Operational Risk & SMS Synergy

- Airspace Safety -

Captain Andrew Elbert
Developed w/ Capt S. Kronenberger

30 Years of Safety
RYANAIR

Muchas Gracias
APROCTA y ENAIRE
y EUROCONTROL

30 Years of Safety
Safety Systems & HF — Airspace Safety

- Commercial Ops in Class E Airspace
- BLUF – Threats, Challenges, Limitations
- Facts-Based Risk Management
- SMS Challenges & Evolutions
- Contrails & Vectors

30 Years of Safety
SMS Components ICAO Annex 6, Part 1 (1.1.09)

- Policy
  - Continual Improvement, Methods & Structures

- Risk Management (Design)
  - Acceptable Risk; Need, Adequacy of Risk Controls

- Safety Assurance (Performance)
  - Evaluate Effectiveness, Identify New Hazards

- Safety Promotion (Outreach)
  - Training, Communication, Culture
**SMS Value**

- **Proactive**
  - Incident Investigation

- **Predictive**
  - Operational Data Collection, Analysis

- **Operational Benefits**
  - Monitors, Enables, Controls *Practical Drift*
  - Enhanced *Safety Space* Navigation
Ryanair Safety Policy & Objectives

“Our primary operations objective is to conduct our air transport activities safely”

“...at all times strive to operate to the “how do we do this safely” philosophy”
RYANAIR

Corporate Safety Strategy & SMS

RYANAIR CORPORATE SAFETY STRATEGY
2013 - 2016

30 Years of Safety
### Key Operational Risk Areas (’13 - ‘16)

**RYR KORAs (listed Alphabetically)**

<table>
<thead>
<tr>
<th>Key Operational Risk Area (KORA)</th>
<th>RYR</th>
<th>EU</th>
<th>IAA</th>
<th>UKCAA</th>
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<tbody>
<tr>
<td>Bird Strike</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controlled Flight into Terrain (CFIT)</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>De-icing (ICE)</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Ground Collision (GCOL)</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Loading error</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Loss of Control In-Flight (LOC-I)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Mid Air Collision (MAC)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Runway Excursion</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Runway Incursion</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Unreported ground damage</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Airborne &amp; Post Crash Fire</td>
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<td></td>
<td>X</td>
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<tr>
<td>Human Factors &amp; Performance</td>
<td></td>
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<td></td>
<td>X</td>
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<tr>
<td>OFDM</td>
<td></td>
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MAC Risk Management (Europe)

EAPAIRR (2009) & Cranfield Studies

“ ’See and avoid’ is seen as a potentially weak barrier in an IFR-VFR flight encounter and the need to strengthen the other barriers...is...reinforced”

EASA (2013)

• Develop actions/processes, preventative measure effectiveness

European Aviation Safety Plan ’14 -’17 (#2 Risk)

• 15 Member States, Only 15% Initiatives Implemented

EASA Directive (2014)

• ATM & Aerodromes will incorporate MAC mitigation
• See & Avoid Not Viable (FSF/ERA/EC Airborne Conflict Forum)
Facts Based Risk Management (‘08 – ‘15)

- 73 bases, 195 destinations, 31 countries
- 1800+ Daily Flights, 310 Boeing 737-800
- On Order:
  - 283 new Boeing 737-800
  - 100+ Boeing 737MAX
- Operational Data Treasure Trove, Unique Experience

**SMS Input:** > 500,000 Flts/Yr
### Facts Based Risk Management (‘08 – ‘15)

<table>
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<tr>
<th>CY</th>
<th>RYR Network</th>
<th>Germany &lt; FL250</th>
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<tr>
<td></td>
<td>FLTs</td>
<td>TCAS&lt;sub&gt;RA&lt;/sub&gt;</td>
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<tr>
<td>‘08</td>
<td>375,713</td>
<td>224</td>
</tr>
<tr>
<td>‘09</td>
<td>421,589</td>
<td>201</td>
</tr>
<tr>
<td>‘10</td>
<td>453,119</td>
<td>263</td>
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<td>‘11</td>
<td>493,661</td>
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<tr>
<td>‘12</td>
<td>516,684</td>
<td>165</td>
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<tr>
<td>‘13</td>
<td>523,746</td>
<td>167</td>
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<tr>
<td>‘14</td>
<td>530,537</td>
<td>132</td>
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<tr>
<td>‘15</td>
<td>437,370</td>
<td>237</td>
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ICAO: 1x10<sup>-8</sup> equates to 1 per 100,000,000 Flts

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Ryanair TCAS Statistics ‘08 – ‘15

- TCAS / AIRPROX Events – 200 (< FL100)
- HOTSPOTS – NRN (72), FMM (56), HHN (39) – 84%
- 65% on Vectors to Final

Typical Scenario (SID/STAR)

- Pilots Identify/Advise of TCAS Target on ND
- Pilot & ATC Radio Discussions: type, location, tracking
- Avoidance Action
- Inclination Trends (Pilot v ATC)
  - Pilots – Lateral Solutions prior TA, RA
  - ATC – Vertical Solutions prior CPA / RA
See & Avoid Human/Systemic Factors

- Airspace **Design**, Classification
- Airfield/Aircraft/Traffic **Density**
- Aircraft Type & Performance **Diversity**
- Judgement of Closure Rates
- Diverging Interpretations, Accepted Practices
  - Rules of the Air
  - Overreliance on TCAS?
  - “Well Clear” – Common Criteria?
### See & Avoid (TCAS)

<table>
<thead>
<tr>
<th>S (km/h)</th>
<th>120</th>
<th>160</th>
<th>200</th>
<th>LT Type</th>
<th>Fuselage</th>
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<tbody>
<tr>
<td>CR (m/s)</td>
<td>67</td>
<td>89</td>
<td>111</td>
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</table>

<table>
<thead>
<tr>
<th>Distance</th>
<th>Time to Collision</th>
<th>Visual</th>
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<tbody>
<tr>
<td>20km</td>
<td>300s</td>
<td></td>
</tr>
<tr>
<td>10km</td>
<td>150s</td>
<td></td>
</tr>
<tr>
<td>5km</td>
<td>75s</td>
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</tr>
<tr>
<td>4km</td>
<td>60s</td>
<td></td>
</tr>
<tr>
<td>3km</td>
<td>45s</td>
<td></td>
</tr>
<tr>
<td>2km</td>
<td>30s</td>
<td></td>
</tr>
<tr>
<td>1km</td>
<td>15s</td>
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</tbody>
</table>

**TCAS RAs Occur 25s prior CPA!**

**30 Years of Safety**
TCAS LIMFACs

• Selective Sight, Dynamic, Counterintuitive
  - B738 in DSCT, TCAS return on ND, TCAS TA
  - Crew reduced descent vertical speed
  - Shortly after, RA triggered a descent

• Cannot Predict “Intruder” Intentions
  - Prior to Takeoff, Tower informed about traffic along SID
  - ATC instructed increase/keep the climb-rate
  - Around 4000’ MSL, “Monitor Vertical Speed"
  - MVS Required Reduced Rate of Climb
TCAS LIMFACs — Overreliance/Well Clear

✓ Airport X, ILS, FAF 9nm 3000’ E/TMZ, CTR (7nm)
✓ ATC Warning "very slow moving traffic, 8NM final Rwy 27 at 2,500ft“ (Glider w/TPX, RT w/TWR)
✓ B738 discontinued approach, avoided
✓ Glider sighted, TA/RA "ADJUST VERTICAL SPEED"
✓ Glider pilot: "I'm full aware of the situation. We avoided the Boeing and they avoided us."
✓ No Collision = Coincidence, or System Design
✓ EDDN, AB - 14.05.15 (150-200’ V / 600’ H)
3.2.2.5.1 An aircraft in flight, or operating on the ground or water, shall give way to aircraft landing or in the final stages of an approach to land.

3.2.5...aircraft operated on or in the vicinity of an aerodrome shall, whether or not within the aerodrome traffic zone:

a) Observe aerodrome traffic for purpose of avoiding collision

b) conform with or avoid the pattern of traffic formed by other aircraft in operation
SMS Challenges – Airspace Design

• Airspace Design = Preventive Safety Barrier
  ✓ Factors = Events, IFR Mvts, Concentration, Composition
  ✓ Goals = Proactive, Safe & Reasonable

Mitigate, Protect, Benefit All Interests

SAFETY FIRST
SMS Challenges – Data

• Aviation, Industry Evolutions
  ✓ Drones, Ultra/Micro-lights
  ✓ Commercial Production Rates (1000 pa)

• Dissemination & Sharing
  ✓ Nat’l v Int’l Reporting Lines

• Determination
  ✓ Standardized Criteria, Protocols
  ✓ Standardized Assessment
SMS Challenges – System Synergies

- **Systems within System**
- **Reporting Channels (Ops, ATC, CAA)**
- **ECCAIRS**
  - Assist transport entities in collecting, sharing and analysing their safety to improve public transport safety
- **Alignment & Overlap**
  - Safe, Orderly, Efficient
  - Data Flows, Competing Interests
Challenges – SMS Interface

Present?

Future

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**Airspace Safety Outlook**

- **Policy & Objectives:**
  - Evolve towards Future TFC/TECH
  - See (ADS-B/FLARM) & Avoid (RNP, TCAS)
  - Overcome System Inertia

- **Risk Management:**
  - Safety = Moving Target, Facts/Events Based

- **Assurance & Awareness:**
  - Communication & Data Flow Synergies
  - Synchronize Systems = Safer by Design

**30 Years of Safety**
Airspace System, HF Considerations

- Common Criteria – Data Collection, Analysis
- Safety Relevant Event? AIRPROX v TCAS?
- Airspace Analysis Protocols Facts-Based?
- National Oversight of International Events?
- ECCAIRS – Incorporate
- System Inertia – Overcome & Evolve
  - “Good Enough” v Continual Improvement
  - Raphus Cullcatus Syndrome
Airspace Safety FAQ

Does TCAS RA Mean... *Safety System Worked*?

Or *Safety System Failed*?

Theory versus Practice

EGPWS(TERR) versus TCAS

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