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Review on ICAO Document and concept ATM Safety Assessment in Change Management



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ATM Safety Assessment in Change Management Webinar
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ICAO's Strategic Objectives





Objectives

❖ To answer to:

- How do we assure the safety of our systems, processes and procedures in ATM during the transition to New Era of Aviation?
- What is the role of each stakeholder?
- So, how and what do we do?





Contents

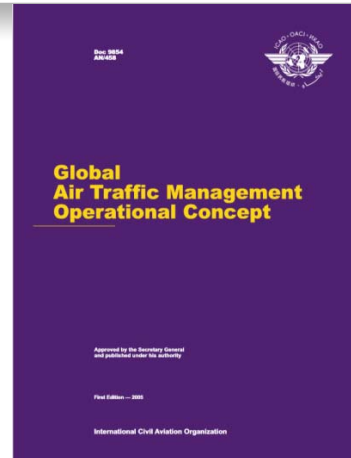
- **Why do we need to do ATM Safety Assessment?**
 - ICAO Requirements & Guidance Material
 - Roles and Responsibilities in SSP & SMS
- **What is Management of Change?**
- **Safety Assessment methodology in ATM**
 - System Description and Hazard identification
 - Safety risk assessment and Mitigation
- **Key Takeaways**



Our Ultimate vision (Doc9854)

Vision

- To achieve globally **interoperable ATM system**
- For all users during all flight phases
- Meeting agreed safety and providing optimum economic operations
- environmentally sustainable



❖ Air Traffic Management

- The dynamic, integrated management of air traffic and airspace
- **safely, economically and efficiently**
- **seamless services** in collaboration with all parties.
- ATM user expectations driving for change, requiring:
 - **Safety and Business**
- through the collaborative integration
 - Human, information, technology, facilities and services
- Supported by CNS



Why do we need to do ATM Safety Assessment?

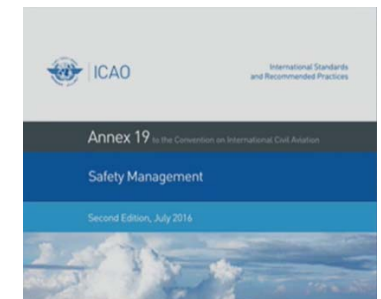
ICAO REQUIREMENTS & GUIDANCE MATERIALS





Key Documents

- **SARPs**
 - Annex 11(ATS)
 - Annex 19(Safety Management)
- **Guidance Materials**
 - Doc 4444(PANS-ATM)
 - Doc 9859 (Safety Management Manual)





Safety-related Provisions in Annex 11 & Doc 4444

❖ Annex 11 Air Traffic Services (para 2.29 Safety Management)

- Any significant safety-related change to the ATS system shall only be effected after a safety assessment has demonstrated that an acceptable level of safety will be met and users have been consulted.
 - The acceptable level of safety can be expressed by quantitative means or qualitative means
- Post-implementation monitoring need to be conducted to verify that the defined level of safety continues to be met.

❖ Doc 4444 PANS-ATM (para 2.6)

- A safety assessment shall be carried out in respect of proposals for
 - Significant airspace reorganizations;
 - Significant changes in the provision of ATS procedures applicable to an airspace or an aerodrome; and
 - The introduction of new equipment, systems or facilities



Doc 4444 (PANS-ATM) ch.2 ATS Safety Management

❖ What. SMS Implementation

- States **shall implement safety management systems (SMS) for the air traffic services** under its jurisdiction. Where appropriate, **ATS SMS should be established on the basis of a regional air navigation agreement.**

❖ Through. ATS Safety Management Activities

- **monitoring** of overall safety levels and **detection** of any adverse trend;
- **safety reviews** of ATS units;
- **safety assessments** in respect of the planned implementation of airspace reorganizations, the introduction of new equipment systems or facilities, and new or changed ATS procedures; and
- **a mechanism for identifying the need for safety enhancing measures**



Doc 4444 (PANS-ATM) ch.2 ATS Safety Management

❖ Before Implementation. Safety Assessments

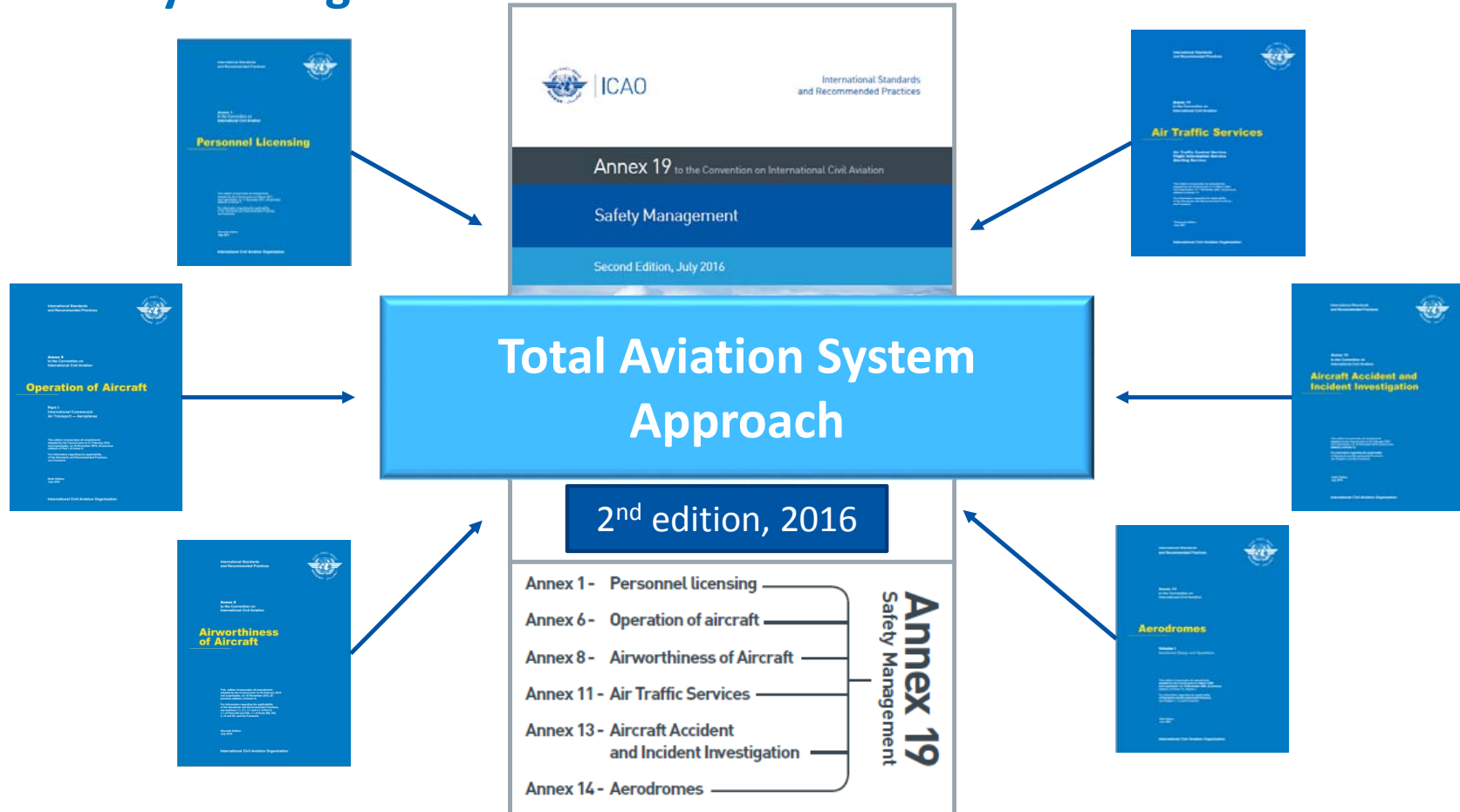
- Safety assessments shall be carried out for changes below;
 - **Significant** airspace reorganizations;
 - **Significant changes** in the provision of ATS procedures to an airspace or an aerodrome;
 - **The introduction of new equipment, systems or facilities**
- Changes shall be implemented **only when** the assessments has shown that an acceptable level of safety will be met.
- Safety assessment shall consider relevant all significant factors.

❖ After Implementation. Monitoring of Safety Levels & Safety Reviews by;

- Collecting and evaluation of safety-related data
- Review of incident and other safety-related reports
- **Review on a regular and systematic basis** by **personnel qualified** through training, experience and expertise having a **full understanding of relevant SARPs, PANS, safe operating practices and Human Factors principles.**



Annex 19 Safety Management





Why do we need to do ATM Safety Assessment?

ROLES & RESPONSIBILITIES

(ANNEX 19. STATE & SERVICE PROVIDER)



Annex 19



States shall establish and maintain an SSP that is commensurate with the size and complexity of the State's civil aviation system

- Integrated set of regulations and activities aimed at improving safety
- critical elements(8CEs) of State's safety oversight (SSO) system
-> The foundation of SSP

- **ensure State's effective legislative framework;**
- **ensure Safety Risk Management and safety assurance** coordination and synergy among relevant State aviation authorities;
- **support effective implementation and appropriate interaction with Service Provider's SMS**
- **facilitate the monitoring and measurement of the safety performance** of State's aviation industry; and
- **maintain continuously improve** the State's overall safety performance

Integrated State Safety Programme (Annex 19)

States' Oversight Obligation



Figure 3. Critical elements of a State's safety oversight system
From APAC Regional Aviation Safety Plan

SSP Component 1 State safety policy, objectives and resources	CE-1 Primary aviation Legislation	CE-3 State system and function	CE-5 Technical guidance, tools and provisions of safety critical information
	CE-2 Specific operating regulations	CE-4 Qualified technical personnel	
SSP Component 2 State safety risk management	CE-6 Licensing, certification, authorisation and/or approval obligations	Accident and incident investigation	Management of safety risks. CE-8 Resolution of safety issues
	Safety management system obligations	Hazard identification and safety risk assessment	
	SSP Component 3 State safety Assurance	CE-7 Surveillance obligations	State safety performance
SSP Component 4 State safety promotion	Internal communication and dissemination of safety information		External communication and dissemination of safety information



Annex 19

Service Providers (SMS)

Definition: A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures

ICAO Doc 9859

4.1.1 The SMS of a service provider shall:

- a) be established in accordance with the framework elements contained in Appendix 2; and
- b) be commensurate with the size of the service provider and the complexity of its aviation products or services.

Annex 19

4.1.2 The State shall ensure that the service provider develops a plan to facilitate SMS implementation.

- a. Approved training organization – **Annex 1**
- b. Operators of aeroplanes or helicopters – **Annex 6**
- c. approved maintenance organizations – **Annex 6**
- d. organizations responsible for the type design or manufacture of aircraft, engines or propellers – **Annex 8**
- e. air traffic services (ATS) providers – **Annex 11**
- f. operators of certified aerodromes – **Annex 14**

Service Provider's Safety Management System (Doc 9859)

Under State's Roles & Responsibility (Safety Oversight and SSP)

SMS for Service Providers

Provides:

- A systematic way to **identify hazards** and **control risks**
- **Assurance** that risk controls remain effective
- A formal means of meeting **regulatory requirements**
- A means for SPs to evaluate an organization's **safety management capability**
- System-wide and performance-based approach
- A set of decision-making processes for management





ICAO's Roles & Responsibilities in Aviation Safety

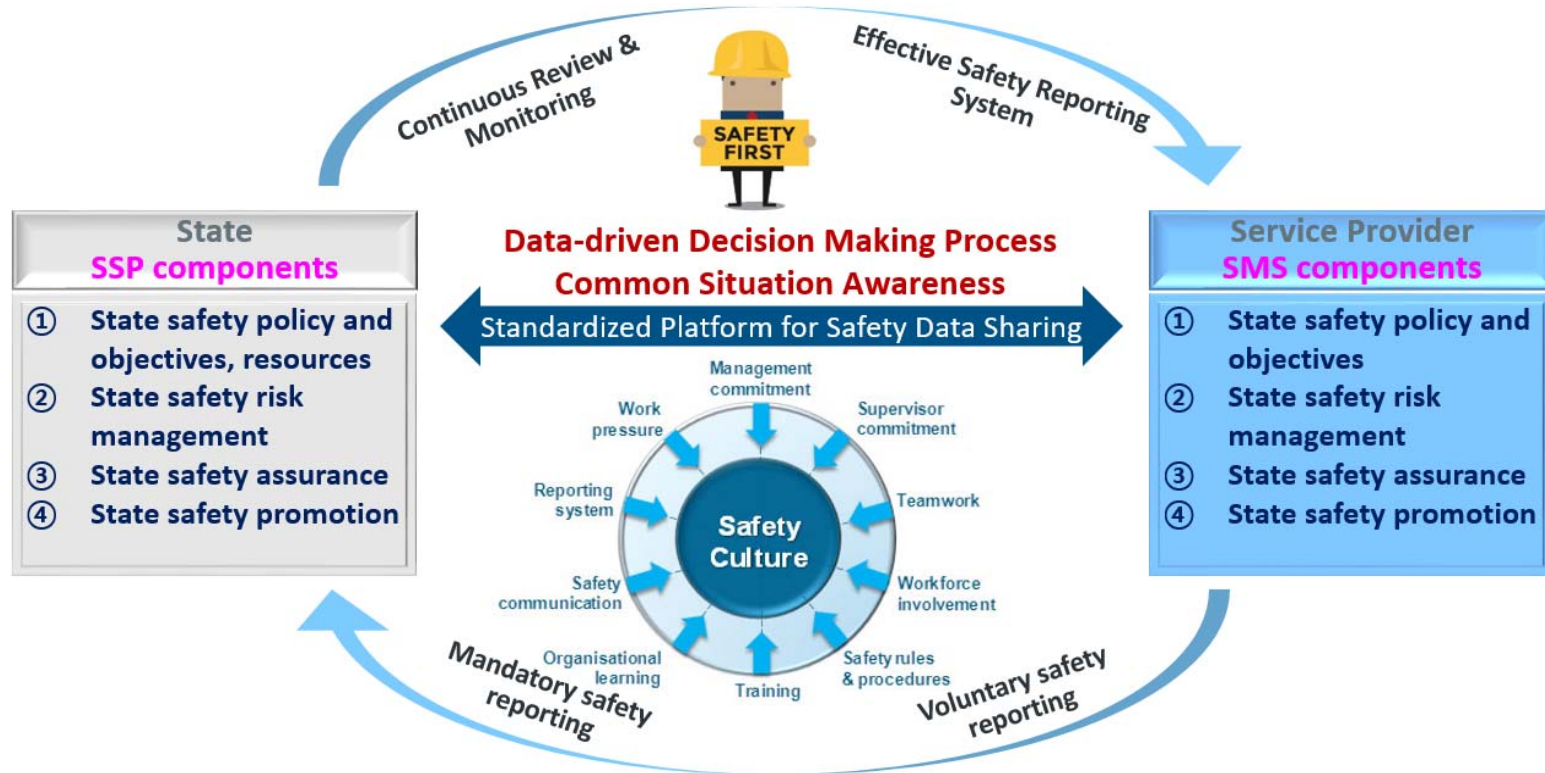


- ❖ **Assist States, regions and industry in safety planning and implementation by:**
 - **establishing GASP** goals, targets and indicators
 - providing **framework** for planning & implementation of **SEIs**
 - **presenting roadmap**
 - Providing resources, implantation tools and assistance via different programmes and initiatives
- ❖ **Assess the effective implementation of the 8 CEs of a safety oversight system**
 - carrying out **USOAP CMA audits, ICVMs and Off-site validation** activities to determine Member States' safety oversight capabilities
- ❖ **Verify the status of the Member States' implementation of:**
 - all safety-related ICAO SARPs, associated procedures, guidance materials, best practices.

Architecture of Safety Management

ICAO Initiatives

GASP, USOAP CMA, Supporting Programmes & Tools





WHAT IS MANAGEMENT OF CHANGE?

(WITHIN SSP & SMS_DOC9859)



So, What is Safety?

Safety

The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.

From Doc 9859 Definitions

- Does it mean “0 risk”?
- Should every organizations have the same level of safety profile?

Acceptable Level of Safety Performance (ALoSP)
According to its own operational context

agreed by State authorities to be achieved, as defined in its State safety programme, expressed in safety performance targets (SPTs) and safety performance indicators (SPIs).



Change Management in ATM

Challenges

- ❖ Changes are inevitable and an ever-present fact in aviation
- ❖ Each time a change occurs, a door is open to inadvertent introduction of hazards
- ❖ Safety is our no.1 mission

When implementing Change, What if...

- It affects the established safety risk picture of the system?
- It introduces hazards that may impact the effectiveness of existing defenses?
- It results in new risk or changes to existing safety risks?



Ever-changing Environment

- The traditional approach to regulating aviation will not be able to keep pace with the change.
- **For the next 15 years** - Innovative business models, advances in technology, air traffic growth
- The increasing complexity of the aviation system requires more structured processes for the management of changes so that unintended consequences are averted as much as possible.



What is Change Management?

- ❖ **An element of Safety Assurance component** of the SMS Framework
- ❖ **A formal process to manage changes within an organization in a systematic manner**, so that changes which may impact identified hazards and risk mitigation strategies are accounted for, **before the implementation of such changes.**

from Definition in Doc 8959 (SMM 4th Edition)





Management of Change

❖ States should:

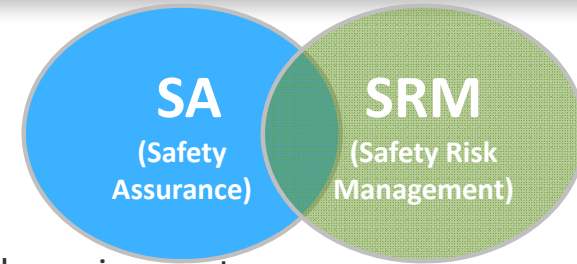
- Evaluate and manage the impact of change in their aviation systems
- Develop procedures to assess the impact of changes at a State level in a structured way
- When changes are planned, analyse the impact of the change on the existing system
 - By using existing SRM process

❖ Service providers are required: (Annex19 Appendix 2. 3.2)

- To develop and maintain a process to identify changes which may affect the level of safety risk associated with its aviation products or services and to identify and manage the safety risk that may arise from those changes.



How: through SA & SRM



❖ Safety Assurance (SA) “Confidence in safety risk controls.”

- To determine whether the SMS is operating according to expectations and requirements
- Continuous monitoring **to detect changes or deviations** that may introduce emerging safety risks or the degradation of existing safety risk controls.
- **Such changes and deviations may then addressed through the SRM process.**
 - Collect and analyze information to determine that process requirements are continuously being met.
 - Assess performance and effectiveness of risk controls.

❖ Safety Risk Management (SRM)

- systematic way to control risk and to provide assurance that those risk controls are effective.
- a process of controlling risk through **hazard identification, analysis, risk assessment and developing risk controls.**



Which changes trigger a formal Safety Management Process?

❖ Changes that:

- Affect the effectiveness of existing safety risk controls
- New hazards and related safety risks may be inadvertently introduced into an operation when change occurs

(Annex 19 Appendix 2 3.2)

Service Providers should define the trigger for the formal change process

(Doc 9859 9.5.5.5)

Change Management Process Triggers

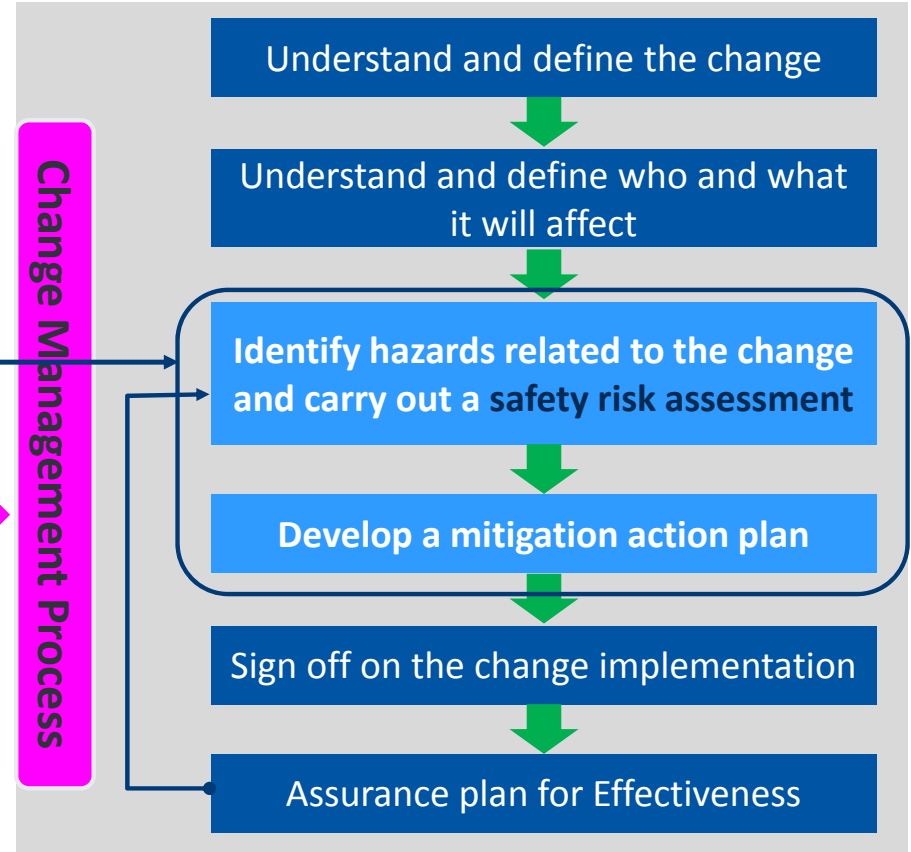
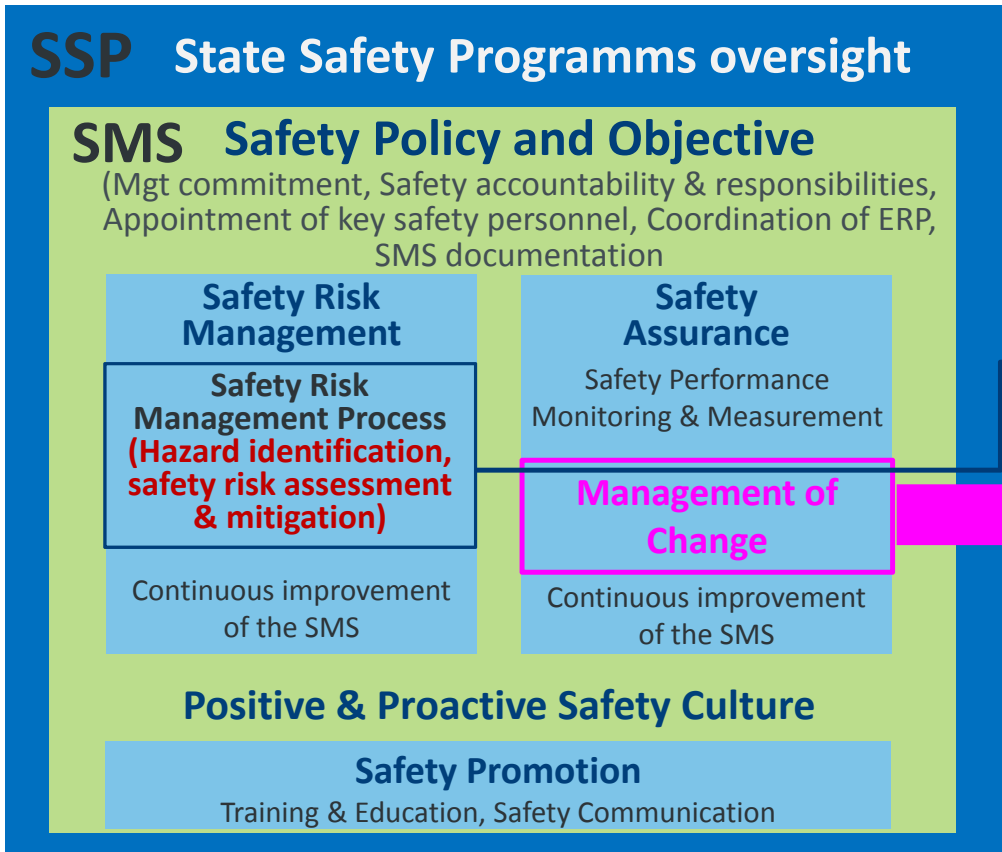
◆ Examples of Changes that trigger the formal change process

- Introduction of new technology or equipment
- Changes in the operating environment
- Changes in key personnel
- Significant changes in staffing levels
- Changes in safety regulatory requirements
- Significant restructuring of the organization
- Physical changes (a new facility, a new base, aerodrome layout changes etc.)



Management of Change Process in SSP & SMS

Based on Doc 9859 8.5.6, 9.5.5





Management of Change Process

1. Understand and define the change: **Description of the Change**

- Description of the change
- **Why** is it being implemented?

2. Understand and define who and what it will affect: **Review the system description and Identify interfaces**

- **Who and what** it will affect? **Who** should be involved in the change?
- May be individuals within organization, other departments or external people and other organization
- Or impact on equipment, systems and processes

✓ **Be mindful !**

Change might affect risk controls already in place to mitigate other risks, and therefore change could increase risks in areas that are not immediately obvious



Management of Change Process

- 3. Identify hazards related to the change and carry out safety risk assessment: SRM Process**
 - Identify any hazards directly related to the change.
 - Review the impact on existing hazards and safety risk controls that may be effected by the change.
- 4. Develop & implement change action plans: Define what is to be done, by whom and by when**
 - Describe how the change will be implemented and who will be responsible for which actions, and the sequencing and scheduling of each tasks
- 5. Sign off the change: Confirm that the change is safe to implement**
 - The individual with overall responsibilities and authority for implementing the change should sign the change plan
- 6. Assurance Plan: Determine what follow-up action is needed (Quality Control)**
 - Consider how the change will be communicated and whether additional activities (such as audits) are needed during or after the change (*Any assumptions made need to be tested*)



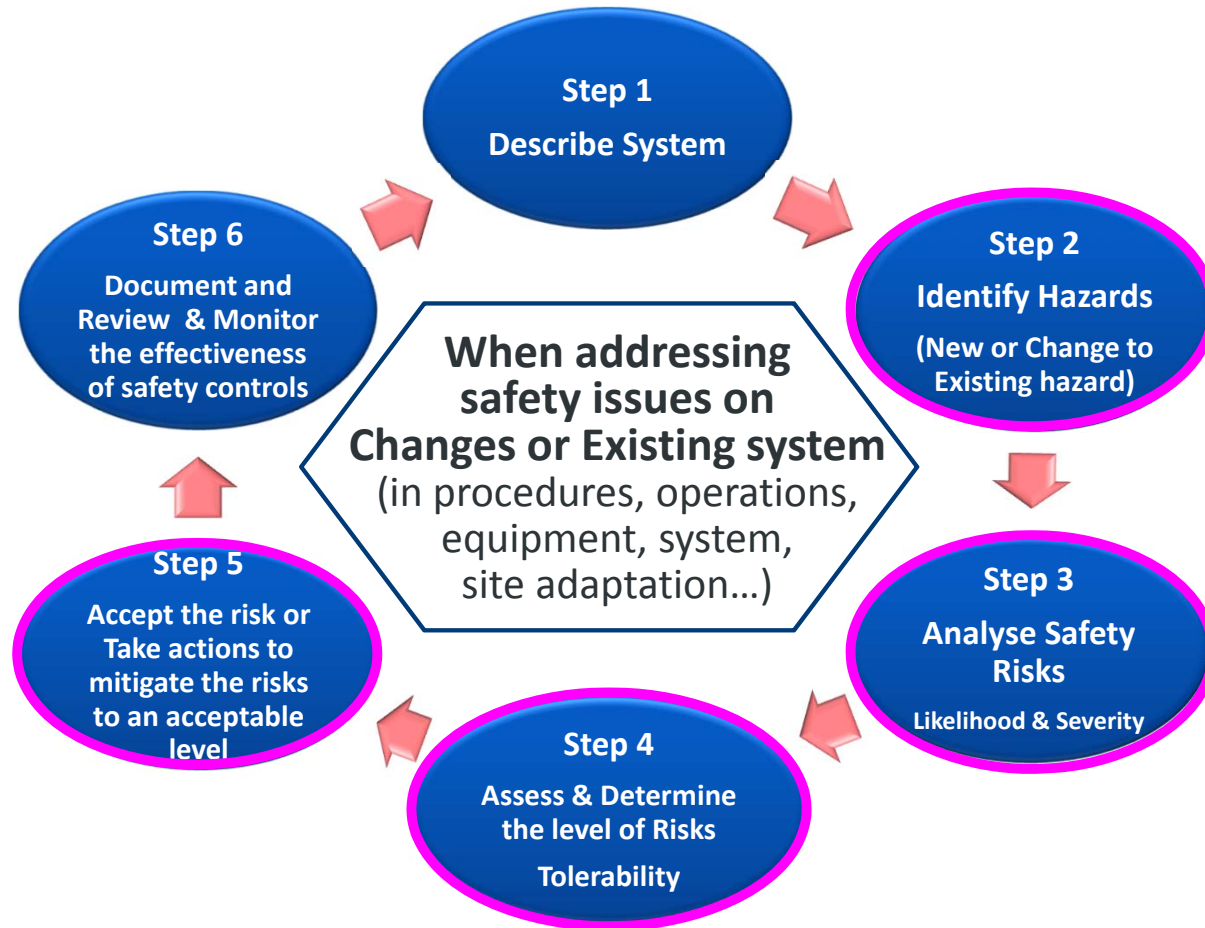
Safety Assessment methodology in ATM

SYSTEM DESCRIPTION & HAZARD IDENTIFICATION

(THROUGH CHANGE MANAGEMENT WITHIN SSP & SMS_DOC9859)



Safety Assessment Process





System Description: Understand and define your system and change

❖ How to Describe System

- *Analyse the system and its operating environment*
- *Define and describe system or change (use, environment, intended function, future configuration, etc.)*
- *Define scope (complexity and breadth) and objective of the change*
- *Identify affected stakeholders (interfaces) and elements in detail*
- *Identify criteria and plan for SRM efforts*
- *Determine the information required about the proposed changes and current system*

❖ Regularly review to determine its continued validity, because;

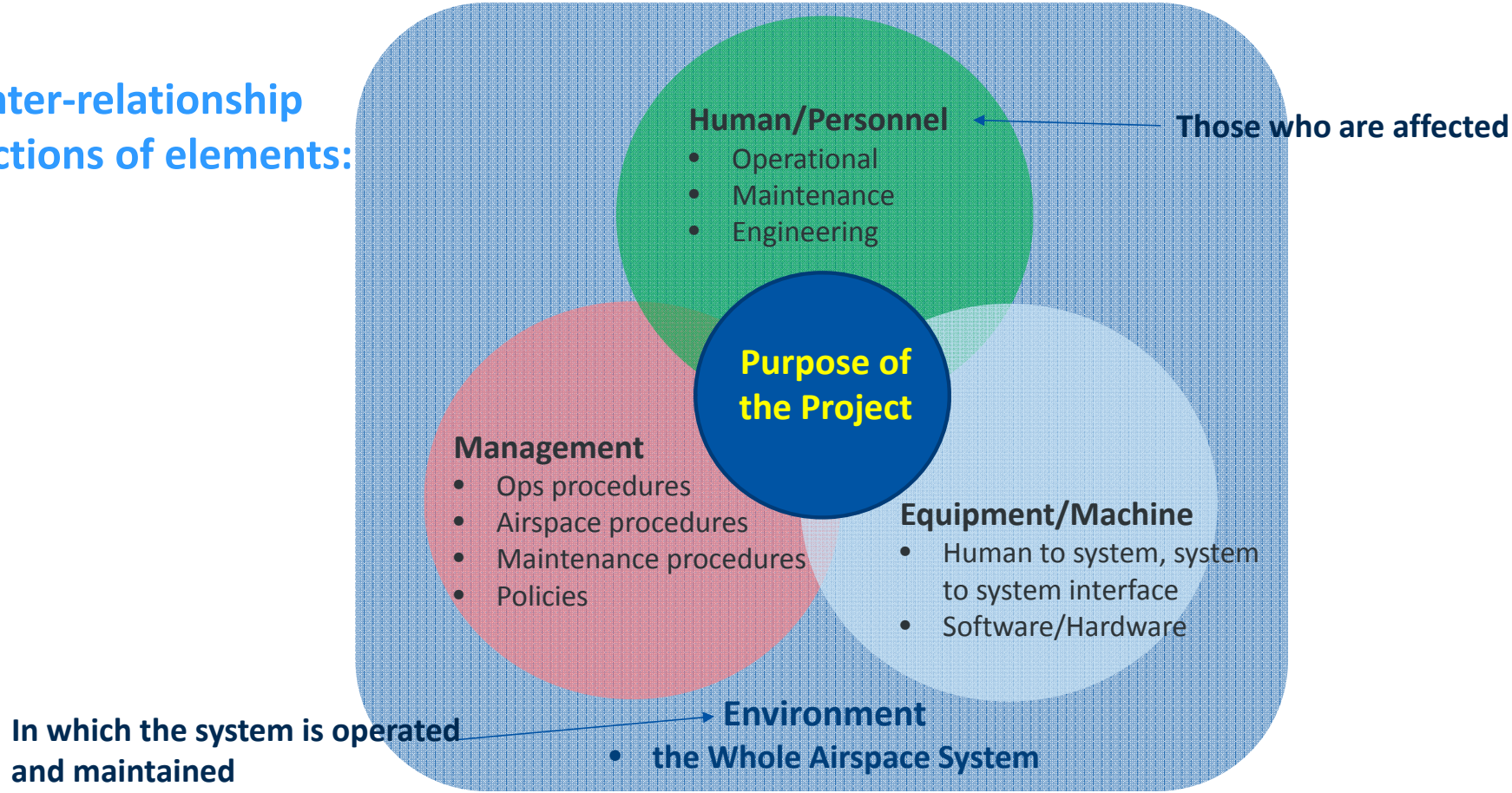
- Most service Providers experience regular, or even continuous change
- Small incremental changes often go unnoticed, but the cumulative effect can be considerable
- Changes, large and small, might affect the organization's system description
- System description will serve as the basis for identifying all hazards and associated risks

Tips !

**In Detail
Accurately
Clearly
Completely**

System Description: Understand and define your system and change

❖ Describe inter-relationship and interactions of elements:



Hazard Identification



❖ What is a hazard and consequences?

➤ **A hazard:** A condition or an object with the potential to cause or to contribute to an aircraft accident or incident (Annex 19 and Doc 9859)

- anything that could cause harm to people, property or environment
- injury, illness, or death to people;
- damage to, or loss of, a system (hardware or software), equipment, or property; and/or
- damage to the operating environment
- a dormant potential for harm in one form or another within the system or its environment (SMM 2.5.1.1)

➤ **Consequences:** The potential outcome that can be triggered by a hazard

➤ **Safety risks:** Measurements of the outcome of hazards

- ✦ Bad weather,
- ✦ Mountainous terrain,
- ✦ FOD,
- ✦ Lack of emergency equipment,
- ✦ High workload
- ✦ Use of alcohol and other drugs.
- ✦ Lack of training,
- ✦ Effects of long-term fatigue

Example



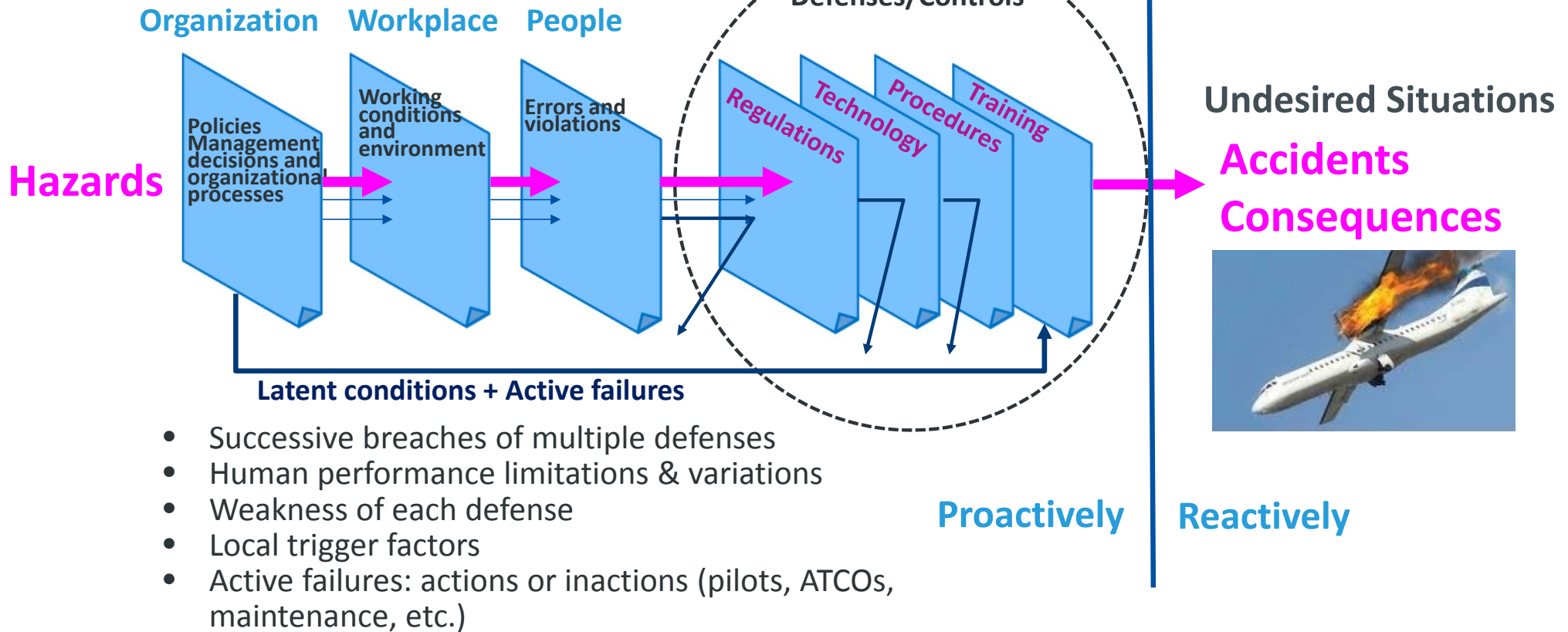
Key points when identifying hazards and consequences

❖ Consider:

- Hazards are **normal system components that can lead to adverse consequences**, and their **consequences are usually manageable**
- When the hazard is released, control is lost and the system may propagate into an adverse outcome
- Hazards are **best identified through monitoring** of work/operational context (i.e. **capturing the practical drift**) and **from safety data sources** including current processes and future changes.
- Hazard should be **described in neutral terms** with **commonly accepted terminology**
- Hazard should be **categorized into a generic component** (natural, environmental, operational, technical/equipment) **and a specific component** (description)

How accident can happen?

❖ Accident Causation



- Successive breaches of multiple defenses
- Human performance limitations & variations
- Weakness of each defense
- Local trigger factors
- Active failures: actions or inactions (pilots, ATCOs, maintenance, etc.)



Hazard Identification

❖ Where to find?

Internal sources:

- Normal operations **monitoring** (LOSA, NOSS)
- **Automated monitoring systems**
- Voluntary/Mandatory **safety reporting systems**
- **Audits, surveys, reviews**
- Feedback from training
- Service provider investigation

External sources:

- Aviation **accident reports**
- State mandatory/voluntary **safety reporting systems**
State **oversight audits** and **third-party audits**
- Trade associations and **information exchange systems**

Other methods:

- Workshops, meetings, Brainstorming sessions, Expert judgment

➤ **Reactive methodologies:** after an event

- Accident and incident investigation reports
- Internal and external investigation results/reports
- Continuing airworthiness reports
- Reporting system
- Internal & External audits
- Safety risk assessments of existing safety issues

➤ **Proactive methodologies:** before a hazard could lead to an accident or incident

- Flight data analysis programme
- Safety assurance function
- Safety studies/reviews
- Safety Reporting system (especially Voluntary)
- Safety risk assessments of changes to the system

➤ **Predictive methodologies:** through

- Safety data analysis which identifies adverse trends
- Predictions about emerging hazards

Understanding Hazards and their Consequences

15kt of wind

A hazard



Potentially affects

aircraft directional controllability
Events



Consequences



Loss of lateral control



Lateral RWY excursion

A fifteen-knot wind blowing directly down the runway?
Improve a/c take-off and landing -> **beneficial**

A fifteen-knot wind blowing across the runway?
Crosswind condition -> **hazardous to operation**

Possible consequences are:

- ✈ aircraft accident and loss of human life
- ✈ aircraft incidents
- ✈ increased flight crew workload
- ✈ passenger discomfort.



An Example of Hazard Analysis

Step 1
State the generic hazard

- Airport construction

Step 2
Identify the specific component of the hazard

- Construction equipment
- Construction debris (FOD)
- Closed runway or taxiway
- ...

Step 3
Naturally leading to specific consequence(s)

- Aircraft colliding with construction equipment,
- FOD coming into aircraft engine
- Aircraft taking the wrong runway or taxiway
- ...



Safety Assessment methodology in ATM

SAFETY ASSESSMENT & MITIGATION

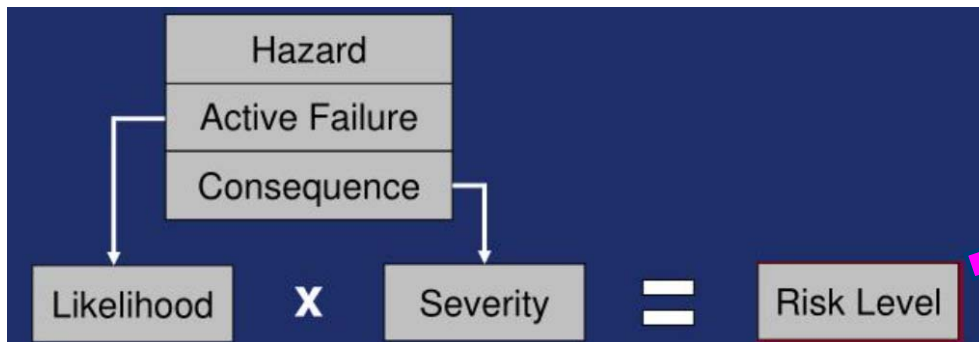
(THROUGH CHANGE MANAGEMENT WITHIN SSP & SMS_DOC9859)



Safety Risk Analysis & Assessment

- ❖ What is the safety risk?
- ❖ How can we analyse the significance?

Risk is the composite of the predicted probability (or likelihood) and severity of each possible consequence (result) of each identified hazard (a condition)



The risk matrix may be **customized to reflect the context of each service provider's local environment**, and aviation activities.

Doc 9859 Table 3. Example safety risk matrix

Safety 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

High (5A, 5B, 5C)
Medium (4A, 4B, 4C, 3A, 3B, 3C, 2A, 2B, 2C, 1A)
Low (3D, 3E, 2D, 2E, 1D, 1E)

Table 4. Example of safety risk tolerability

Safety Risk Index Range	Safety Risk Description	Recommended Action
High 5A, 5B, 5C, 4A, 4B, 3A	INTOLERABLE	Take immediate action to mitigate the risk or stop the activity. Perform priority safety risk mitigation to ensure additional or enhanced preventative controls are in place to bring down the safety risk index to tolerable.
Medium 5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	TOLERABLE	Can be tolerated based on the safety risk mitigation. It may require management decision to accept the risk
Low 3E, 2D, 2E, 1B, 1C, 1D, 1E	ACCEPTABLE	Acceptable as is. No further safety risk mitigation required.



Safety Risk Probability Analysis

❖ Safety risk probability is:

The likelihood or probability that a safety consequence or outcome will occur

- Consider a different variety of scenarios to capture all potential consequences.
- Ask following questions to determine probability:

Doc 9859

- ✓ Is there a history of similar occurrences or is this an isolated occurrence?
- ✓ What other similar equipment or components might have identical issues?
- ✓ What is the number of personnel following the procedures in question?
- ✓ What is the exposure of the hazard under consideration?

Likelihood	Meaning	Value
Frequent	Likely to occur many times (has occurred frequently)	5
Occasional	Likely to occur sometimes (has occurred infrequently)	4
Remote	Unlikely to occur, but possible (has occurred rarely)	3
Improbable	Very unlikely to occur (not known to have occurred)	2
Extremely improbable	Almost inconceivable that the event will occur	1

Table 1. Safety risk probability table

- This table uses qualitative terms
- Quantitative terms could be defined to provide a more accurate assessment



Safety Risk Severity Analysis

❖ Safety risk severity

The extent of harm that might reasonably be expected to occur as a consequence or outcome of the identified hazard

➤ Severity classification should consider:

- **Fatalities or serious injury** as a result of:
 - being in the a/c, direct contact with any a/c part, direct exposure to jet blast
- **Damage**:
 - a/c damage or structural failure which adversely affect a/c's performance, major repair or replacement, ATC or aerodrome equipment damage, adversely affected separation minima or landing capability
- **all possible consequences** related to a hazard, considering the worst foreseeable situation

Doc 9859

Safety Risk Severity Analysis

❖ **SAFETY RISK**
The extent of harm expected to occur at the identified hazard

➤ consider:

Severity	Meaning	Value
Catastrophic	<ul style="list-style-type: none"> • Aircraft / equipment destroyed • Multiple deaths 	A
Hazardous	<ul style="list-style-type: none"> • A large reduction in safety margins, physical distress or a workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely • Serious injury • Major equipment damage 	B
Major	<ul style="list-style-type: none"> • A significant reduction in safety margins, a reduction in the ability of operational personnel to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency • Serious incident • Injury to persons 	C
Minor	<ul style="list-style-type: none"> • Nuisance • Operating limitations • Use of emergency procedures • Minor incident 	D
Negligible	<ul style="list-style-type: none"> • Few consequences 	E

ast
major repair or
eparation
able situation

Table 2. Example safety risk severity table

Safety Risk Assessment : Tolerability

❖ Determine the level of the Safety Risk Tolerability

- Assign the **alphanumerical safety risk index** in the safety risk matrix:
 - the combination of the results of probability and severity
- Apply the safety risk index into the **safety risk tolerability table**:
 - in a narrative form, **the tolerability criteria** of an organization: Intolerable/Tolerable/Acceptable
- Take risk **control action** to reduce the level of a risk according to the result of assessment
 - If the risk assessment results falls in the intolerable and unacceptable under any circumstances, mitigation action is required or activities are stopped

Doc 9859 Table 3. Example safety risk matrix

Safety 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

Note: In the original image, a red box highlights cells 5A, 5B, 5C, 4A, 4B, 4C, 4D, 4E with the text 'Mitigations required'. A blue box highlights cells 2D, 3D, 4D, 5D with the text 'High'. A green box highlights cells 1D, 2D, 3D, 4D, 5D with the text 'Medium'.

Table 4. Example of safety risk tolerability

Safety Risk Index Range	Safety Risk Description	Recommended Action
High 5A, 5B, 5C, 4A, 4B, 4C	INTOLERABLE	Take immediate action to mitigate the risk or stop the activity. Perform priority safety risk mitigation to ensure additional or enhanced preventative controls are in place to bring down the safety risk index to tolerable.
Medium 5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	TOLERABLE	Can be tolerated based on the safety risk mitigation. It may require management decision to accept the risk
Low 3E, 2D, 2E, 1B, 1C, 1D, 1E	ACCEPTABLE	Acceptable as is. No further safety risk mitigation required.

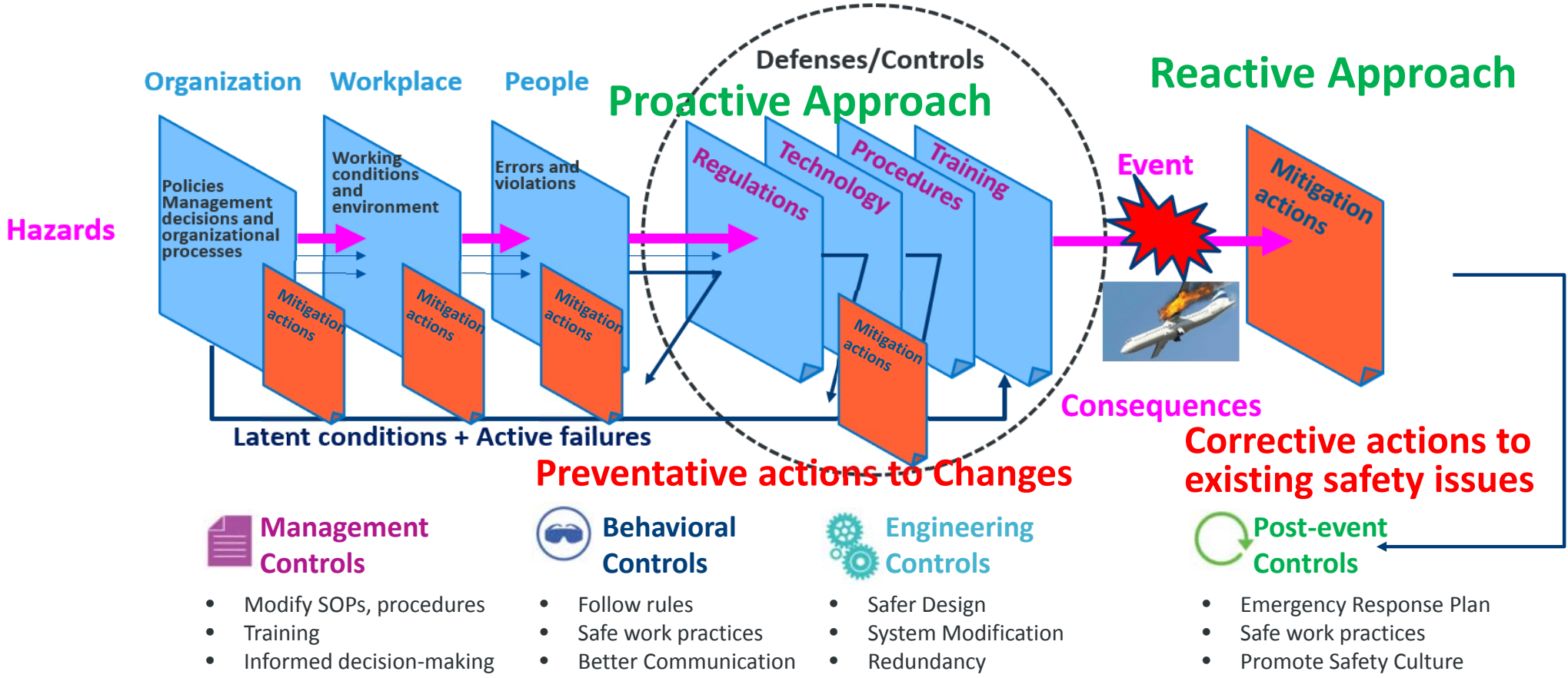


Safety Risk Mitigation/Control Strategies

❖ Safety Risk Mitigation/Control Action should:

- Be **balanced against the time, cost and difficulty of taking action** to reduce or eliminate the safety risk (conduct **cost benefit or cost effectiveness analysis**)
 - Be **managed to an acceptable level** by mitigating the safety risk through application of appropriate safety control:
 - By reducing the severity of the potential consequences
 - By reducing the likelihood of occurrence or by reducing exposure to that safety risk
 - By using both
 - Be bringing changes to the existing **operational procedures, equipment or infrastructure**
- It is easier and more common to reduce the likelihood than the severity

Safety Risk Mitigation/Control Strategies





Safety Risk Mitigation/Control Strategies

Avoid	Reduce	Segregate
<p>The operation or activity is canceled or avoided because the safety risk exceeds the benefits of continuing the activity, thereby eliminating the the safety risk entirely</p> <p>Operations into an aerodrome surrounded by complex geography and without the necessary aids are <u>cancelled</u></p>	<p>The frequency of the operation or activity is reduced, or action is taken to reduce the magnitude of the consequences of the safety risk</p> <p>Operations into an aerodrome surrounded by complex geography and without the necessary aids are <u>limited to day-time, visual conditions</u></p>	<p>Action is taken to Isolate the effects of the consequences of the safety risk or build in redundancy to protect against them</p> <p>Operations into an aerodrome surrounded by complex geography are <u>limited to a/c with specific performance navigation capabilities. Non RVSM equipped a/c not allowed to operate into RVSM airspace</u></p>

Reasonably Practicable !
To an acceptable level of safety performance !!



KEY TAKEAWAYS





Takeaways

- State ATM officer should apply the **SMM** which is in line with **SSP** and **ICAO SARPS**
- **Safety Assessment** should be done before the implementation of any change to ATM system
- **Safety Management** is ongoing process, check and monitor the ATM system regularly to see if the level of intended safety performance remains effective
- **Commensurate with the size and complexity of the organization**
- **Effective safety reviews and safety assessment are not possible without an effective safety culture (in other words, this is the foundation)**



Takeaways

➤ Recommendations when doing ATM safety assessment

- **Collaborative exercise**: Gather the different operational expertise from inside and outside to ensure that your safety assessment is valid
- **Communication through the Plan**: People create safety, early buy in people at front line of operations, especially ultimate users of whatever the changes is for
- **High level commitment and informed decision making is essential**
- **Positive safety culture**: Everyone has a role to play to maintain or improve the safety in ATM system
- Safety assessments must not to be conducted by managers proposing the changes (**independence of the safety team**)
- **The right people involvement** will maximize the practicability of safety risk assessment and mitigation



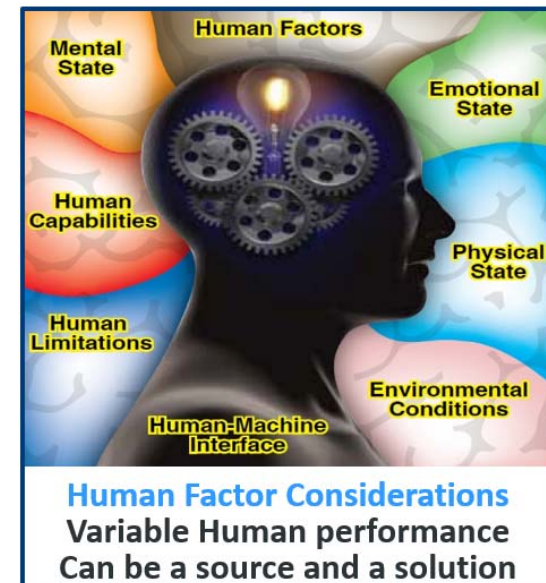
Takeaways

➤ Don't forget Humans in the System

- **Variable human performance** can be a source and a solution
- **Explain, communicate and consult** with people at front line of operations as early as possible especially those who are affected by the change
- **Share** lessons learned and your safety data/information
- Consult with your “End users” & Subject matter experts

■ People are part of change

No change occurs without affecting and being affected by the humans in the system





SMI Public website : More Examples & Tools, Best Practices

Complementary Safety Management Implementation (SMI) public website

(<https://www.unitingaviation.com/publications/safetymanagementimplementation/content/#/>)

- a repository of examples and tools from States and service providers when implementing and maintaining safety management in their organization in accordance with the guidance material found in the 4th edition of the SMM.



ICAO

Welcome to the Safety Management Implementation Website.

- Complementary to the 4th edition of SMM
- Many examples and tools and supporting educational material for the diverse needs
- Additional examples and tools collected, validated and posted on the SMI public website
- **Free e-book version** of advance unedited SMM



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and Caribbean
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(SAM) Office
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(APAC) Sub-office
Beijing

Asia and Pacific
(APAC) Office
Bangkok



THANK YOU



Definitions :

- **ATM system.** The ATM system is a system that provides air traffic management through the collaborative integration of humans, information, technology, facilities and services, supported by air, ground and/or space-based communications, navigation and surveillance
- **State safety programme (SSP).** An integrated set of regulations and activities aimed at improving safety.
- **Safety management system (SMS).** A systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures.
- **SMM.** Safety Management Manual(Doc9859)
- **Safety.** The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.
- **Acceptable level of safety performance (ALoSP).** The level of safety performance agreed by State authorities to be achieved for the civil aviation system in a State, as defined in its State safety programme, expressed in terms of safety performance targets and safety performance indicators
- **Change management.** A formal process to manage changes within an organization in a systematic manner, so that changes which may impact identified hazards and risk mitigation strategies are accounted for, before the implementation of such changes Significant/major/minor change
- **Hazard.** A condition or an object with the potential to cause or contribute to an aircraft incident or accident. Safety risk
- **Safety risk.** The predicted probability and severity of the consequences or outcomes of a hazard.
- **Safety risk probability.** the likelihood or probability that a safety consequence or outcome will occur.
- **Safety risk Severity.** the extent of harm that might reasonably occur as a consequence or outcome of the identified hazard.



Definitions :

- **Risk mitigation.** The process of incorporating defences, preventive controls or recovery measures to lower the severity and/or likelihood of a hazard's projected consequence. SSP
- **Safety oversight.** A function performed by a State to ensure that individuals and organizations performing an aviation activity comply with safety-related national laws and regulations.
- **Safety performance.** A State's or service provider's safety achievement as defined by its safety performance targets and safety performance indicators.
- **Safety performance indicator.** A data-based parameter used for monitoring and assessing safety performance.
- **Safety performance target.** The State or service provider's planned or intended target for a safety performance indicator over a given period that aligns with the safety objectives.



Change Management Process through SA with SRM

the objective of SMS: Continuous improvement

Safety Risk Management (SRM) Process

System Description

Hazard Identification

Risk Analysis

Risk Assessment

Risk Control

Risk Control Effectiveness Validation

Changes or Existing safety issue

Safety Assurance & Surveillance Activities

Continuous Review & Ongoing Monitoring of SMS

Strong link between change management and risk management—the two processes support each other and should be used in conjunction

Review and Monitor the system and operations to:

- Identify new hazards/ineffective control or adverse safety trend by analyzing safety data
- Ensure compliance with regulatory requirements

- Internal or External audit
- Safety performance (Safety Objectives SPIs, SPTs) monitoring and measurement
- The management of change**
- Assessment of safety culture and SMS effectiveness
- Management reviews and addressing lessons learnt

Safety Assurance (SA): Safety Risk-based/Performance-based Surveillance approach



Examples of Likelihood Table

US FAA

US FAA

Table 3.5: Likelihood of the Effect Standards – ATO Operations and NAS Equipment

	Operations: Expected Occurrence Rate (per operation / flight hour / operational hour ³) Quantitative (ATC / Flight Procedures / Systems Engineering)
Frequent A	(Probability) ≥ 1 per 1000
Probable B	1 per 1000 > (Probability) ≥ 1 per 100,000
Remote C	1 per 100,000 > (Probability) ≥ 1 per 10,000,000
Extremely Remote D	1 per 10,000,000 > (Probability) ≥ 1 per 1,000,000,000
Extremely Improbable E	1 per 1,000,000,000 > (Probability) ≥ 1 per 10 ¹⁴

$$\text{Likelihood} = \frac{\text{Expected number of occurrences of the effect}}{\text{Known number of affected operations}}$$

Korea Airport Cooperate

Code	Probability	Criteria
5	Frequent	Likely to occur within a week
4	Occasional	Likely to occur within a month
3	Remote	Likely to occur within a year
2	Improbable	Likely to occur within 10 years
1	Extremely Improbable	Unlikely to occur within a 10 years

Table 3.6: Calendar-Based Likelihood of the Effect Definitions – Operations/Domain-Wide

	Operations: Expected Occurrence Rate (Calendar-based) (Domain-wide: NAS-wide, Terminal, or En Route)
Frequent A	Equal to or more than once per week
Probable B	Less than once per week and equal to or more than once per three months
Remote C	Less than once per three months and equal to or more than once per three years
Extremely Remote D	Less than once per three years and equal to or more than once per 30 years
Extremely Improbable E	Less than once per 30 years



Examples of Severity Table US FAA

Korea Airport Cooperate

Hazard Severity Classification					
<i>Note: Severities related to ground-based effects apply to movement areas only.</i>					
Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic ⁴ 1	
CONDITIONS RESULTING IN ANY ONE OF THE FOLLOWING:					
ATC Services	A minimal reduction in ATC services	Low Risk Analysis Event severity, ³ two or fewer indicators fail	Medium Risk Analysis Event severity, three indicators fail	High Risk Analysis Event severity, four indicators fail	Ground collision ⁵ Mid-air collision Controlled flight into terrain or obstacles
	CAT D runway incursion ¹ Proximity Event, Operational Deviation, or measure of compliance greater than or equal to 66 percent ²	CAT C runway incursion	CAT B runway incursion	CAT A runway incursion	

Hazard Severity Classification					
<i>Note: Severities related to ground-based effects apply to movement areas only.</i>					
Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic ⁴ 1	
CONDITIONS RESULTING IN ANY ONE OF THE FOLLOWING:					
Flying Public	Minimal injury or discomfort to persons on board	Physical discomfort to passenger(s) (e.g., extreme braking action, clear air turbulence causing unexpected movement of aircraft resulting in injuries to one or two passengers out of their seats)	Physical distress to passengers (e.g., abrupt evasive action, severe turbulence causing unexpected aircraft movements)	Serious injury to persons on board ⁷	Fatal injuries to persons on board ⁸
		Minor injury to less than or equal to 10 percent of persons on board ⁶	Minor injury to greater than 10 percent of persons on board		

Code	Severity	Criteria	
5	Catastrophic	Person	Occurrence of death (over 10 people)
		Property	Loss of 10 billion Won or more
		Airport ops.	Airport Closure
4	Hazardous	Person	Occurrence of death (1~9 people)
		Property	Loss of 1 ~ 10 billion Won
		Airport ops.	Runway closure(over 24h), Taxiway, Ramp Closure (over 72h)
3	Major	Person	Serious injury
		Property	Loss of 100million ~ 1 billion Won
		Airport ops.	Runway closure(under 24h), Taxiway, Ramp Closure (under 72h)
2	Minor	Person	Injury requiring over 4 weeks for cure
		Property	Loss of 10million ~ 100 million Won
		Airport ops.	Flight delay(over 3h) or cancelation
1	Negligible	Person	Injury requiring less than 4 weeks for cure
		Property	Loss of less than 10million
		Airport ops.	Nothing



Examples of Severity Table

Table 3.4: NAS Equipment Worst Credible Severity Table¹ US FAA

Service	Functionality	Failure Condition/Hazard	Environment / System State	Effect	Worst Credible Severity/Rating
NAV	Visual Glide Slope Indicators (Precision Approach Path Indicator / Visual Approach Slope Indicator)	Loss of function	Night, VMC	None	No safety effect
		Malfunction	Night, VMC	Pilot penetrates OCS	Major Significant reduction in safety margin
	En route guidance	Loss of function	IMC	Pilot transitions to alternate navigation method	Minor Slight reduction in safety margin
		Malfunction	IMC	HMI exceeds minimum en route altitude	Hazardous Large reduction in safety margin
	Runway visual range	Loss of function / malfunction	IMC	Missed approach	Minor Increased flight crew workload



Examples of Safety Risk Tolerability Matrix

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

AAI (India)

Korea Airport Cooperate

		Severity				
		Catastrophic 5	Hazardous 4	Major 3	Minor 2	Negligible 1
Probability	Frequent 5	Very high (25)	Very high (20)	High (15)	High (10)	Middle (5)
	Occasional 4	Very high (20)	Very high (16)	High (12)	Middle (8)	Middle (4)
	Remote 3	High (15)	High (12)	High (9)	Middle (6)	Low (3)
	Improbable 2	High (10)	Middle (8)	Middle (6)	Middle (4)	Low (2)
	Extremely Improbable 1	Middle (5)	Middle (4)	Low (3)	Low (2)	Low (1)

Severity Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A	Low	Medium	High	High	High
Probable B	Low	Medium	High	High	High
Remote C	Low	Medium	Medium	High	High
Extremely Remote D	Low	Low	Medium	Medium	High
Extremely Improbable E	Low	Low	Low	Medium	High* Medium

US FAA

*Risk is high when there is a single point or common cause failure.

Figure 3.7: Risk Matrix



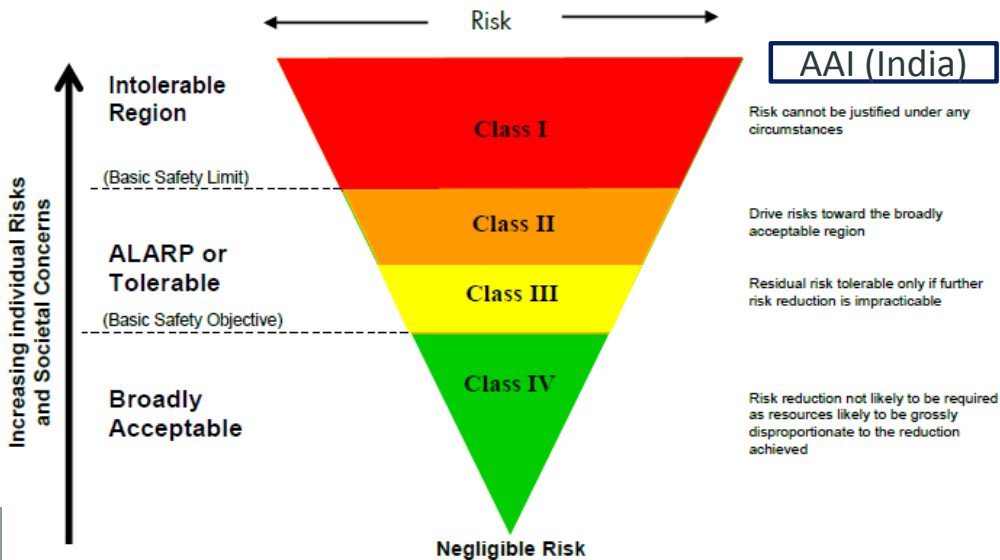
Korea Airport Cooperate

Risk		acceptability	Criteria for management
25~16	Very high	Intolerable	It is needed to be eliminated immediately. If can't, the operation shall be stopped.
15~ 9	High	Tolerable	It is needed to be eliminated. If can't, the risk shall be managed as a middle level by conducting proper risk mitigation.
8~4	Middle		Acceptable, but the risk mitigation is required to bring down the risk to the acceptable level.
3~1	Low	Acceptable	No further action is required.

Risk Category

AAI (India)

Class	Risk
I	5A, 5B, 5C, 4A, 4B & 3A
II	5D, 5E, 4C, 3 B, 3C & 2A
III	4D, 4E, 3D, 2C & 2B
IV	3E, 2D, 2E, 1A, 1B, 1C, 1D & 1E



Risk Acceptance Authority

Class	Authority
Cat I	Risk Unacceptable, action required to treat the risk
Cat II	Undesirable but may be accepted in exceptional circumstances with the approval of the appropriate Executive Director
Cat III	Tolerable, may be accepted by the appropriate General Manager
Cat IV	Risk Acceptable with conditions with the approval of ATM/CNS/Airport In-charge as the case may be