NPF/SIP/2011-WP/19

Safety Management principles

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International Civil Aviation Organization

Workshop on the development of
National Performance Framework for Air Navigation Systems
(Nadi, Fiji, 28 March-1 April 2011)

Objective

- *To introduce the new perspectives and methods for managing safety.*
- *To review the ICAO requirements for the Safety Management Systems (SMS) and the State safety programme (SSP) and the relationship between the SMS and the SSP.*

Contents

- Basic contemporary concepts
- Hazard identification and risk management
- SMS requirements
- SSP requirements

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Basic contemporary safety concepts

Safety

- Traditional approach – Preventing accidents
  - Focus on outcomes (causes)
  - Unsafe acts by operational personnel
  - Attach blame/punish for failures to "perform safely"
  - Address identified safety concern exclusively
- Identifies:

WHAT? WHO? WHEN?

- But not always discloses:

WHY? HOW?

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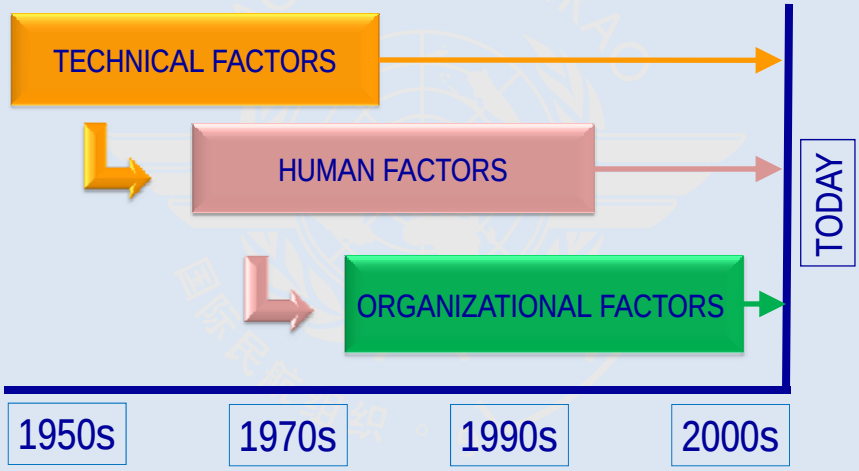
The evolution of safety thinking



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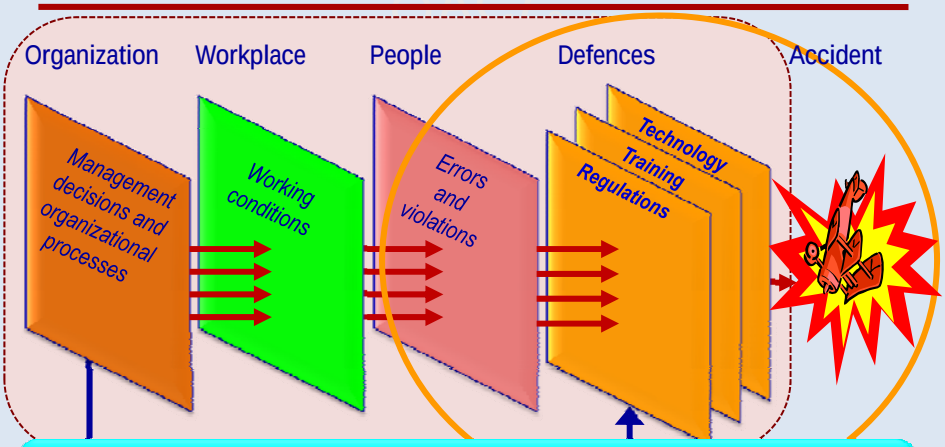
A concept of accident causation



Conditions present in the system before the accident, made evident by triggering factors.

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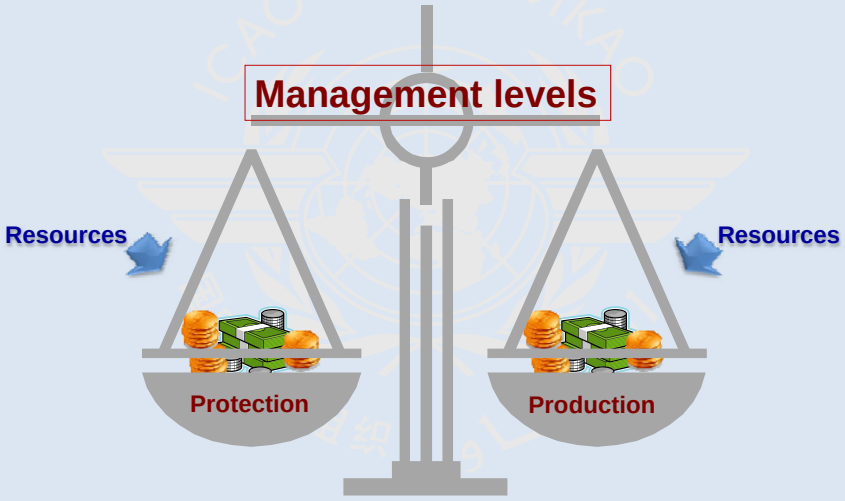
The management dilemma



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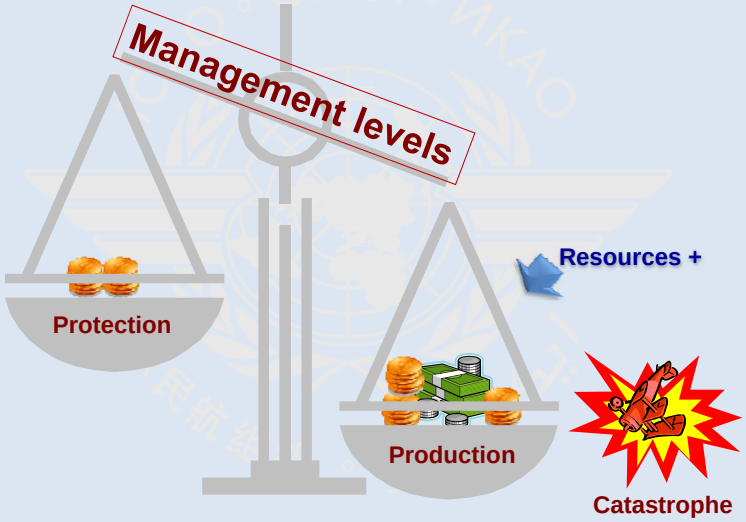
The management dilemma



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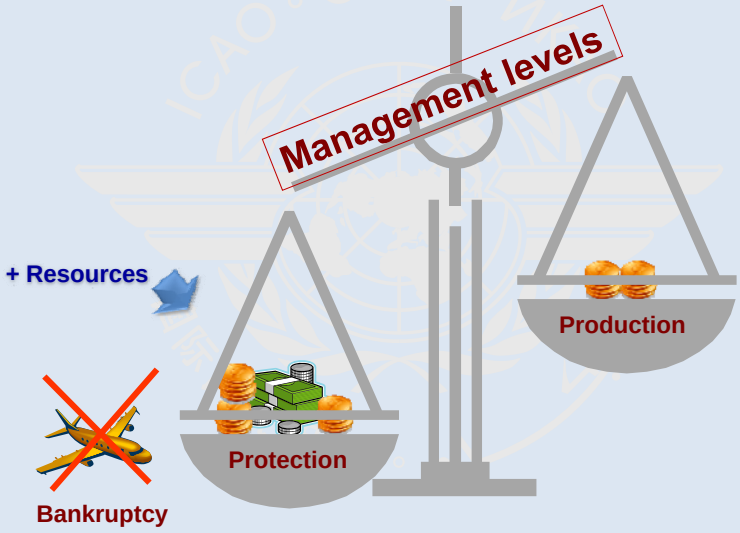
The management dilemma



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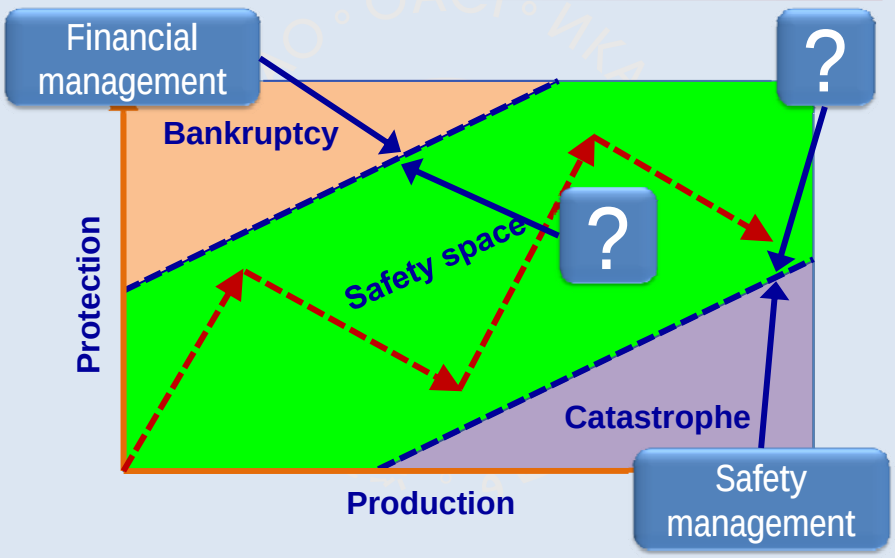
Safety space



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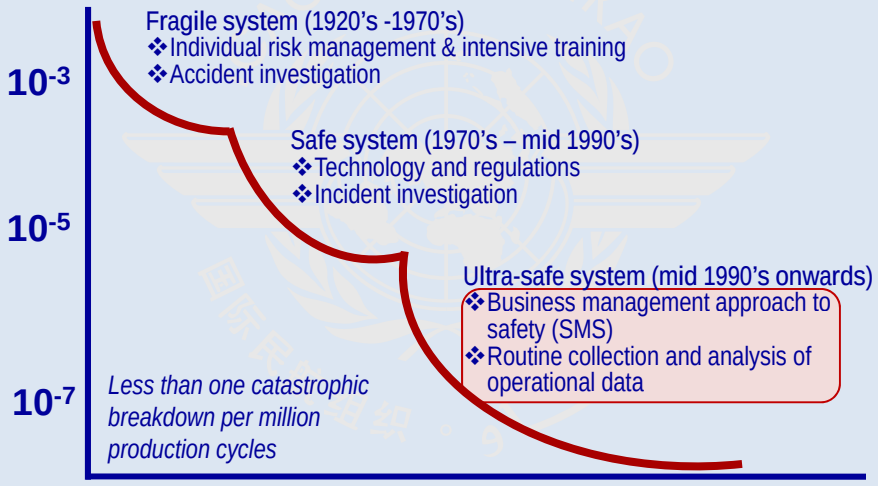
Why SM? – The first ultra-safe industrial system



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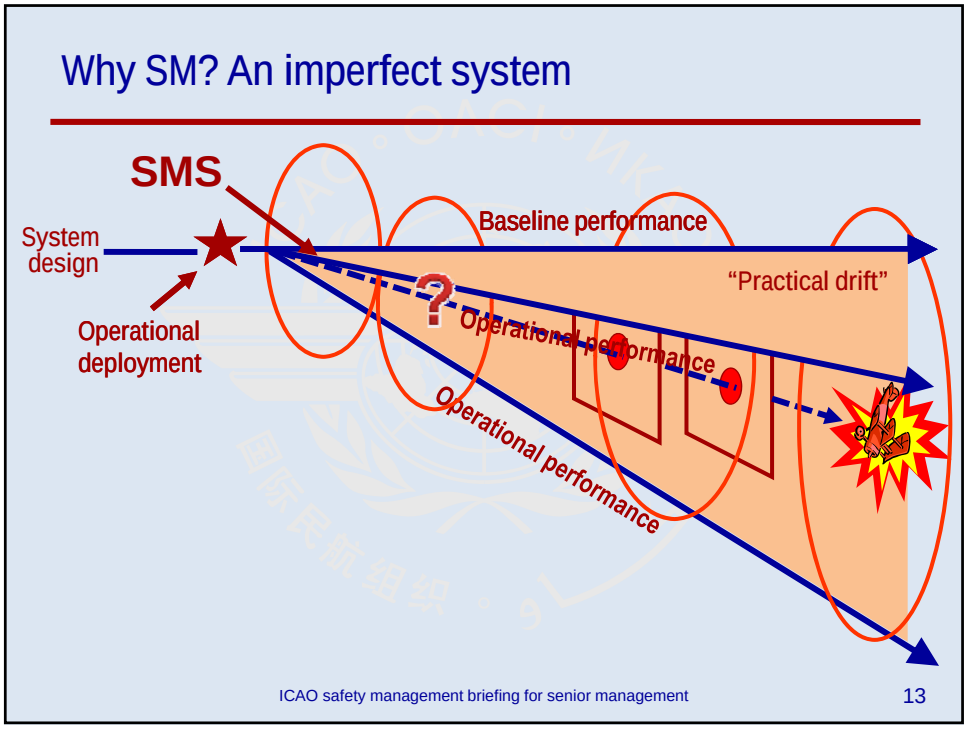
Why SM? An imperfect system
SMS
System design
Operational deployment
Baseline performance
"Practical drift"
Operational performance
Operational performance
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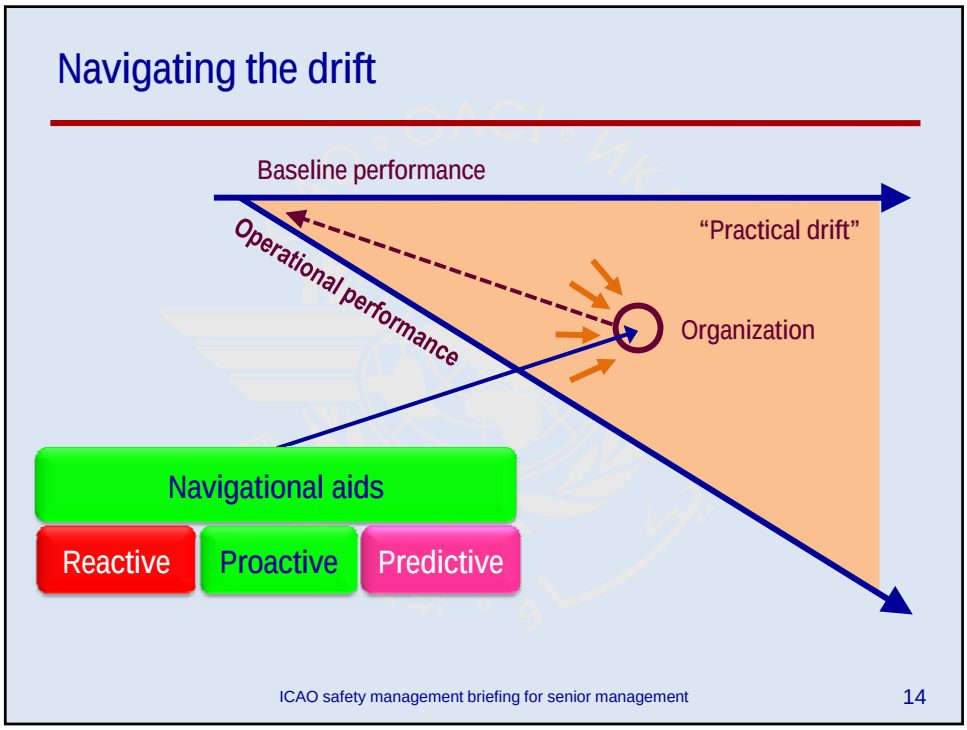
Navigating the drift
Baseline performance
"Practical drift"
Operational performance
Organization
Navigational aids
Reactive
Proactive
Predictive
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Strategies – Three methods

Reactive method
The reactive method responds to the events that already happened, such as incidents and accidents

Proactive method
The proactive method looks actively for the identification of safety risks through the analysis of the organization's activities

Predictive method
The predictive method captures system performance as it happens in real-time normal operations to identify potential future problems

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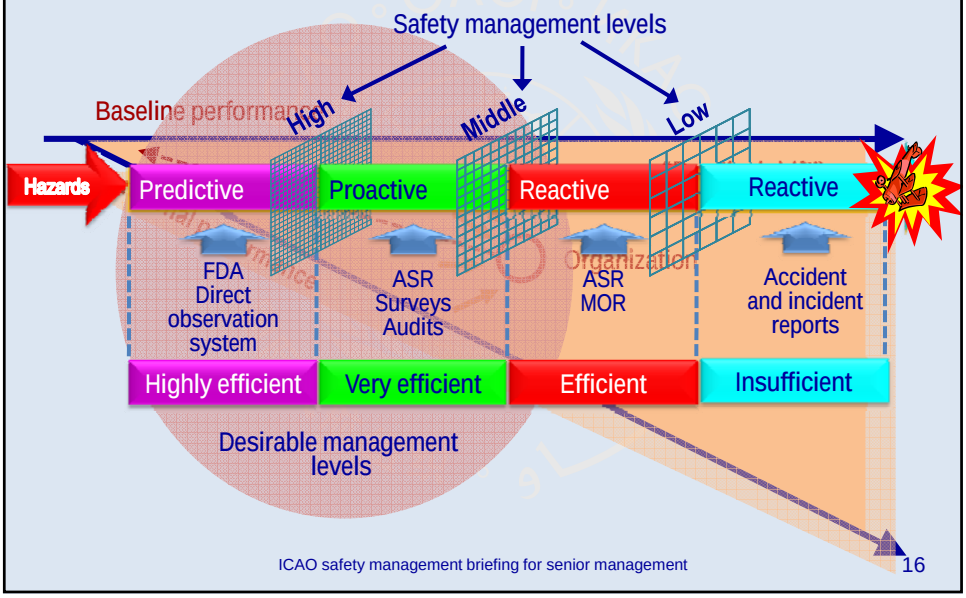
Strategies – Levels of intervention and tools



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Three possible organizational cultures

Regarding the management of information

	Pathological	Bureaucratic	Generative
Information	Hidden	Ignored	Sought
Messengers	Shouted	Tolerated	Trained
Responsibilities	Shirked	Boxed	Shared
Reports	Discouraged	Allowed	Rewarded
Failures	Covered up	Merciful	Scrutinized
New ideas	Crushed	Problematic	Welcomed
Resulting organization	Conflicted organization	"Red tape" organization	Reliable organization

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Hazard identification and risk management

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Two definitions

- Hazard – Condition or object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.
- Consequence – Potential outcome(s) of the hazard.
  - *A wind of 15 knots blowing directly across the runway is a hazard.*
  - *The potential that a pilot may not be able to control the aircraft during takeoff or landing is one of the consequences of the hazard.*

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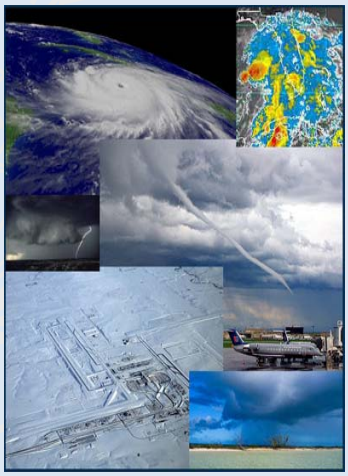
Examples of natural hazards

- Severe weather or climatic events:
  - *E.g.: hurricanes, major winter storms, tornadoes and wind shear.*
- Geophysical events:
  - *E.g.: earthquakes, volcanoes, tsunamis, floods and landslides.*
- Geographical conditions:
  - *E.g.: adverse terrain or large bodies of water.*
- Environmental events:
  - *E.g.: wildfires, wildlife activity, and insect or pest infestation.*



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Examples of technical and economics hazards

- Deficiencies regarding:
  - *E.g.: aircraft and aircraft components, systems, subsystems and related equipment.*
- Major trends related to:
  - Growth.
  - Recession.
  - Cost of material or equipment.
  - Etc.

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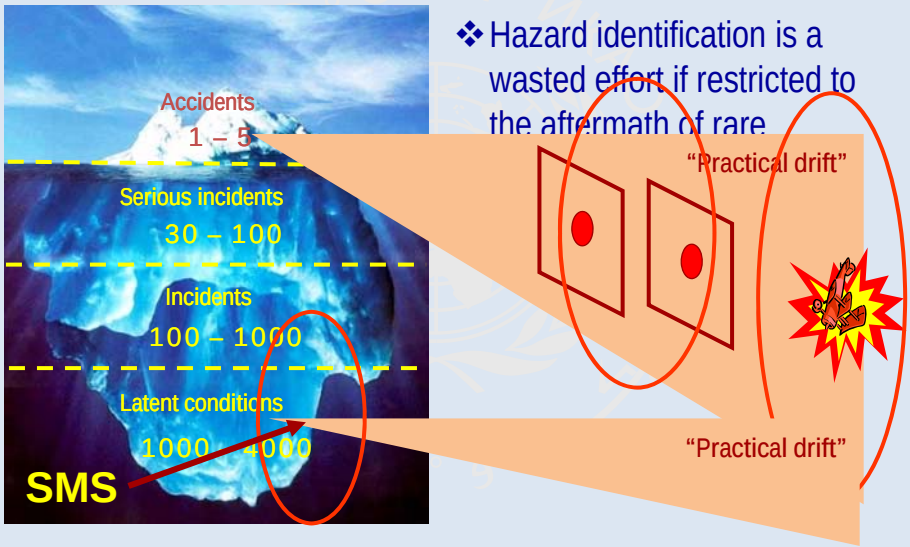
The focus of hazard identification



- Hazard identification is a wasted effort if restricted to the aftermath of rare

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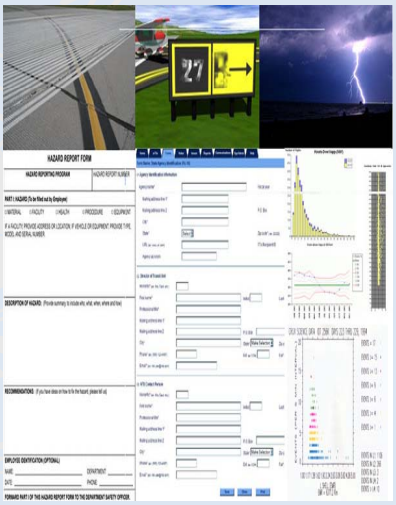
Sources of hazard identification

- Internal
  - Flight Data Analysis
  - Company voluntary reporting system
  - Audits and surveys
- External
  - Accident reports
  - State mandatory occurrence system
- As a reminder
  - Predictive
  - Proactive
  - Reactive



Hazard analysis

- Efficient and safe operations or provision of service require a constant balance between production goals...
  - *maintaining regular aerodrome operations during a runway construction project*
- ...and safety goals
  - *maintaining existing margins of safety in aerodrome operations during runway construction project*
- Aviation workplaces may contain hazards which may not be cost-effective to address even when operations must continue.

Documentation of hazards

- Appropriate documentation management is important as:
  - A formal procedure to translate operational safety data into hazard-related information.
  - Becomes the "safety library" of an organization.

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Definition of risk

- Risk – The assessment, expressed in terms of predicted probability and severity, of the consequence(s) of a hazard taking as reference the worst foreseeable situation.
  - *A wind of 15 knots blowing directly across the runway is a hazard.*
  - *The potential that a pilot may not be able to control the aircraft during takeoff or landing is one of the consequences of the hazard.*
  - *The assessment of the consequences of the potential loss of control of the aircraft by the pilot expressed in terms of probability and severity is the risk.*

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Risk assessment

Risk probability		Risk severity				
		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

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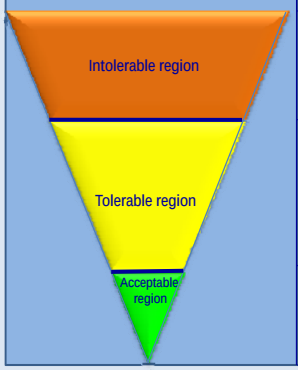
Risk tolerability

Risk management	Assessment risk index	Suggested criteria
	5A, 5B, 5C, 4A, 4B, 3A	Unacceptable under the existing circumstances
	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Acceptable based on risk mitigation. It might require management decision
	3E, 2D, 2E, 1A, 1B ,1C, 1D, 1E	Acceptable

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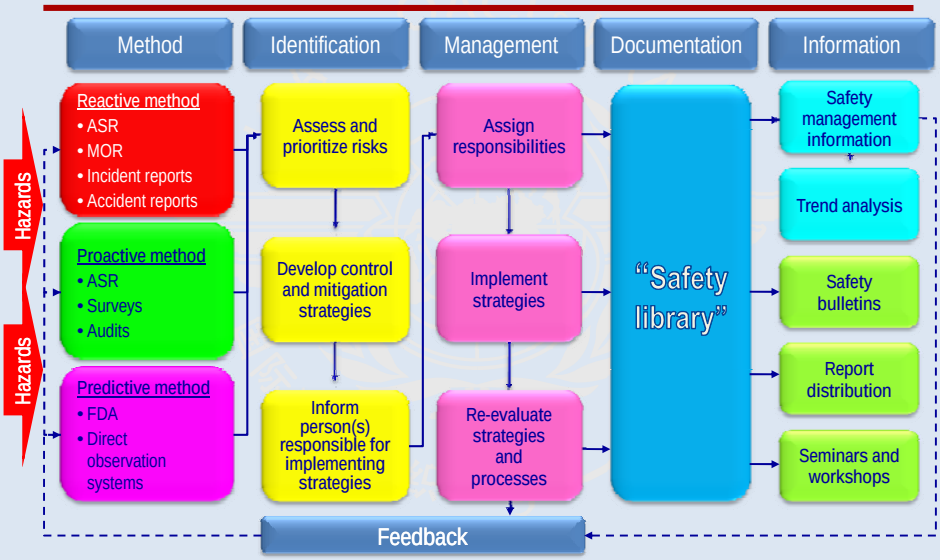
Connecting processes



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SMS requirements

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What is an SMS?

- *A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.*
- Service providers are responsible for establishing an SMS.
- States are responsible, under the SSP, for the acceptance and oversight of service providers' SMS.

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Shift from prescription to performance

Prescriptive

Regulations as administrative controls

- Regulatory framework
- Inspections
- Audits
  - ✓ *Regulatory compliance*

Performance-based

Regulations as risk controls

- Regulatory framework, but:
  - Data based identification and prioritization of safety risks
- Develop regulations to control safety risks
  - ✓ *Effective safety performance*

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SMS requirements

- *States shall require, as part of their State safety programme (SSP), that a service provider implements a safety management system (SMS) acceptable to the State that, as a minimum:*
  - *a) identifies safety hazards;*
  - *b) ensures that remedial action necessary to maintain safety performance is implemented;*
  - *c) provides for continuous monitoring and regular assessment of the safety performance; and*
  - *d) aims at a continuous improvement of the overall performance of the safety management system.*

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SMS requirements

- *A safety management system shall clearly define lines of safety accountability throughout a service provider organization, including a direct accountability for safety on the part of senior management.*

  (Accountability – Obligation or willingness to account for one's actions)

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Safety performance of services provider's SMS

- Within each State, the safety performance of the SMS will be agreed between the State oversight authority and individual aviation organizations.
- Each agreed safety performance should be commensurate to the:
  - complexity of individual aviation organization specific operational context; and
  - availability of aviation organization resources to address them.

Safety performance of services provider's SMS

- The safety performance of service providers shall be expressed in practical terms by two measures or metrics:
  - *Safety performance indicators*
  - *Safety performance targets*
- It is delivered through various tools and means:
  - *Safety requirements*.

Safety performance of services provider's SMS

Safety requirements	1. Training course for drivers / installation of specific signage 2. Thrice-daily walk-in ramp inspection programme 3. …
Safety performance targets	1. Maintain no more than 20 events of unauthorized vehicles on the taxiways per 10.000 operations 2. By January 2009 reduce to 8 FOD events on the apron per 10.000 operations 3. …
Safety performance indicators	1. 20 events of unauthorized vehicles on the taxiways per 10.000 operations 2. 15 FOD events on the apron per 10.000 operations 3. …
Service provider SMS	Will comply all applicable national and international standards

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Legal considerations

- Service providers
  - Establishing safety performance for the SMS leaves unaffected the obligations of services providers and other related parties, and it does not relieve the services providers and other related parties from compliance with SARPs and/or national regulations, as applicable.

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Performance-based regulatory environment

- The notion of safety performance is an essential ingredient of the effective operation of an SMS.
- It serves for developing a performance-based regulatory environment, in order to monitor the actual performance of an SMS.
- At the same time, it is also important to remember the management axiom that *"one cannot manage what one cannot measure"*.

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Safety performance of the SMS

Safety requirements	1. Training course for drivers / installation of specific signage 2. Thrice-daily walk-in ramp inspection programme 3. …
Safety performance targets	1. Maintain no more than 20 events of unauthorized vehicles on the taxiways per 10.000 operations 2. By January 2009 reduce to 8 FOD events on the apron per 10.000 operations 3. …
Safety performance indicators	1. 20 events of unauthorized vehicles on the taxiways per 10.000 operations 2. 15 FOD events on the apron per 10.000 operations 3. …
Service provider SMS	Will comply all applicable national and international standards

Performance

Prescriptive

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SSP requirements

State's safety programme

- Definition
  - *An integrated set of regulations and activities aimed at improving safety.*
- Requirements
  - *States shall establish a State safety programme (SSP), in order to achieve an acceptable level of safety in civil aviation.*

State's safety programme

- States are responsible for establishing an SSP, encompassing the following responsibilities:
  - Safety regulation
  - Accident/incident investigation
  - Mandatory/voluntary reporting systems
  - Safety data analysis and exchange
  - Safety assurance
  - Safety promotion

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Acceptable level of safety (ALoS)

- State acceptable level of safety – A concept
  - High level safety management goals of an SSP
    - safety measurement
  - Minimum safety performance the State should achieve through the implementation of its SSP
    - safety performance measurement
  - An indirect reference against of the measure safety performance of the service providers.

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ALoS – A fundamental differentiation

- Safety measurement
  - Quantification of high-level outcomes or high-consequence events
    - accident rates
    - serious incident rates
- Safety performance measurement
  - Quantification of low-level process
    - provide a measure of the actual performance of an individual SSP or SMS

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ALoS of an SSP

- Expresses the safety goals (or expectations) of a State.
- It is the reference
  - for safety measurement by the State
  - for safety performance measurement of the SSP
- It is an indirect reference against which the State can weigh the safety performance of service providers' SMS.
- When establishing ALoS, consideration must be given to
  - the level of safety risk that applies,
  - the cost/benefits of improvements to the system
  - the public expectations in civil aviation system.

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ALoS of an SSP

- The ALoS of an SSP shall be established by the State and it is expressed in practical terms by two measures or metrics:
  - *Safety performance indicators*
  - *Safety performance targets*
- It is delivered through various tools and means:
  - *Safety requirements*.

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Acceptable level of safety of an SSP

Safety requirements	1. Airspace management – Constant Descend Arrivals (CDA) procedures implemented – Arrival procedure charts designed for stabilized approaches. 2. Installation of ASDE/X in 5 international [State] airports.
Safety performance targets	1. By 2010, reduce Controlled Flight into Terrain (CFIT) events to 0.04 per 100,0000 operations on all large public transport aircraft in [State] airspace. 2. By 2011, reduce runway incursions to 0.6 per 10,000 operations in 5 international [State] airports.
Safety performance indicators	1. 0.08 Controlled Flight into Terrain (CFIT) events per 100,0000 operations on all large public transport aircraft in [State] airspace. 2. 1.2 runway incursions per 10,000 operations in 5 international [State] airports areas – large passenger aircraft, large freighter aircraft, small public transport aircraft, large public transport helicopters and general aviation.
State SSP	Will comply all applicable international standards.

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Legal considerations

- States
  - Establishing acceptable level of safety for their SSP does not replace legal, regulatory, or other already established requirements, but it must support compliance with them.
  - Establishing acceptable level of safety for their SSP leaves unaffected the obligations of States, and does not relieve States from compliance with SARPs.
  - …

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THANK YOU

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