Risk modelling:
from safety data to a risk picture

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EUROCONTROL - FSS P4
Models within the Risk Observatory

Structuring of safety data → Feed into integrated risk assessment framework

Acquire safety information

FDM data
Occurrence data
Exposure data
....

User:
Analyst
Manager

Domain:
Operator
ANSP
Manufacturer
Airport Authority

Prototype risk observatory

SAFETY | FUTURE SKY

16 March, 2017
Currently available ....

Different types of models, with different scope and purpose, using different type of data ...

- barriers based,
- event sequence diagrams,
- physical models,
- safety models for design, ...
Barrier Model

MAC

<table>
<thead>
<tr>
<th>Accident risk</th>
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<tbody>
<tr>
<td>Providence</td>
</tr>
<tr>
<td>Near Collision</td>
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<tr>
<td>Imminent Collision</td>
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<tr>
<td>Imminent infringement</td>
</tr>
<tr>
<td>ACAS</td>
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<tr>
<td>STCA</td>
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<tr>
<td>Tactical</td>
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<tr>
<td>Planning</td>
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<tr>
<td>DCB</td>
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<td>Strategic PIn</td>
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Precursors

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<thead>
<tr>
<th>Groundside Induced</th>
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<tbody>
<tr>
<td>Airside Induced</td>
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Induced Events

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<tr>
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<tr>
<td>Pre-Tactical</td>
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<tr>
<td>Tactical</td>
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</tbody>
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Barriers

Causal elements

Cont Cont Cont Cont Cont
Event Sequence Diagram
Physical Models

Contributing Factors

- Weight
- Wind
- Speed
- Flaps
- Start of Braking
- ...

Runway overrun

Incident Model

Landing distance available

Source: The Aviation Herald / AP / Kyodo News

Technische Universität München
Safety Models for design

Flight Phases
- Cruise
- Descent
- Approach
- Landing
- Go-Around

Procedure inhibit or customization

A/C initial state(s)
Transition level
- 500 ft
- 100 ft
- DH/MDA

External events / factors
Influencing factors (environmental events, runway characteristics & condition, ...)

Aircraft Functions & Systems
- A/C Functions
  - System Breakdown & Dependencies
- Observations
- System controls
- Cockpit HMI:
  - PFD/ND parameters
  - CAS alerts
  - Control Panels, etc.
- Cockpit effects

FHA - System Failure Conditions
- Observations
- Actions on systems
- FC initiation
- Initial state(s)
- External events / factors
- Procedure inhibit or customization

Pilot Abnormal Procedures
- Crew abnormal procedure:
  - triggered by an alert or others cockpit effects

Aircraft Functions & Systems
- Determine Cockpit HMI parameters, CAS alerts, Control Panels, etc.
- Observations
- System controls
- Cockpit effects

Cockpit HMI:
- Four Displayed Data (FDD)
- Instrument Panel (IP)
- Multi-Function Display (MFD)
- Navigation Display (ND)
- Flight Display (FD)

Cockpit effects:
- Master Caution Flashing
- CAS alerts
- Control Panels
- etc.

A/C Functions
- System Breakdown & Dependencies
- Observations
- System controls
- Cockpit HMI:
  - PFD/ND parameters
  - CAS alerts
  - Control Panels, etc.
- Cockpit effects

FHA - System Failure Conditions
- Observations
- Actions on systems
- FC initiation
- Initial state(s)
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From ‘piecemeal’ view to the full picture...
Structuring the Risk Observatory

Need for a Risk Observatory structured in a way allowing to ‘plug’ different types of models in order to provide

- a full risk picture
- the risk associated to the several contributors of the different domains

BackBone Model
Backbone models

Safety Indicators

Contributing Factors

Influencing Factors

RO INTERFACE

BACKBONE MODELS

DOMAIN / SPECIFIC MODELS

MAC ER

RWY EXC

16 March, 2017

SAFETY | FUTURE SKY
Short Term Conflict Alert (STCA) functional chain

Backbone multi-domain model for STCA contributor factor

Adapation model to link backbone model to domain specific models

Domain-specific model

Ground equipment models

Airborne equipment models

Incident description:

- STCA tool fails to give effective warning in time
- Incorrect input data provided to STCA tool
- Incorrect STCA display
- Incorrect STCA processing
- Incorrect on-board transponder data (3D position, ID, DAPS)
- Surveillance technical failure
- Insufficient STCA Tool configuration integrity
- Insufficient STCA Tool reliability
- Insufficient STCA Tool configuration integrity
- Insufficient STCA Tool software integrity
- Insufficient STCA Tool hardware reliability (screen, graphic card, …)
- Insufficient operational configuration of STCA Tool (filtering in inhibition zones)

How it looks like …
Contributing Factors - Influencing Factors

Generic Contributing Factors

Specific Contributing Factors per domain:
- ANSP
- AC manufacturer
- Airborne SYS manufacturer
- Operator
- Ground SYS manufacturer

Mainly one to one

Mainly many to many
Risk Overview for current situation

**Occurrences and Risk**

- Mid-Air Collision
- Near Mid-Air Collision
- Separation Minima Infringement
- Tactical Conflicts
- Overloads

**Safety Indicators**

- SMI / RIN / AI (per 100k movements)
- Fire-risk
- Generic contributing factors (2 level of items max.)

**Risk Areas**

Ref. | Generic contributing factors (2 level of items max.)
--- | ---
31 | Airborne collision avoidance
32 | ATC collision prevention
33 | Tactical Conflict Management - Separation provision
34 | Traffic planning & coordination
35 | Airspace infringements Management
36 | AC Deviation Management
37 | Trajectory management
38 | Flow & Capacity management
Risk impact assessment for a specific change or situation

Risk Impact when modifying:

Contributing factors

Influencing factors
P4 - Total system risk assessment

- Providing a full risk picture
- Showing the contribution to risk from the several domains
- Supporting the safety impact assessment of changes within one or several domains

Models

P4 will deliver a Proof of concept, including the modelling part. Implementation, maintenance and operational use aspects in a real environment are beyond the timeframe of P4.
Consortium

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