

Risk-based FDM Safety Performance Indicators

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Agenda

Background and Context

Conceptual Framework

Methodology and SPI Calculation

SPI Dissemination and Usage

Future Work

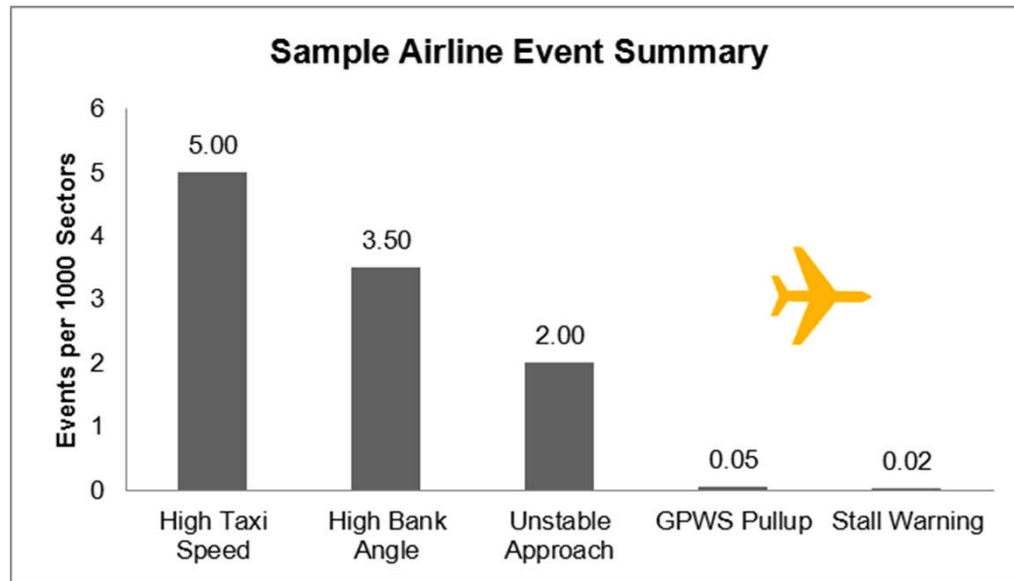
Risk Assessment for FDM Events to complete SMS data model



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- How can we generate meaningful information regarding the risk associated with FDM events?
- How can we be consistent with other data sources of the SMS for reporting?

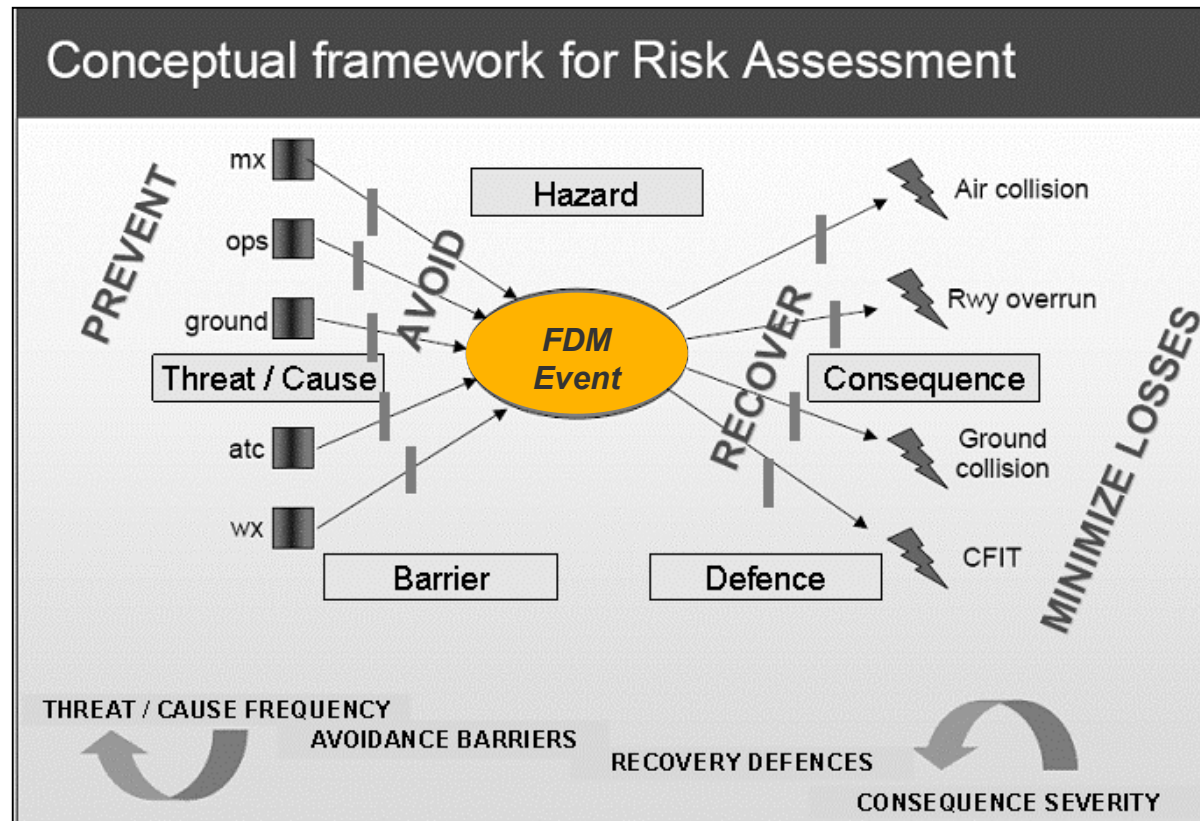
Current FDM practice does not provide quantified risk information



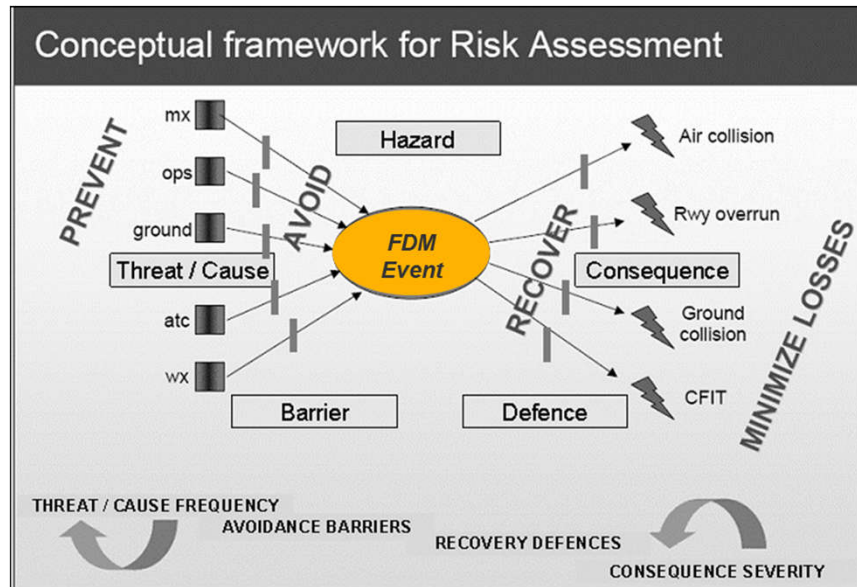
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- **Safety:** To avoid unacceptable risk (SMS concept). Continuous risk monitoring, mitigation and control is required.
- **Problem:** So where should we deploy our resources for risk mitigation and control?
- **Solution:** SPIs shall guide us by reflecting risk. Risk is expressed in severity and probability of the event's possible negative outcome. They are correlated to the event.
- **Challenge:** Severity as well as probability of an event have to be considered by an SPI.

Bow-tie model provides framework for FDM event risk assessment



Bow-tie model provides framework for FDM event risk assessment



Consequences

- Grouped by ICAO/CAST Occurrence Categories
- 16 categories are applicable for FDM events

Hazards

- Event frequency not a proper risk indicator
- Severity needs to be allocated to event type
- Weighting of events in categories required

Bow-tie model provides framework for FDM event risk assessment

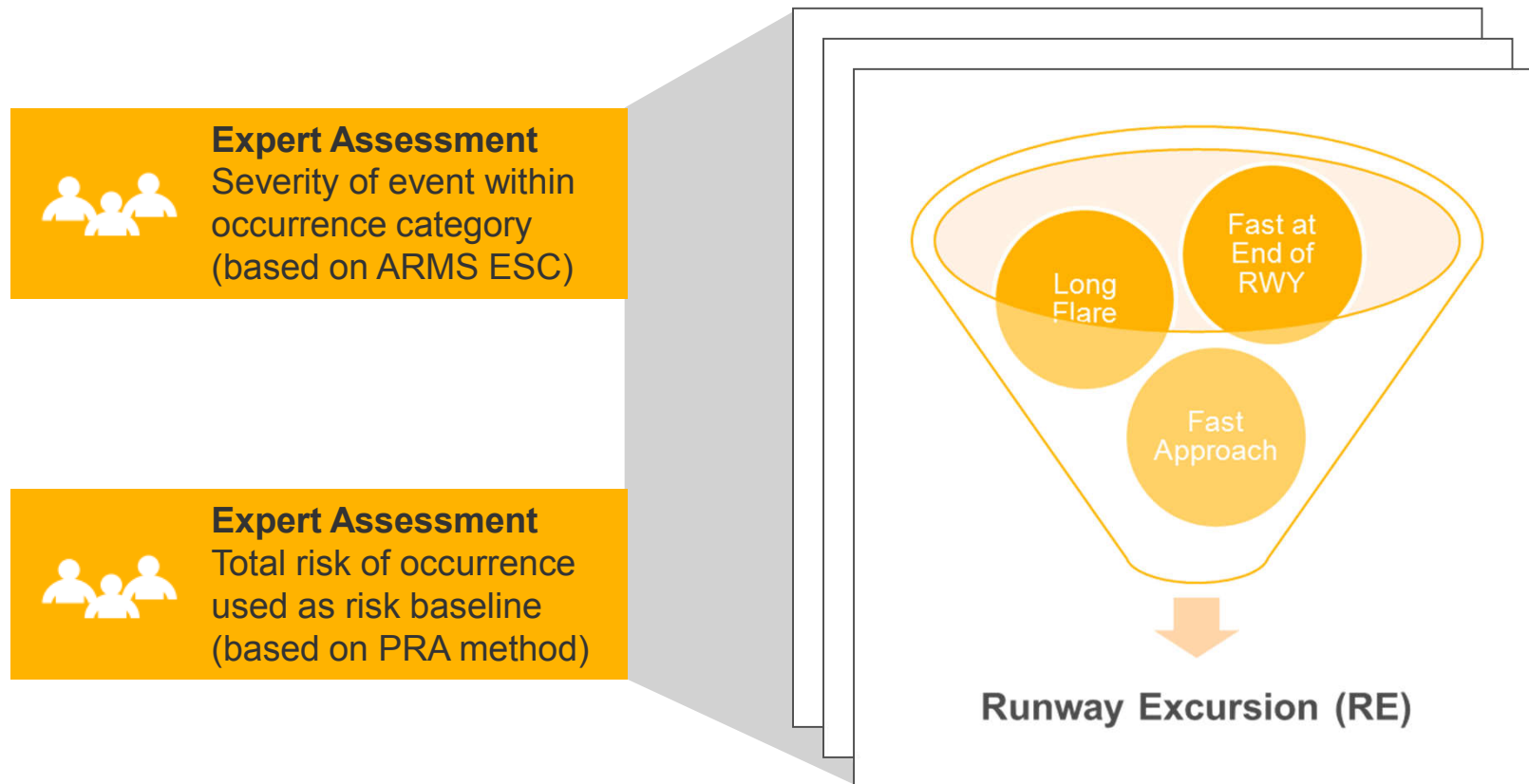
16 ICAO/CAST Occurrence Categories can be risk-assessed via FDM

Cover five of the „Significant Seven“ Accident Scenarios



- Abnormal runway contact (ARC)
- Controlled flight into or toward terrain (CFIT)
- Collision with obstacle(s) during take-off and landing (CTOL)
- Fire/smoke (non-impact) (F-NI)
- Ground Collision (GCOL)
- Loss of control - inflight (LOC-I)
- Airprox/ ACAS alert/ loss of separation/(near) midair collisions (MAC)
- Runway excursion (RE)
- Runway incursion - vehicle, aircraft or person (RI-VAP)
- System/component failure or malfunction [non-powerplant] (SCF-NP)
- Powerplant failure or malfunction (SCF-PP)
- Undershoot/overshoot (USOS)
- Loss of control - ground (LOC-G)
- Turbulence encounter (TURB)
- Windshear or thunderstorm (WSTRW)
- Abrupt manoeuvre (AMAN)

Merge expert knowledge with FDM data to generate risk information



Event severity allocated by assessment based on ARMS ESC




Event Severity Classification Matrix	Question 2: What was the effectiveness of the remaining barriers between this event and the most credible accident scenario? (answer below)						
Question 1: If this event had escalated into an accident outcome, what would have been the most credible accident scenario? (answer below)	Not effective (<90%)	Minimal (99%)		Limited (99,9%)		Effective (>99,99%)	
	1 accident out of 10 similar events	1 accident out of 30 similar events	1 accident out of 100 similar events	1 accident out of 300 similar events	1 accident out of 1.000 similar events	1 accident out of 3.000 similar events	1 accident out of 10.000 similar events
Loss of aircraft or multiple fatalities (3 or more) ¹ <i>Catastrophic Accident (S5)</i>	Event Severity a	Event Severity a-b	Event Severity b	Event Severity b-c	Event Severity c	Event Severity c-d	Event Severity d
1 or 2 fatalities, multiple serious injuries, major damage to the aircraft ² <i>Major Accident (S4, S3)</i>	Event Severity b	Event Severity b-c	Event Severity c	Event Severity c-d	Event Severity d	Event Severity d-e	Event Severity e
Minor injuries, minor damage to aircraft ³ <i>Minor Injuries or damage (S2)</i>	Event Severity c	Event Severity c-d	Event Severity d	Event Severity d-e	Event Severity e	Event Severity e	Event Severity e
No potential damage or injury could occur ⁴ <i>No accident outcome (S1, S0)</i>	Event Severity d	Event Severity d-e	Event Severity e	Event Severity e	Event Severity e	Event Severity e	Event Severity e

a – close call
b – heavy stuff
c – take seriously
d – interesting
e – nice to know

- Conduct ESC for event type (typical event), not a singular event instance.
- Fuzzy severity description provides additional guidance



Expert panel determines risk baseline for each ICAO/CAST OC

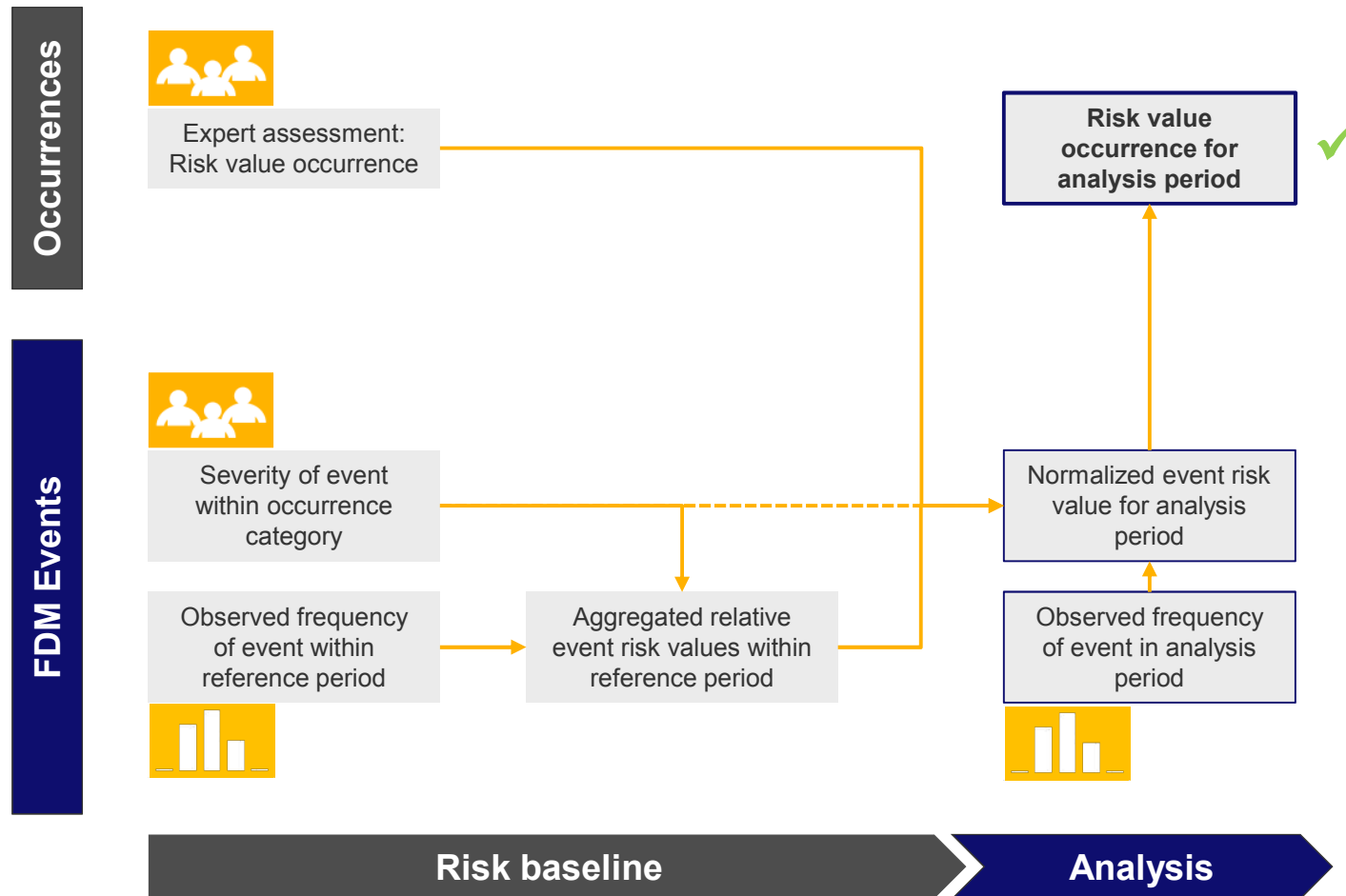


	Severity Level					
Probability Level	S5	S4	S3	S2	S1	S0
P5	A	A	B	C	D	E

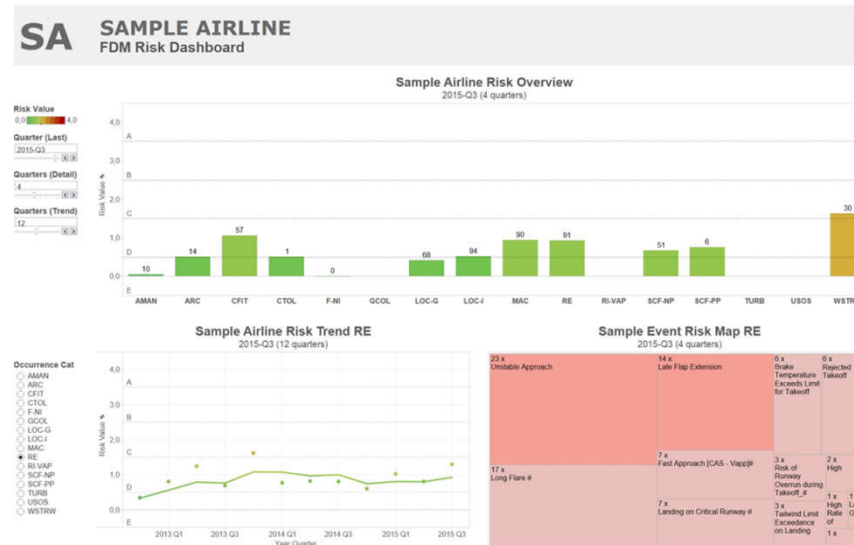
Severity per Event	Extreme	High	Medium	Low	Minor	None						
Upper Boundary	unlimited	20 Mio €	400,000 €	10,000 €	300 €	10 €		A	B	C	D	E
Lower Boundary	20 Mio €	400,000 €	10,000 €	300 €	10 €	0 €		B	C	D	E	E
Aircraft Accident or Incident/Injury	Total Loss or Hull Loss	Accident with serious injuries or fatalities, or significant damage to aircraft	Serious incident with injuries and/or substantial damage to aircraft	Incident with minor injury and/or minor aircraft damage	Incident with discomfort and/or less than minor system damage	No damage or injury		B	C	D	E	E
Severity Level	S5	S4	S3	S2	S1	S0		C	D	E	E	E

Probability of Event per Flight	Very High	High	Medium	Low	Very Low	Rare	Remote					
Value	7,30E-03	9.00E-04	1.00E-04	1.00E-05	2.00E-06	2.00E-07	2.00E-08		C	D	E	E
One out of flights	140	1100	10000	100000	500000	5000000	50000000		D	E	E	E
Lower Boundary	always	3,5 per day	2,9 per week	1,3 per month	2,2 per year	every 3,2 years	every 32 years					
Occurrences in the Airline	10 per day	once per day	once per week	every two months	every year	every 10 years	every 100 years					
Upper Boundary	3,5 per day	2,9 per week	1,3 per month	2,2 per year	every 3,2 years	every 32 years	every 320 years					
Probability Level	P5	P4	P3	P2	P1	P0	Pe					

Risk for each category is then calculated relative to baseline



Airline risk dashboard provides insight down to event level



Components of the risk dashboard

- Risk overview by category based on quarter and year views
- Risk trend information by occurrence category
- Event risk map delivering information on event frequency and event risk weight
- Dashboard is interactive allowing the user to adjust time periods and filter for occurrence categories

Future work has to been done to improve model

1

Improve Detail Level

- Reviewing Pilot should be able to adjust weight of individual events
- Replace average severity for event type by severity for event instances

2

Improve Trend Analysis

- Model depends on sufficient number of FDM events to produce a meaningful risk trend
- Use lower-threshold FDM events (precursors)

3

Additional Risk Information

- Introduce calculation of individual flight risk



Thank you!
Your feedback and comments are welcome.

