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Operational Risk & SMS Synergy

- Airspace Safety -

Captain Andrew Elbert

Developed w/ Capt S. Kronenberger

30 Years of Safety

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Muchas Gracias
APROCTA y ENAIRE
y EUROCONTROL

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Safety Systems & HF — Airspace Safety

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

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

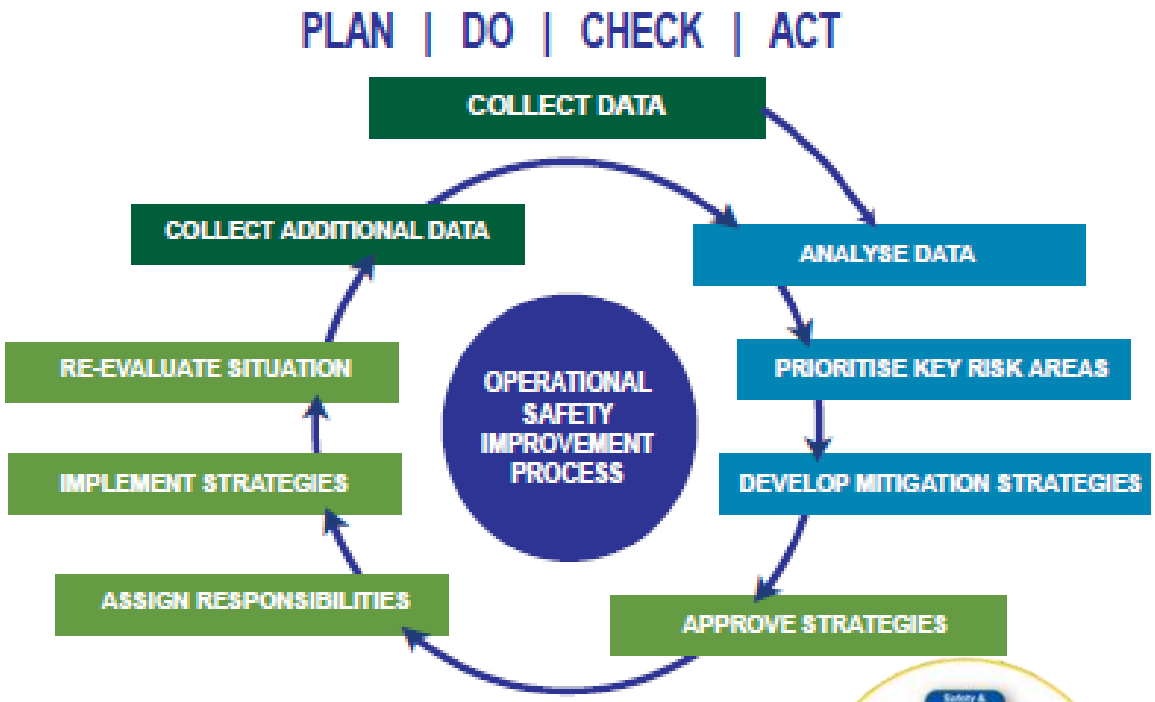
- ***Proactive***
  - ✓ *Incident Investigation*
- ***Predictive***
  - ✓ *Operational Data Collection, Analysis*
- ***Operational Benefits***
  - ✓ *Monitors, Enables, Controls* ***Practical Drift***
  - ✓ *Enhanced* ***Safety Space*** *Navigation*

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"

Corporate Safety Strategy & SMS



Key Operational Risk Areas ('13 -'16)

RYR KORAs (listed Alphabetically)

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

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

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Facts Based Risk Management ('08 – '15)

	RYR Network			Germany < FL250			
CY	FLTs	$TCAS_{RA}$	RATE	FLTs	TO/C	D/AP	RATE
'08	375,713	224	$5.96x10^{-4}$	30,111	18	16	$1.13x10^{-3}$
'09	421,589	201	$4.77x10^{-4}$	35,726	26	25	$1.43x10^{-3}$
'10	453,119	263	$5.80x10^{-4}$	38,743	38	32	$1.81x10^{-3}$
'11	493,661	199	$4.03x10^{-4}$	28,815	21	23	$1.53x10^{-3}$
'12	516,684	165	$3.19x10^{-4}$	57,932	22	12	$7.60x10^{-4}$
'13	523,746	167	$3.19x10^{-4}$	61,266	23	13	$5.88x10^{-4}$
'14	530,537	132	$2.49x10^{-4}$	25,676	15	6	$8.18x10^{-4}$
'15	*437,370*	*237*	*$5.42x10^{-4}$*	*21,625*	*8*	*20*	*$1.29x10^{-3}$*

ICAO: $1x10^{-8}$ equates to 1 per 100,000,000 Flts

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?*

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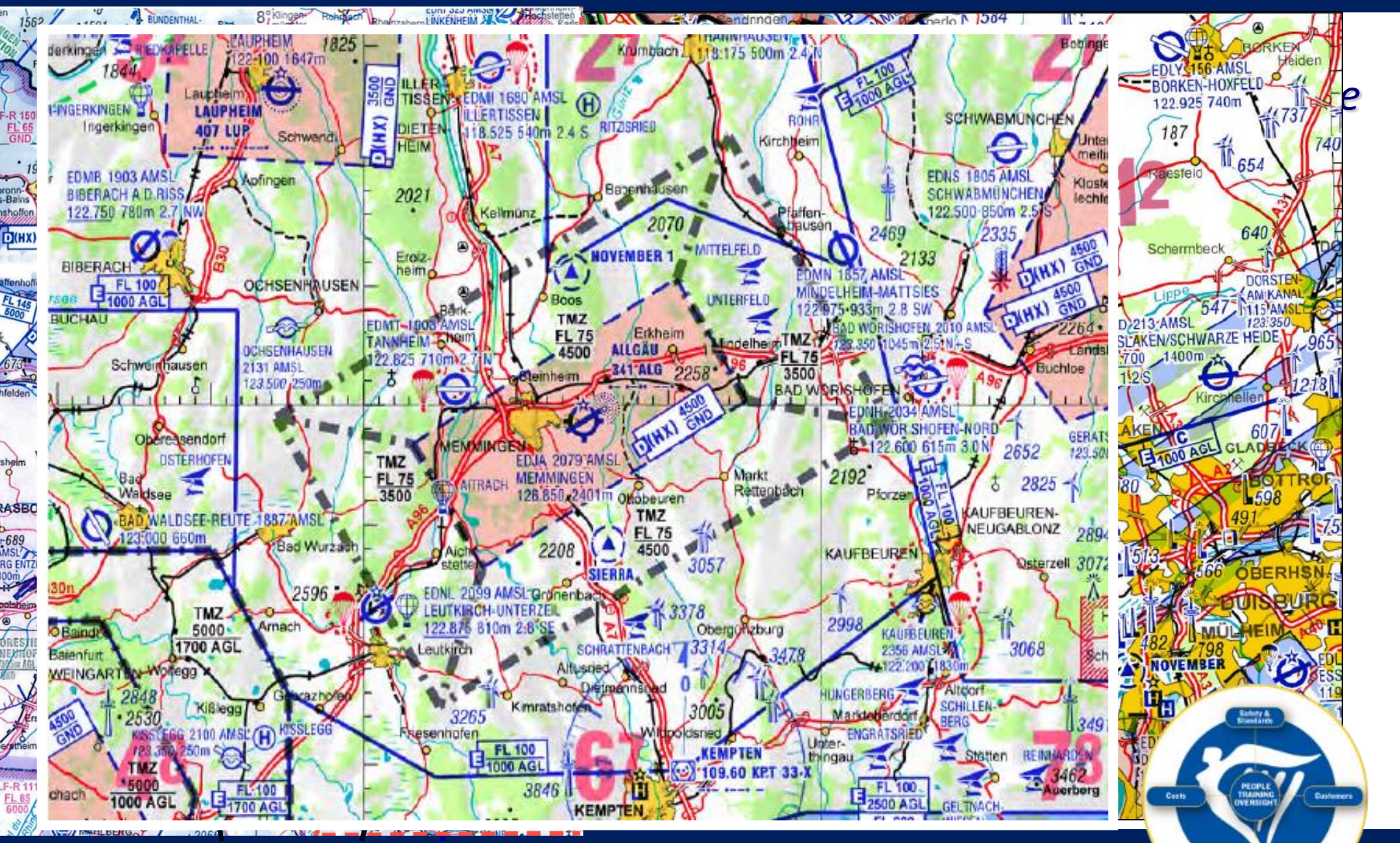

Europe's favourite low fares airline

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See & Avoid

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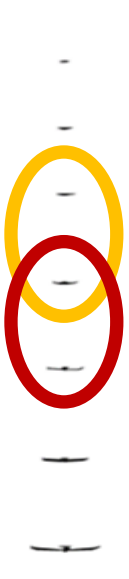
See & Avoid (TCAS)				
S (km/h)	120	160	200	LT Type Fuselage
CR (m/s)	67	89	111	
Distance	Time to Collision			Visual
20km	300s	225s	180s	
10km	150s	113s	90s	
5km	75s	56s	45s	
4km	60s	45s	36s	
3km	45s	34s	27s	
2km	30s	23s	18s	
1km	15s	11s	9s	

< TA

< RA

TCAS RAs Occur 25s prior CPA!

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)*

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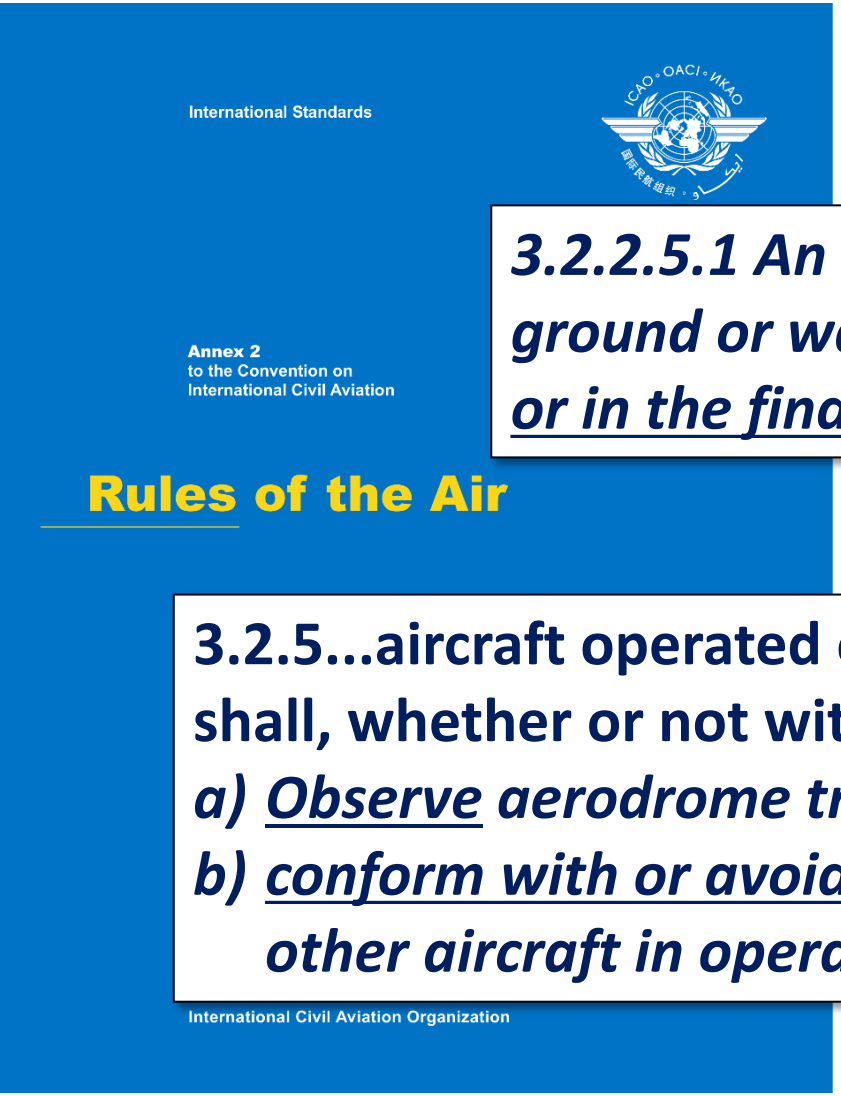
See & Avoid



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

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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

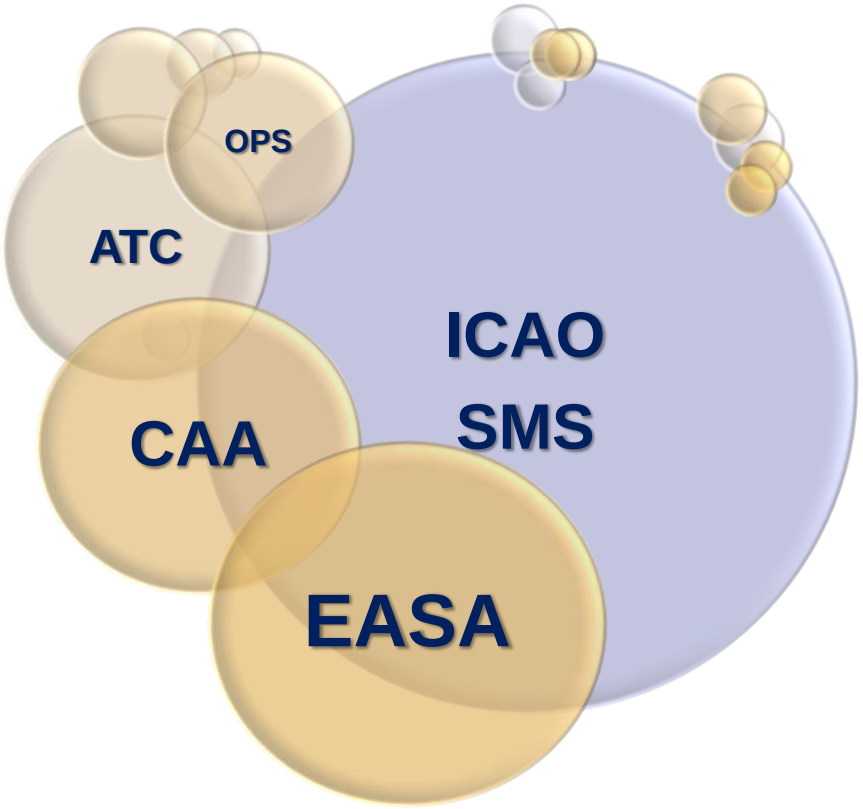
SMS Challenges – Data

- **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*

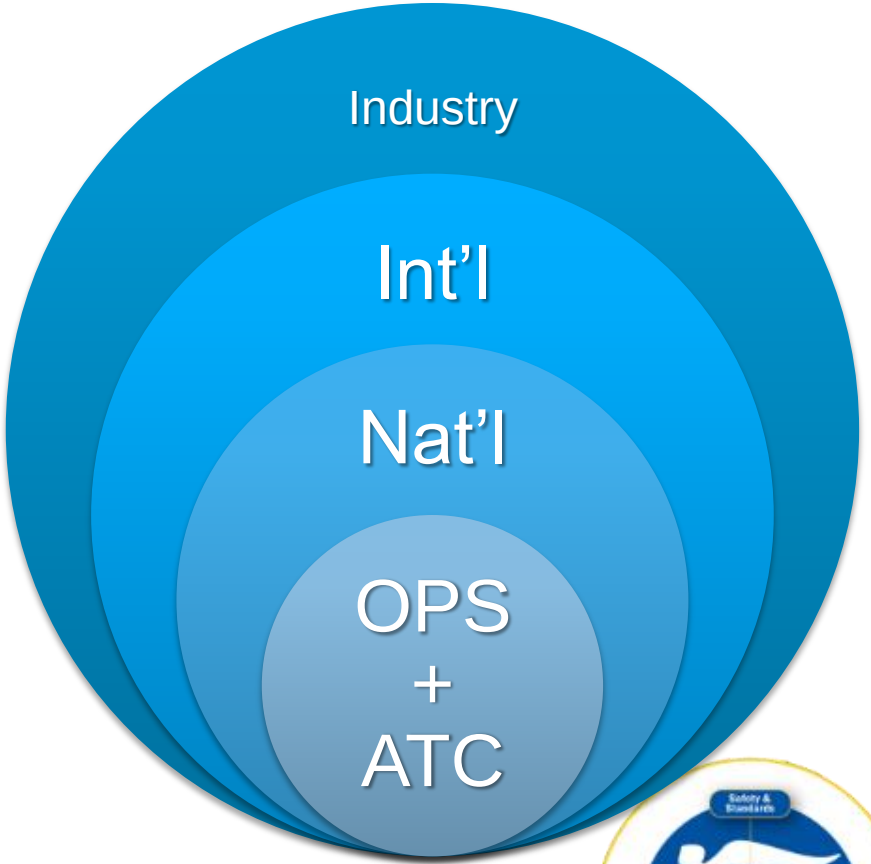
SMS Challenges – System Synergies

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

Challenges – SMS Interface



Present?



Future

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*

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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*

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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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