NLR Air Transport Safety Institute

Research & Consultancy

Development and Validation of a Comprehensive Hybrid Causal Model for Safety Assessment and Management of Aviation Systems

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- **Background & objective**

- **Model architecture**

- **Quantification**

- **Validation**

- **Software tool**

- **Conclusion and recommendations**
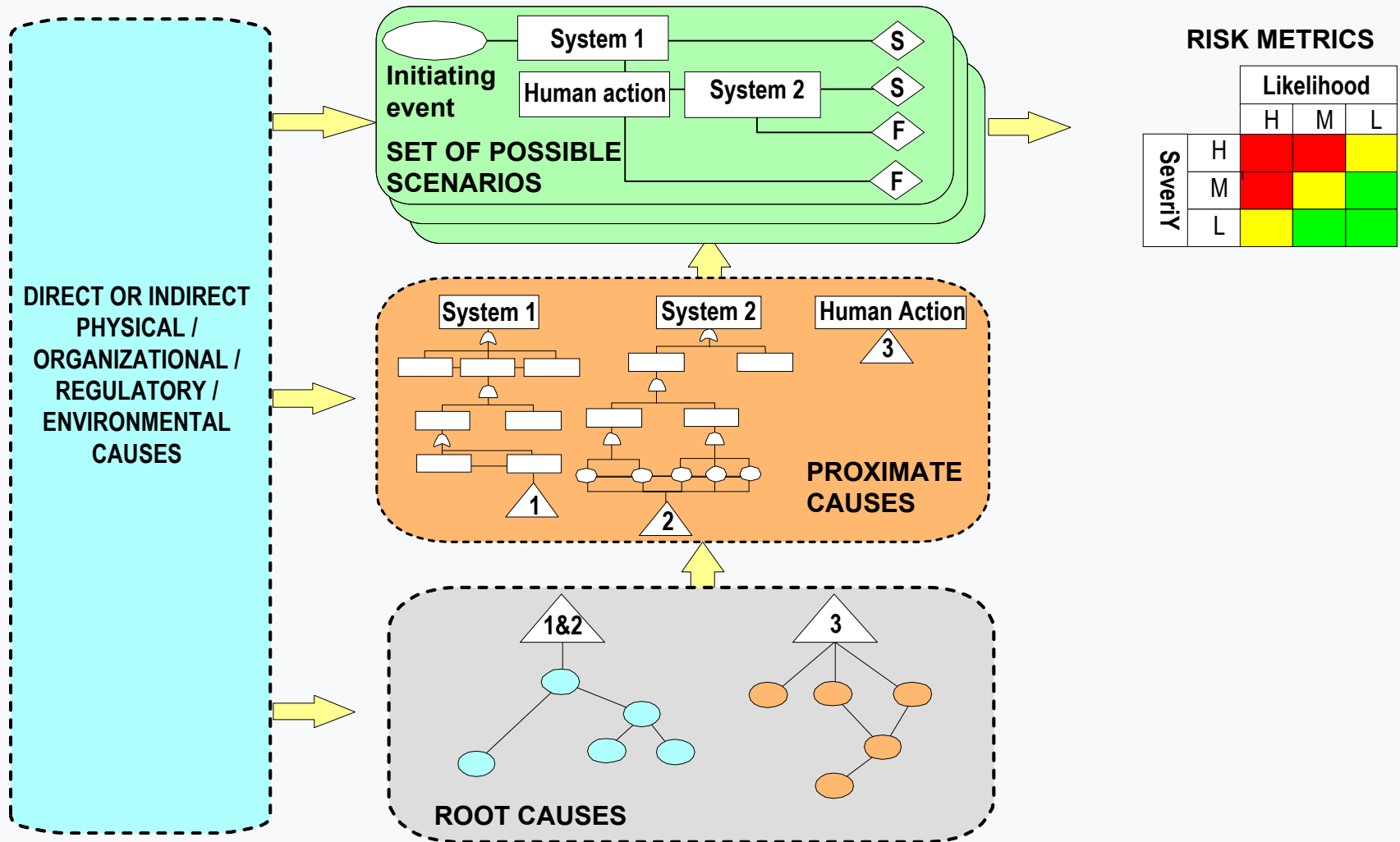
Background

Systems Approach for Safety Oversight

Objective

Method to

- **identify hazards**

- **asses risks**

for commercial aviation

in support of risk based inspection.

Hybrid model architecture

RISK METRICS

		Likelihood		
		H	M	L
Severity	H			
	M			
	L			

Generic accident scenarios

Accidents are not random sequences of events.

Example of a generic accident: Take-off with a contaminated wing followed by loss of control and crash.

Date	Airline	Aircraft type	Location	Weather
13 January 1982	Air Florida	Boeing 737-200	Washington, D.C. USA	-4 degrees Celsius. Heavy snowfall.
5 February 1985	Airborne Express	Douglas DC-9-15	Philadelphia, Pennsylvania, USA	-2 degrees Celsius. Ice pellets, snow.
15 November 1987	Continental Airlines	Douglas DC-9-14	Denver, Colorado, USA	-2 degrees Celsius. Moderate snow.
10 March 1989	Air Ontario	Fokker F-28	Dryden, Ontario, Canada	+ 2 degrees Celsius. Locally heavy snow.
17 February 1991	Ryan International Airlines	Douglas DC-9-15	Cleveland, Ohio, USA	-5 degrees Celsius. Light snow.
22 March 1992	USAir	Fokker F-28	Flushing, New York, USA	0 degrees Celsius. Drifting snow.
5 March 1993	Palair Macedonian	Fokker 100	Skopje, Macedonia.	0 degrees Celsius. Moderate snowfall.

Western-built large jet aircraft, 1982-1993

Rapport préliminaire

Accident survenu le **25 janvier 2007**
sur l'**aérodrome de Pau Pyrénées (64)**
au **Fokker 28-100**
immatriculé **F-GMPG**
exploité par **Régional**

BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

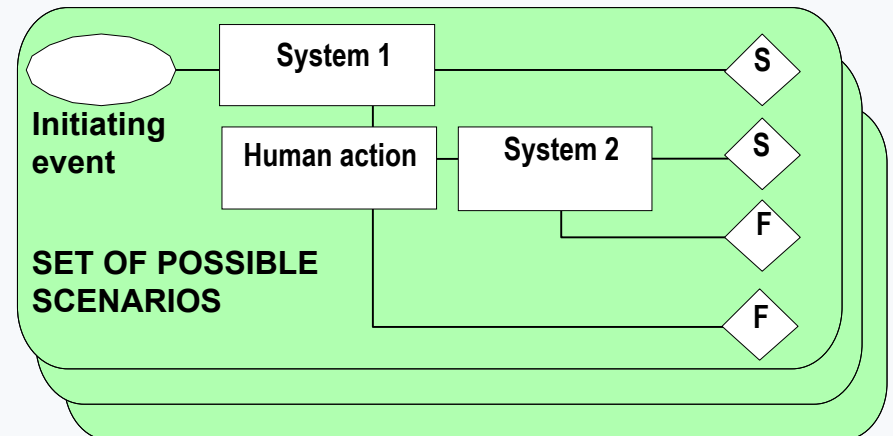MINISTERE DES TRANSPORTS, DE L'EQUIPEMENT, DU TOURISME ET DE LA MER

Model backbone

31 generic accident scenarios represented as ESDs

Cover all flight phases

Represent all possible accident types

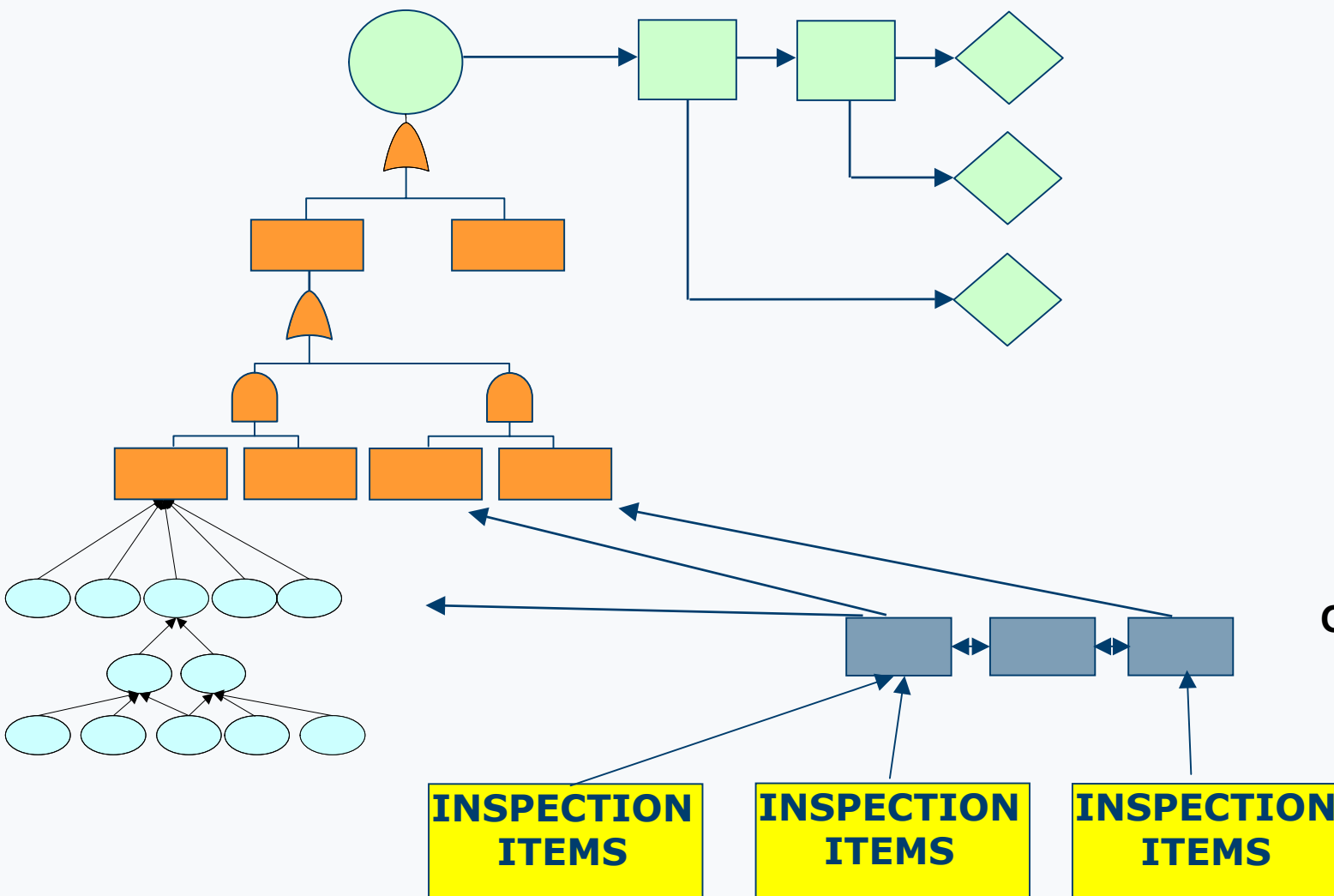**These generic accident scenarios are the backbone of the causal risk model**

ACCIDENT SCENARIO

OPERATIONAL PROCESS

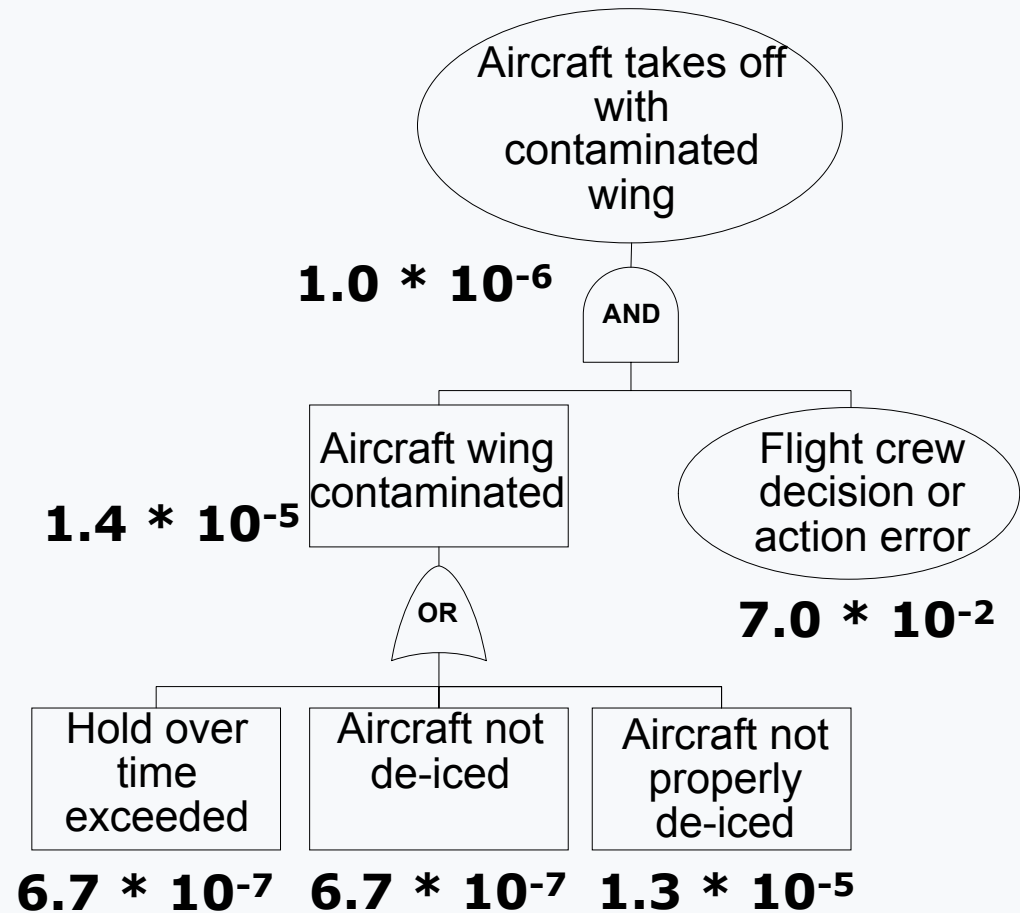INSPECTION ITEMS   INSPECTION ITEMS   INSPECTION ITEMS   OVERSIGHT DATA

Quantification

Probabilities are obtained from

- databases
  - accidents
  - incidents
  - operational data
  - exposure data
- expert judgement

Aircraft takes off with contaminated wing

$1.0 * 10^{-6}$

AND

Aircraft wing contaminated

$1.4 * 10^{-5}$

Flight crew decision or action error

$7.0 * 10^{-2}$

OR

Hold over time exceeded

Aircraft not de-iced

Aircraft not properly de-iced

$6.7 * 10^{-7}$ $6.7 * 10^{-7}$ $1.3 * 10^{-5}$

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Example – overrun accidents

Comparison of results

	FAA HCL Model 1990–2004	NLR study 1980–2004	Boeing study 1990–1999	NLR study 1970–2004
Take-off overrun	1.27×10^{-7}	1.36×10^{-7}	1.4×10^{-7}	
Landing overrun	4.17×10^{-7}	3.87×10^{-7}		5.0×10^{-7}

Integrated Risk Information System – IRIS
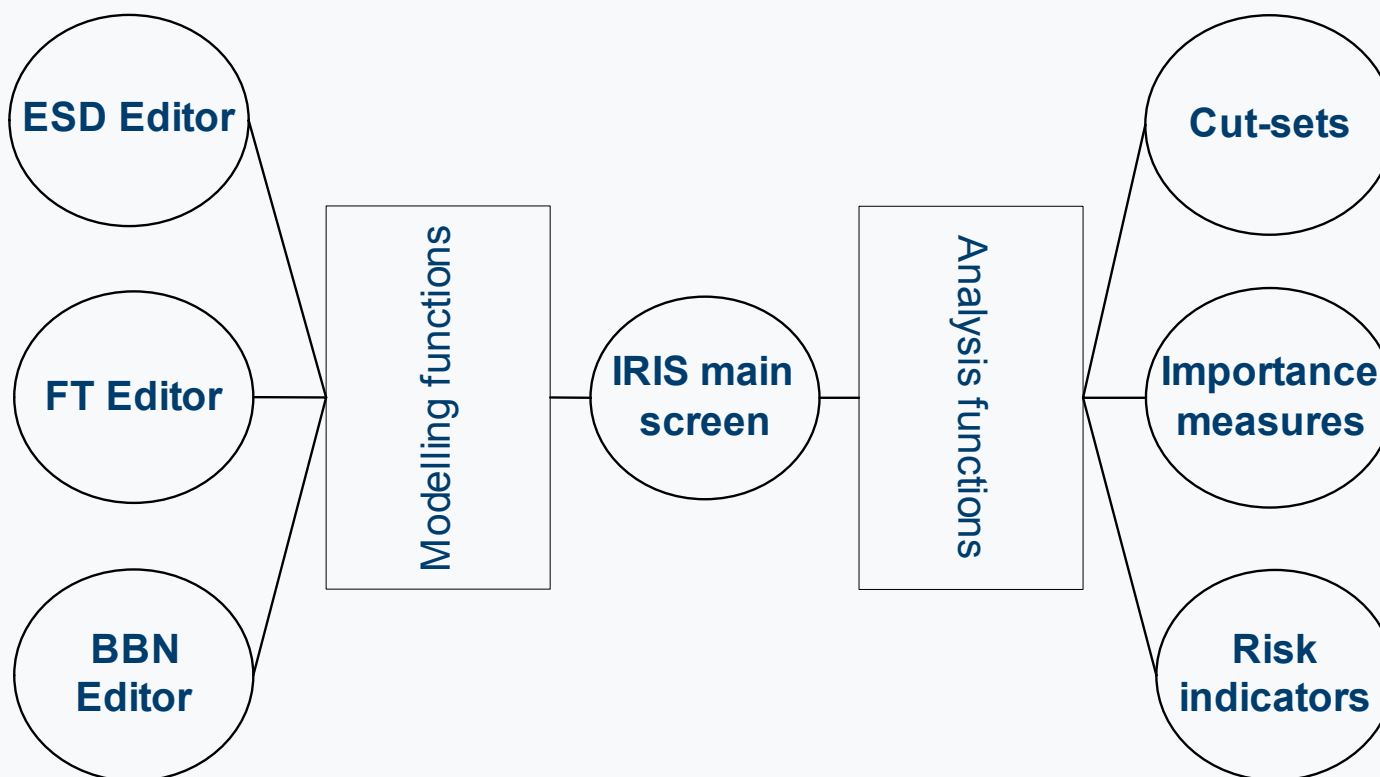
Software tool application

Support

- **Hazard identification**

- **Hazard / risk assessment**

- **Risk based inspection**

By

- **Principal Inspectors**

- **Operational Research Analysts**

- **FAA headquarters staff**

Conclusions and recommendations

Model is a prototype

- Needs to be operationalized

Model should be linked directly to data system

Further research required on representation of

- Social-economic factors

- Organisational factors