Development of the Safety Case for the CREDOS operation

WakeNet Workshop, 8/9 January 2009

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CREDOS Project Objectives

- **Demonstrate feasibility of operational concept for crosswind reduced separation during single runway departures**
  - **Safety, Human Factors, Business, and Environmental Cases**
- **Provide stakeholders (airlines, airports, ANSPs) with required information for implementation in the near term (pre-2012)**
  - **Validation of concept and support tools**
  - **Outline local safety case**
  - **Recommendations training & technology requirements**
- **To increase the body of knowledge concerning WV behaviour during the initial climb phase of flight**

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Operational Objectives

- **To temporarily increase departure runway throughput; to absorb capacity peaks or reduce departure delays during crosswind conditions (*criteria to be decided*)**

- **To safely suspend or reduce WV separation minima for departure operations under specific crosswind conditions, optimally allowing a spacing equal to 3 NM**

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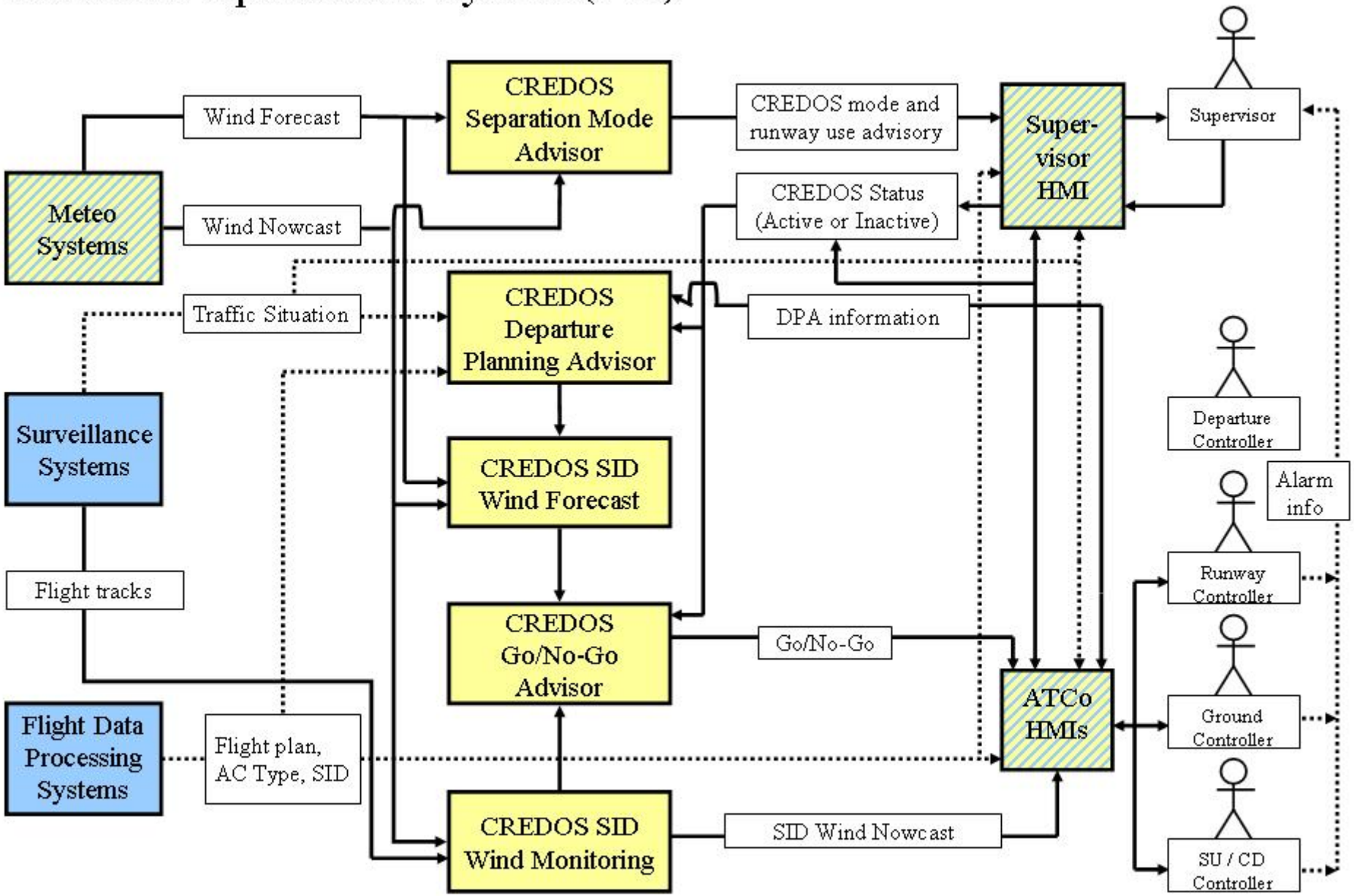
CREDOS Operational System (V1.0)



CREDOS Safety activities

Wake vortex safety management (WV SMS)	***Completed***
Plan for ESARR4 conformance	***Completed***
Functional Hazard Assessment (FHA)	***Completed***
Preliminary System Safety Assessment (PSSA)	**Ongoing**
Preliminary Safety Case (PSC)	**Ongoing**

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ANSP WV Safety Management Why?

- **ICAO SARPs requires that authorities establish a safety programme, and states that implementing this requires a SMS for all aviation organisations**
- **ESARR3 specifies the required European use of SMS (and its content) by ANSPs in more detail**
- **WV SMS is to ensure that a newly proposed ATM operation for reduced aircraft WV separation – after its introduction – *if it is safe, remains safe***

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ANSP WV safety management What?

- **ESARR3 compliant wake Vortex Safety Management System recommendations have been established**
- **Five *WV safety policy* statements are proposed**
- ***WV safety achievement* via safety assessment, quantitative safety levels, safety occurrence analysis**
- ***WV safety assurance* via WV safety surveys, WV safety records, and risk management processes**
- ***WV safety promotion* via dissemination of lessons learned, WV safety articles, bulletins, and alerts**

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ANSP WV safety management Recommended WV policy

1. Reduction of airport separation minima shall be based on ground based wind prediction systems to support actors
2. Where possible, they should be supplemented by ground based WV detection systems. Airborne WV DWA systems are recommended as a safety net in support of ATC only.
3. In case reduced aircraft separation is being applied, data on actual aircraft separations shall be gathered and analysed. Deviations are to be reported to the (national) authorities.
4. Detailed reports on WV incidents/accidents shall be gathered and shall comprise an ATCO part and a pilot reporting part.
5. As part of the annual safety report to the authorities, an ANSP shall give specific attention to WV incidents and accidents.

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ANSP WV safety management Implementation issues

- ANSPs have an operational SMS & Normal Operations Safety Surveys are being carried out; but the Wake Vortex component should be added to existing SMS
- ANSPs usually have incident/accident database; but WV safety performance indicators/targets are to be added
- ATCos shall (together with pilots) be able and willing to report WV encounters and separation infringements
- Availability of Flight Data Analysis (FDA) or FOQA data for Wake Vortex safety investigation purposes
- Availability supporting software/databases (ADREP, ECCAIRS, QAR, ASR, WAVENDA) for incident analysis

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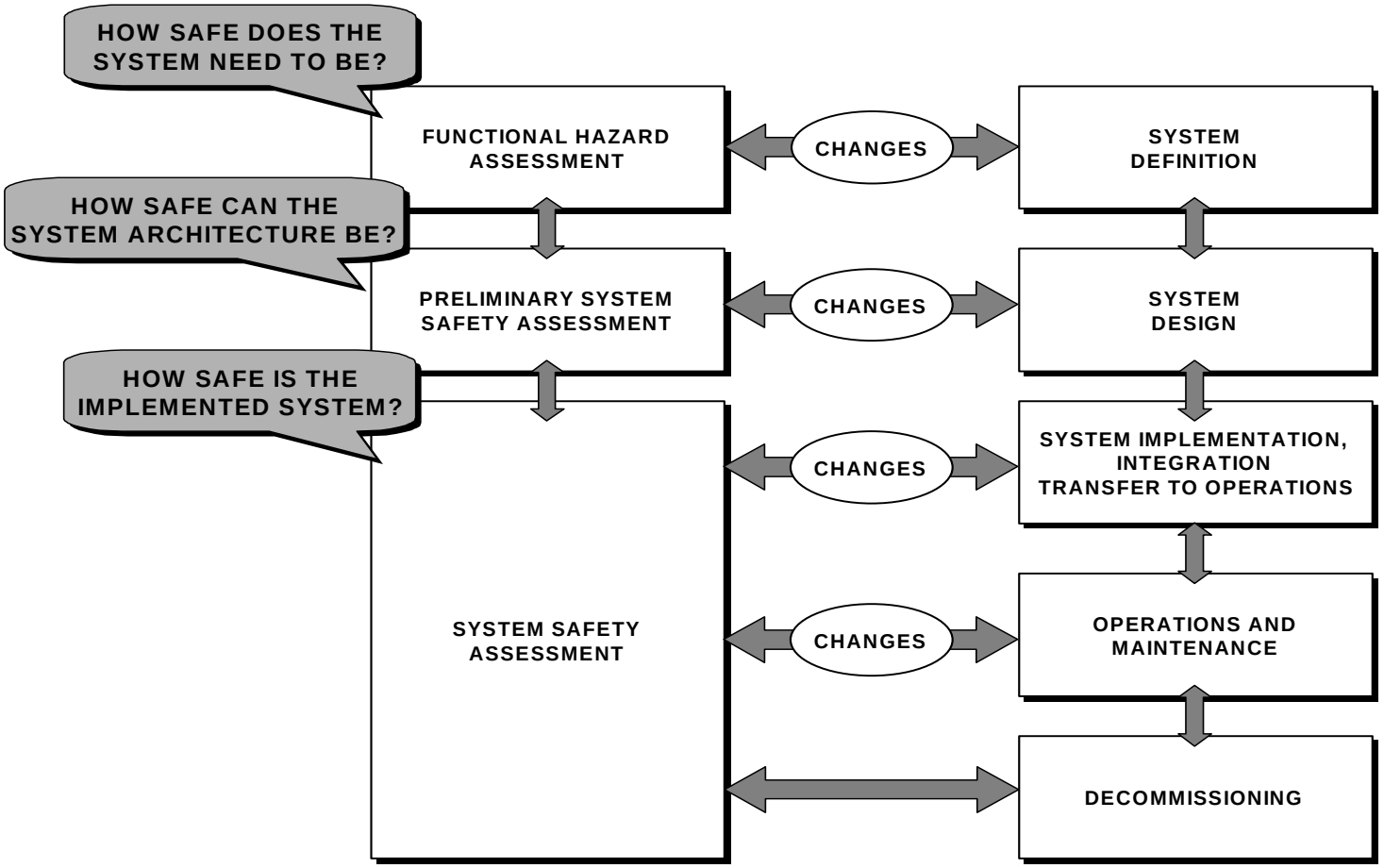
Plan for ESARR conformance
SAM Methodology

Crosswind-reduced Separations for Departure Operations



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Functional Hazard Assessment
Safety Objectives Specification

Crosswind-reduced Separations for Departure Operations

FHA-SOS

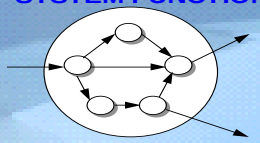
Brainstorming

FUNCTIONAL

HAZARD IDENTIFICATION

WHAT CAN GO WRONG ?

LOSS OR DEGRADATION OF SYSTEM FUNCTIONS



HAZARD EFFECTS IDENTIFICATION

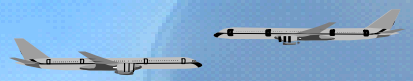
WHAT ARE THE POTENTIAL CONSEQUENCES?

POTENTIAL IMPACT ON THE SAFETY OF THE PROVIDED SERVICE

EFFECTS SEVERITY CLASSIFICATION

HOW SEVERE ARE THE CONSEQUENCES?

CONTRIBUTION TO THE RISK OF AN AIRCRAFT COLLISION



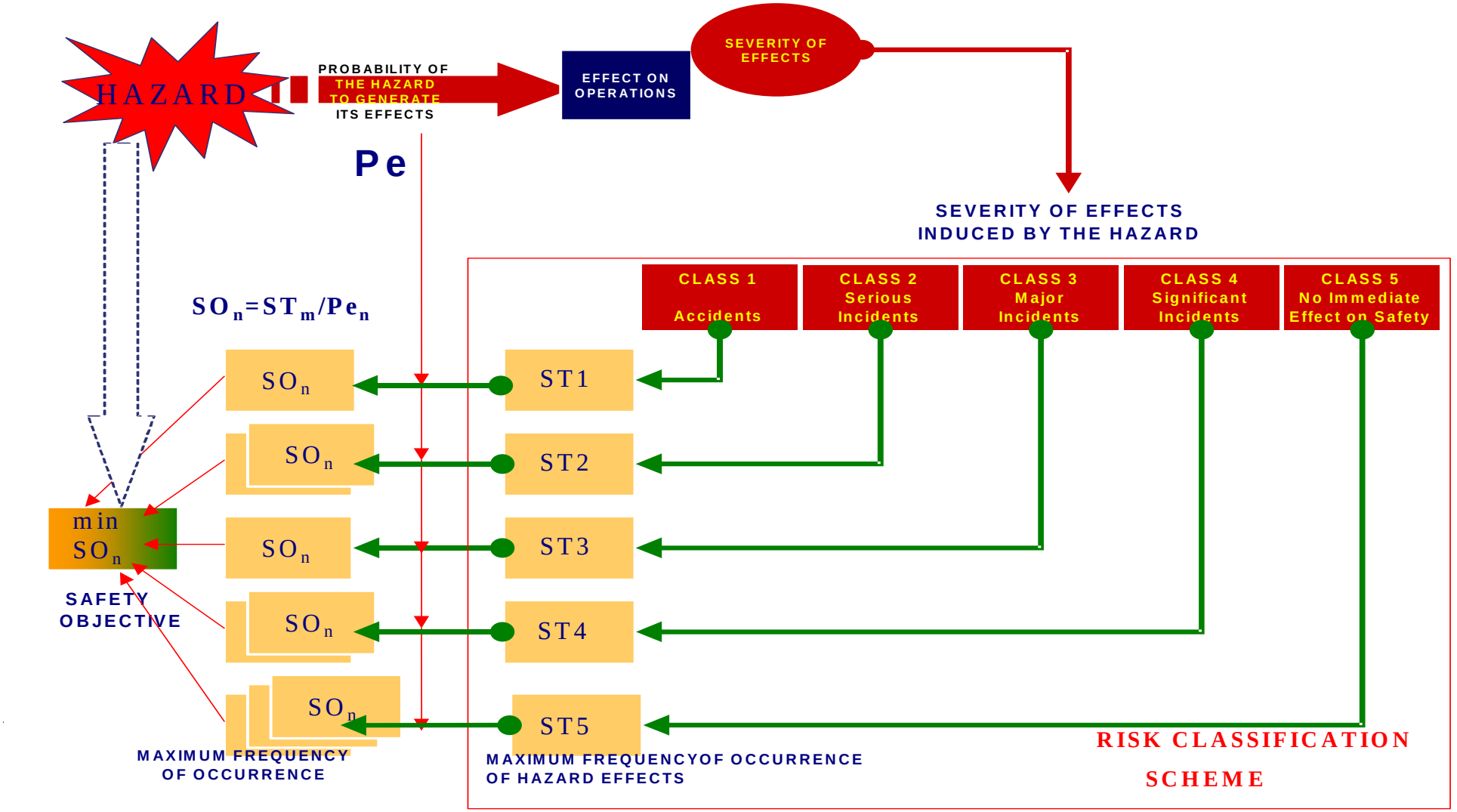
SAFETY OBJECTIVES SPECIFICATION

HOW SAFE DOES THE SYSTEM NEED TO BE?

EUROCONTROL

Functional Hazard Assessment
Safety Objectives Method

Crosswind-reduced Separations for Departure Operations



Functional Hazard Assessment Safety Objectives

Crosswind-reduced Separations for Departure Operations

Main hazard ID	Description	Severity of worst effect	First indication of Safety Objective (per hazard / per take-off)
M1& M2	CREDOS operation active while wake turbulence advisory is not correct (detected and undetected)	1	$1*10^{-8}$
M3	Runway controller applies CREDOS while conditions are not met (CREDOS system functions correctly)	1	$1*10^{-8}$
M4	Runway controller applies CREDOS with less than 3 NM while CREDOS conditions are met.	5	Not safety related
M5	Separation is less than ICAO wake vortex separation after 4NM	3	$1*10^{-4}$
M7	Incorrect track keeping of leading or following aircraft	2	$5*10^{-6}$
M8	In anticipating action crew turns to unsafe side (WV, traffic, terrain)	2	$5*10^{-6}$
M9	Crew initiates take-off while CREDOS conditions are not met	1	$1*10^{-8}$

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Next steps

- Complete Preliminary System Safety Assessment
- Produce Preliminary Safety Case
  - Part 1 - Validation of proposed crosswind criterion
  - Part 2 - Validation of simulator models used
  - Part 3 - Validation of suspended WV separations
  - Part 4 - Validation of tower controller functions
  - Part 5 - Validation of departure controller functions
- Discuss results with e.g. EHQ, SRU, ICAO, EASA, FAA.

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