Number of incidents per class**: \( X_k | \lambda, n_k \sim \text{Po}(\lambda n_k) \)
- **Number of operations**: \( n_k \)

---

### (b) Matriz de riesgo 2015

- **Severity**: 0, 0.2, 0.4, 0.6, 0.8, 1
- **Frequency**: 0, 0.2, 0.4, 0.6, 0.8, 1

---

*© AESA* | *Queda terminantemente prohibida la reproducción total o parcial de este documento, así como su uso indebido y/o su exhibición o comunicación a terceros.*
USES: SCREENING

Sucesos | Ref. | ADREP
--- | --- | ---
1. Presencia de obstáculos / FOD | 123 | ADRM
2. Laser | - | -
3. Golpes de aves | 554 | BIRD
4. Incursión aeronave en otras superficies | 321+! | HI-VA(P)
5. Fallos de sistema motor | 441 | SCP-PF
6. Fallos de sistema NO motor | 431 | SCF-NP
7. Turbulencias meteorológicas | 92 | TURB
8. Vientos | 922 | OTHR
9. Colisión con aves | 554 | BIRD
10. Tomo de tierra dura, pesada, rápida o larga | 231 | ARC
11. Manejo de la aeronave | 2121 | OTHR
12. Choque | 612 | WSTFW
13. Choque en cabezadas | - | -
14. Fallos técnicos sin identificar | 451 | OTHR
15. Otras condiciones meteorológicas | 941 | OTHR/UMC
16. Pérdida de control en vuelo | 252 | LOCA
RIMAS: THE ARCHITECTURE

Based on R! and ECCAIRS (and other aviation safety databases), it supports building:

• Forecasting models for numbers of 88 types of occurrences (including number of operations)
• Forecasting models for occurrence severity classes (1 to 5)
• Forecasting models for occurrence consequences (deaths, delays,...)
• A multiattribute utility function to assess such consequences
• Risk maps (and risk matrices)
• Screening of occurrences
• Optimal assignment of resources to reduce and mitigate aviation safety risks
• Displaying all types of graphs to build aviation safety reports
RIMAS: THE ARCHITECTURE

DATA LOAD
- Excel
  - Operations
  - Occurrences

CORRELATION ANALYSIS
- Excel
  - Occurrences
  - Rates

EFFECTS ANALYSIS
- Stress
- Seasonal
- Linear
- Group

FORECASTING
- Operations
- Occurrences

EXPLORATORY ANALYSIS
- Occurrences
- Rates
- Severity Classes
- Geo Maps

RESOURCE ALLOCATION

CONSEQUENCE ASSESSMENT
- Risk Map
- Risk Matrix

OCCURRENCES SCREENING

INTERFACE

GEO MAPS

GROUP

SEASONAL

STRESS

LINEAR

EXPLORATORY ANALYSIS

RATES

SEVERITY CLASSES

OCCURRENCES

RISK MATRIX

RISK MAP

OCCURRENCES SCREENING

OCCURRENCES

GROUP

SEASONAL

STRESS

LINEAR

EXPLORATORY ANALYSIS

RATES

SEVERITY CLASSES

OCCURRENCES

RISK MATRIX

RISK MAP

OCCURRENCES SCREENING

OCCURRENCES
EXPLORATORY ANALYSIS
EFFECT ANALYSIS: GROUP
EFFECT ANALYSIS: SEASONAL
CORRELATIONS MATRIX
OPERATIONS FORECASTING
RISK MAPS
Participation on Data4Safety
Our View

**D4S** is a *data collection and analysis programme* that will support the goal to ensure the and environmental protection for the European aviation *highest common level of safety* system

**Why?** AESA’s *strategic interest* in leading big data projects

**Contribution?**
- *previous experience* in national and international projects
- *highly qualified team* of safety analysts

**Main problems...** *protection* and *use* of safety *information*

**Expected achievements...** *safety improvements* under *SSP* and *EPAS*
1 The Project

Applied research - laboratory validation

Data management, infrastructure, data protection, data mining tools, visualisation

Aviation safety knowledge discovery

Systematic identification of hazards

Started in October 2016
2 The team
2 The Team

The user role in the Big data process

- Users and Scenarios
- Question-Driven Analytics Definition
- Knowledge Discovery

Data protection

Data processing and infrastructure

Domain knowledge + analytics

IT Development

Domain knowledge + analytics
3 The data

14 Data Sources identified and documented

- Description
- Structure and size
- Data Items description
- Range of available data
- Delivery procedure (when and how)
- Technical limitations

Open data

Proprietary data - Data Protection Agreements signed + technical procedures
4 Data protection
Basic procedures in the Consortium Agreement

- Any dataset provided to the project treated with **maximum confidentiality**
- SafeClouds **will not publish datasets** by any means, paper or electronically
- SafeClouds **will not publish details of a concrete safety event**
- All **publications** to be **approved by the data owners**
4 Data Protection

Data Protection Annex - legal agreement

- Data owners + research partners
- SafeClouds possible scenarios
- Specific scenario of interest (SC1)

Data protection agreement
Details on:
· How a Data Requirement Annex is documented
· Overall Data Requirements on the different data sources

Data protection Annex (for SC1)
Details on:
· Which data are used
· How data should be fused
· What are the protection requirements
· How protection is guaranteed
· When the data need to be deleted

Details on the scenario:
· Operational environment
· Expected output
· Analysis of data requirements

© AESA. Queda terminantemente prohibida la reproducción total o parcial de este documento, así como su uso indebido y/o su exhibición o comunicación a terceros.
4 Data Protection

Data Protection Annex - technological procedures

The **Smart Data Fusion** algorithm allows fusion/identification of datasets without private data leaving the private environment.

This is performed storing **randomized hashes** as references in the shared environment and **encrypted** values and seeds on the private environment, i.e. **hash key bank**.
4 Data Protection

Additional Data protection mechanisms

- A **user hierarchy** defines roles and limits data access.
- User actions are **continuously monitored** and logged.
- Any **suspicious behaviour** will trigger a series of **alarms**
5 Scenarios

Input from SafeClouds partners

- Airprox
- CFIT
- Runway utilization
- Unstable approach
- Hard landing
- Wake vortex separation
- Real-time congestion monitoring
- Level bust
5 Scenarios

Use Cases

Operational + mathematical description (metric)

Data supporting the use cases

Data Protection requirements (legal + technical)

Analytics supporting the use cases

Details on how to embed the analytics in the operations

User experience and visualisation requirements
5 Scenarios
Use Cases - CFIT

CFIT-1: Hotspot Detection
CFIT-2: Identifying unreported situations of Aircraft Flying Below Minima
5 Scenarios

Use Cases - Runway utilization

RU-1: Runway usage prediction:

a) runway vacate
b) distance to threshold
5 Scenarios
Use Cases - Unstable Approach

UA-1: Prediction of UA due to data theoretically available on board an aircraft in real time
UA-2: Prediction of UA due to data theoretically available to ATC in real time
UA-3: Blind Benchmarking
5 Scenarios

Use Cases - AIRPROX

AIRPROX-1: Detection and characterisation of hotspots in En-Route environment
AIRPROX-2: Detection and characterisation of hotspots in TMA environment
6 User-driven analytics

<table>
<thead>
<tr>
<th>User + Questions</th>
<th>Outcomes</th>
<th>Methodologies, technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>What happened?</td>
<td>Well-defined case studies, opportunities and</td>
<td>· Clustering · Link prediction</td>
</tr>
<tr>
<td>What’s happening?</td>
<td>challenges</td>
<td>· Co-occurrence grouping</td>
</tr>
<tr>
<td>Descriptive analysis</td>
<td></td>
<td>· Profiling · Similarity matching</td>
</tr>
<tr>
<td>What will happen?</td>
<td>Accurate projections of future states</td>
<td>· Parametric modelling</td>
</tr>
<tr>
<td>Predictive analysis</td>
<td></td>
<td>· Methods to avoid overfitting</td>
</tr>
<tr>
<td>What should we do?</td>
<td>Best-possible decisions</td>
<td>· Similarity networks and clusters</td>
</tr>
<tr>
<td>Prescriptive analysis</td>
<td></td>
<td>· Supervised / unsupervised segmentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>· Optimization · Simulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>· Decision modelling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>· Causality modelling</td>
</tr>
</tbody>
</table>
7 Supporting infrastructure

Your SafeClouds remote
- Data de-identified
- Analysts controlled/secure access
- No local copies of data
- No data fusion among airlines - unless agreed

Your SafeClouds local
- Data semi-identified for data fusion (e.g. meteo)
- No Data Analyst access
- Data Protection team remote access

Your own systems
- Data identified
- No SafeClouds access
7 Supporting infrastructure

Integration infrastructure-analytics

Data Analytics

Data Management
- SafeClouds
- Smart Data Fusion Protocol

Data Protection
- SafeClouds
- Secure Blind Benchmarking

Storage & Computation
SUMMARY and DISCUSSION
SUMMARY and DISCUSSION

- Safety data: the system’s blood
- Safety data & sources protection: key SSP/SMS
- Safety risk management is pervaded by simplistic methods based on risk matrices

WITHOUT APPROPRIATE DATA PROTECTION... NO EFFECTIVE SSP/SMS
Thank you very much

END OF THE PRESENTATION

AVIATION DATA SYMPOSIUM

case study

www.seguridadaerea.gob.es
Networking Coffee Break

Thank you to our Sponsor

mcmillan
Virtual Reality –
How VR will Shape Aviation Training

- April Slovensky
  Deloitte
- Frederic Leger
  Director, Airport, Passenger, Cargo and Security, Products, IATA
Digital Reality

April Slovensky

Deloitte
Virtual Reality
CReates a Digital Environment that replaces the user’s real-world environment

Digital Reality
Solves real-world business problems and creates new sources of competitive advantage.

360° Video
A New Perspective
Allowing users to look every direction

Augmented Reality
Overlays digitally-created content into the user’s real-world environment

Immersive
Multisensory, Digital Experience
Delivered through any of these technologies

Mixed Reality
BLENDS DIGITAL CONTENT INTO REAL-WORLD
both environments can coexist and interact

Based on Consumer Technology Association Definitions, 2016
Data is the key to delivering digital realities

**Think**
- Evaluate solutions, identify starting points, pivot based on learnings

**Connect**
- Connect people remotely, communicate via “See what I see” and interact with the same information

**Know**
- Augment data and resources to give team members a new way to do their jobs

**Learn**
- Immerse in training, analytics, and research, lowering time, risk & cost required

**Explore**
- Bring consumers on a journey of exploration across time and geography

**Play**
- Deliver digital reality experiences through content creation, enablement and consumption

Identify ~ Capture ~ Cleanse ~ Translate

---

Aviation Data Symposium 2017
Immersive training for key use cases in a curriculum

**Virtual Reality Capabilities**

- Scalable Low-Cost Training Simulations
- Experiential Learning Environment
- Instant Best Practice Sharing

**Train a workforce for mission-critical, high cost, complex scenarios by creating an interactive, scalable, experiential reality**

- Light Barrier Maintenance

*Aviation Data Symposium 2017*
Provide workers hands-free access to issue resolution as well as on-demand global expertise with SME’s using see-what-I-see technology.

Augmented Reality (AR) Solutions Capabilities:
- Hands-Free Remote Assistance
- See-What-I-See Guidance
- Automatic Visual Task Assistance

Real-time support and quality built into task execution.
Alter your Reality

1. **Think.** Leverage early adoption, strategic decisions and high priority areas.

2. **Connect.** Use your ecosystem to collaborate.

3. **Know.** Embed learning into the operational activities.

4. **Explore.** Shift the thinking about new ways to create a learning environment.

5. **Consume.** Transform data into content users understand and consume.
RampVR:
Virtual Reality in Aviation

Frederic Leger
Director, Airport, Passenger, Cargo & Security Products
IATA
IATA Training in 2016

• **100,000+** professionals trained in 2016

• **20+** IATA Training Centers

• IATA training offered in **90+** countries

• Our students come from **190+** countries
  • Students represent **2,000+** organizations & government authorities
Current operational training is good, but...

- Not evolved and remains “passive”
- Subject to capacity and availability limitations
- Not benefiting from state of the art and most advanced technology
- Knowledge retention rate could be improved
- Examination remains very theoretical vs. operational
Consultation helped us improve effectiveness of existing training

• Consulted with airlines, airports and ground service providers to understand training needs and pain points

• Common thread: “need for live, practical, on-the-ground experience while minimizing ramp access”

• Common need: “immersion in a close-to-reality environment, simulating live operations, enhancing knowledge retention”
Virtual reality addresses limitations of training

• Immersion in a fully interactive, realistic 3D environment

• Full compliance with industry standards, e.g. Airport Handling Manual (AHM) and IATA Ground Operations Manual (IGOM)

• Accessible anytime

• Easy to set-up and use
Making RampVR™ simple to use was key in adoption

• A plug-and-play system with an intuitive user interface

• Simple setup in any 3x3 meter space with straightforward wire connections

• Quick change between users for time-constrained training sessions

• Easy web download of new VR modules or updated versions of existing modules
We currently offer 2 training modules

- **Aircraft Turnaround Inspection** – Review of procedures to be performed by ramp handlers/supervisors in the safety inspection of the apron prior to an aircraft’s arrival as well as damage inspection of the arriving aircraft prior to docking of equipment.

- **Marshalling** – Using IATA Marshalling Signals to train and evaluate aircraft marshallers to guide an aircraft safely to its final parking position.
Turnaround Inspections
Marshalling
RampVR™ experience

- Be reminded on key principles of training while “on” the ground
- Spot common errors experienced in operations that the system will randomly inject
- Experience infrequent errors to familiarize with unusual situations
- Choose from multiple aircraft categories and “teleport” where needed to conduct the inspections
- Simulate day and night operations in combination with clear and low visibility
- Check score to ensure the inspection or marshalling has been successfully performed
Teleport around the aircraft
Simulate day and night
Simulate issues
Record results

RAMPVR™
Score: 9 / 10
Total Time: 04:59
Please remove your headset
Benefits of virtual reality training

- Practical training in a safe and immersive environment
- Access aircraft and apron anytime, anywhere
- Replicate incidents and issues infrequently seen in operations
- Expose trainees to different lighting and weather conditions
- Improve knowledge retention and staff engagement
- Comply with IATA standards
- Easy set-up, usage and download of new version and modules
Distributing virtual reality training

1. Training at IATA Training Centers
2. Training in Customers’ Premises
3. Company Purchases RampVR
What is included in the RampVR solution?

• The RampVR kit includes:
  • High-spec PC
  • HTC Vive
  • Headphones
  • Setup equipment (tripods, wires, etc)
  • VR training modules

• Other services:
  • Easy download of new or updated modules
  • On-site setup and user familiarization
  • Customer support
Future IATA VR Modules

- Cargo: ULD build up, Dangerous Goods
- Security: Cabin Security
- Ground Ops: Aircraft loading
- Passenger Experience: Inflight Experience
Other IATA VR/AR Activities

- Aviation AR/VR Ecosystem
- VR User Group
- AR/VR Events
- AR/VR Strategic Partnership Program
SAVE THE DATE

Air Transport Virtual & Augmented Reality Conference

15-16 May 2018
Geneva
More information at:

rampvr@iata.org

www.iata.org/rampvr
Machine Learning – The Future of Aviation Data and Information

↑ Usman Shuja
General Manager, Industrial IoT, Spark Cognition

↑ Erica Brinker
Senior Director, Business Development, Honeywell Aerospace
Augmenting our world with A.I. 3.0

Usman Shuja  
*General Manager Industrial IoT, SparkCognition*  
@kshuja @sparkcognition

Erica Brinker  
*Senior Director BD, Honeywell Aerospace*  
@ericaBrinker
Software is Eating the World...
and A.I. is Eating Software
SOFTWARE TRIGGERED SHIFTS IN VALUE...

In the AI-powered disruption, everything will be up for grabs...
HOW SOFTWARE EATS THE WORLD...

Traditional Gas Engine Components

Electric Engine Components
Why is AI 3.0 working out?

**Data**
- Sensor Proliferation
- Physical Actuation

**Compute**
- Cloud
- CPUs/ASICs
- Smarts at the Edge

**Algorithms**
- Deep Learning
- Auto Rule Generations, no need for extracting human expertise

The Transformation of Industry by AI has Begun
What does this mean for the industry?

**Cognitive Maintenance – AI + AR**
Truly long-view predictions, Explanations and exposing root-causes (Explainable AI)

**Prescriptive Assistance for Humans:**
Transforming millions of pages of text into context-based step by step guides

**Safety through Autonomy:**
Autonomous Aircraft, Self driving cars

**Cognitive Security:**
Cyber defenses for 100 Billion “things”

**Optimization of Revenue & Events**
Broader and deeper analytics

*Artificial Intelligence Must Become a Critical Driver*
### AI will take enormous cost out of maintenance

<table>
<thead>
<tr>
<th>Prediction</th>
<th>Diagnostic</th>
<th>Optimization</th>
<th>Advisory</th>
<th>UI/UX</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sensor / system data to provide early warning system</td>
<td>• Identifying relevant correlations between sensor activity and system failures/warnings</td>
<td>• Optimize performance, corrective actions and maintenance</td>
<td>• Link probable repair to diagnostics procedures</td>
<td>• Integrate insights into handsfree visual device</td>
</tr>
<tr>
<td>• Build Models automatically</td>
<td>• Explainable AI</td>
<td>• Determine next best actions for allocation of equipment, resources and location</td>
<td>• Technician assist through repair and diagnostics</td>
<td>• Interact with machines and remote support technicians</td>
</tr>
<tr>
<td>• Secure end-points from cyber attacks</td>
<td></td>
<td>• Connect maintenance technician with engineering assist</td>
<td>• Collect data in the field using scanners</td>
<td></td>
</tr>
</tbody>
</table>

**Security**
Cognitive Prognostics
AI + AR
Prescriptive Assistance for Humans
GoDirect™
Connected Maintenance

RIGHT TIME TO REPAIR
Predict when a part will fail before it becomes an unscheduled event

RIGHT MAINTENANCE ACTION
Quickly know what corrective action has solved that problem most often in the past

RIGHT PART FOR THE JOB
Have the right part available when it is needed

RIGHT LABOR AVAILABLE
Have the right labor/skillset available for the repair

RIGHT PLACE FOR THE REPAIR
Have the right part available for the repair when needed

RIGHT INSTRUCTIONS
Have the instructions to repair/operate equipment readily available

An integrated vision that delivers top maintenance operational performance and gets smarter with time

Connected Honeywell Components
(APU, ECU, Wheels & Brakes, ECS, Mechanical)

Aircraft-wide maintenance log analytics, and diagnostic reasoning

Performance Based Contracts, and asset tracking

Ground Operations

Ground Operations

Maintenance Advisor
Connected APU Case Study

Explore Phase: **A330 Root Cause Analysis**
- Identified all root causes for APU disruptions (operations and service) from MEL events:
  - 60 A330 in fleet
  - 16 Mo. of Ops
  - 90K Flight Sectors
  - 327K Mx Tech Log Entries

- 13k APU Perf. Reports
- 570 APU Auto – Shutdown Reports
- 1.6M Flight Data Records

Investigate Phase: **Quantified MEL Reduction Analysis**
- Delivered a report in 8 weeks forecasting performance improvement using GoDirect Connected Maintenance Service:
  - 40% REDUCTION MEL Sectors
  - 51% REDUCTION IN DELAY MINUTES
  - 14 AVOIDED COMPONENT REPLACEMENTS
  - 1% FALSE REMOVAL RATE

Final Results: **Significant Reduction in APU MELs**

**A330 APU MEL Flights**

- Percentage of MELs eliminated
- Additional MEL reduction if action taken on all notifications
- New reduced MEL level

**WHAT IT IS**
Connected APU leverages existing aircraft data along with maintenance and shop records to provide a predictive and smart diagnostics solution.

**KEY PROBLEM SOLVED**
- Reduces APU related disruptions on MEL flights
- Reduces maintenance costs & delays

**HOW IT WORKS**
- Big data analytics approach
- Leverage AC data, operational Data, and shop data
- Generate reports to predict LRU failures

**CUSTOMERS**
- Cathay Pacific A330
- Hainan A330
- Unannounced A320
- Unannounced 777 (results 30-40% reduction in MELs)
- Unannounced 737

**FUTURE FEATURES & TIMING**
- Available on A330, A320 & B777
- In development on B737NG launching Q1 2018
WHAT IT IS
• Connected mobile + cloud platform designed to transform maintenance operations using advanced computing techniques and artificial intelligence

KEY PROBLEM SOLVED
• Increases aircraft availability by reducing maintenance execution times and digitally transforming maintenance operations.

HOW IT WORKS
• Advises line mechanics on which troubleshooting steps to follow, steps them through the right instructions, and captures and shares that information for reporting and communication with other stakeholders.
• Maintenance manuals are ingested into an advanced cognitive computer system, allowing simple natural language queries of any information in the entire set of maintenance manuals and delivery of step-by-step instructions from the manual via mobile or hands-free equipment.

CUSTOMERS
Platform is trial in progress, go live date is Q1 2018

FUTURE FEATURES & TIMING
• Presently we have developed the technology to ingest the maintenance manuals and perform natural language searches. Integration of the platform is underway. Step-by-step mobile interfaces and integrated stakeholder dashboards are future items.
Cognitive Security
Threat Vector Space for Aviation

- Host Level Protection
- Network Firewall
- Network Intrusion Detection System
- Information Systems Continuous Monitoring
- Security Information Event Management
- Vulnerability Scanning
- Boundary Protections
- OS Standard
- Cyber Risk Assessment
- Tabletop Mission Cyber Risk Assessment
- Supply Chain Risk Management (Trusted Networks & Systems)

Source: Cyber Threat Insider Blog
Malware Detected 6/50

Traditional Signature Based Security

Malware Detected 50/50

Cognitive Anti Malware

Cognitive Security
Wrap-up and Closing

Thank you to our Sponsor

Deloitte.