# WORKING TOGETHER TO ENHANCE AIRPORT OPERATIONAL SAFETY

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# Safety assessment in aerodromes

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*The safety assessment process addresses the* ***impact of a safety concern, including a change or deviation, on the safety of operations at the aerodrome and takes into consideration the aerodrome's capacity and the efficiency of operations,*** *as necessary.*

# Safety assessment in aerodromes

A safety assessment **is an element of the risk management process of an SMS that is used to assess safety concerns** arising from, inter alia, deviations from standards and applicable regulations, identified changes at an aerodrome specified, or when any other safety concerns arise.

When a safety concern, change or a deviation **has an impact on several aerodrome stakeholders, consideration shall be given to the involvement of all stakeholders affected in the safety assessment process**.

In some cases, **the stakeholders impacted by the change will need to conduct a separate safety assessment themselves in order to fulfil the requirements of their SMSs** and coordinate with other relevant stakeholders.

# Safety assessment in aerodromes

**When a change has an impact on multiple stakeholders, a collaborative safety assessment should be conducted** to ensure compatibility of the final solutions.

A safety assessment considers the impact of the safety concern on **all relevant factors determined to be safety-significant.**

# Safety assessment in aerodromes

The items in this list are not exhaustive and in no particular order:

a) **aerodrome layout**, including runway configurations; runway length; taxiway, taxilane and apron configurations; gates; jet bridges; visual aids; and the RFF services infrastructure and capabilities;

b) **types of aircraft**, and their dimensions and performance characteristics, intended to operate at the aerodrome;

c) **traffic** density and distribution;

d) **aerodrome ground services**;

e) **air-ground communications** and time parameters for voice and data link communications;

# Safety assessment in aerodromes

f) **type and capabilities of surveillance systems** and the availability of systems providing controller support and alert functions;

g) **flight instrument procedures** and related aerodrome equipment;

h) **complex operational procedures**, such as collaborative decision-making (CDM);

i) **aerodrome technical installations**, such as advanced surface movement guidance and control systems (A-SMGCS) or other air navigation aids;

j) **obstacles or hazardous activities** at or in the vicinity of the aerodrome;

k) **planned construction or maintenance works** at or in the vicinity of the aerodrome;

# Safety assessment in aerodromes

l) any **local or regional hazardous meteorological conditions** (such as wind shear); and

m) **airspace complexity**, ATS route structure and classification of the airspace, which may change the pattern of operations or the capacity of the same airspace.

Subsequent to the completion of the safety assessment, **the aerodrome operator is responsible for implementing and periodically monitoring the effectiveness of the identified mitigation measures**.


**The State reviews the safety assessment provided by the aerodrome** operator and its identified mitigation measures, and is responsible for the subsequent regulatory oversight of their application.

# Safety assessment process

The primary objective of a safety assessment is to **assess the impact of a safety concern such as a design change or deviation in operational procedures** at an existing aerodrome.

Such a **safety concern can often impact multiple stakeholders**; therefore, **safety assessments often need to be carried out in a cross-organizational manner**, involving experts from all the involved stakeholders.

Prior to the assessment, a **preliminary identification of the required tasks and the organizations** to be involved in the process is conducted.

# Safety assessment process

A safety assessment is initially composed of four basic steps:

a) **definition of a safety concern** and identification of the regulatory compliance;

b) **hazard identification** and analysis;

c) **risk assessment** and development of mitigation measures; and

d) **development of an implementation plan** for the mitigation measures and conclusion of the assessment.

# Safety concern/identification of regulatory compliance

Any perceived safety concerns must be described in **detail, including timescales, projected phases, location, stakeholders involved or affected as well as their potential influence on specific processes, procedures, systems and operations**.

The perceived safety concern **is first analysed to determine whether it is retained or rejected**.

**If rejected, the justification for rejecting the safety concern is to be provided and documented**.

An **initial evaluation of compliance** with the appropriate provisions in the regulations applicable to the aerodrome is conducted and documented.

# Safety concern/identification of regulatory compliance

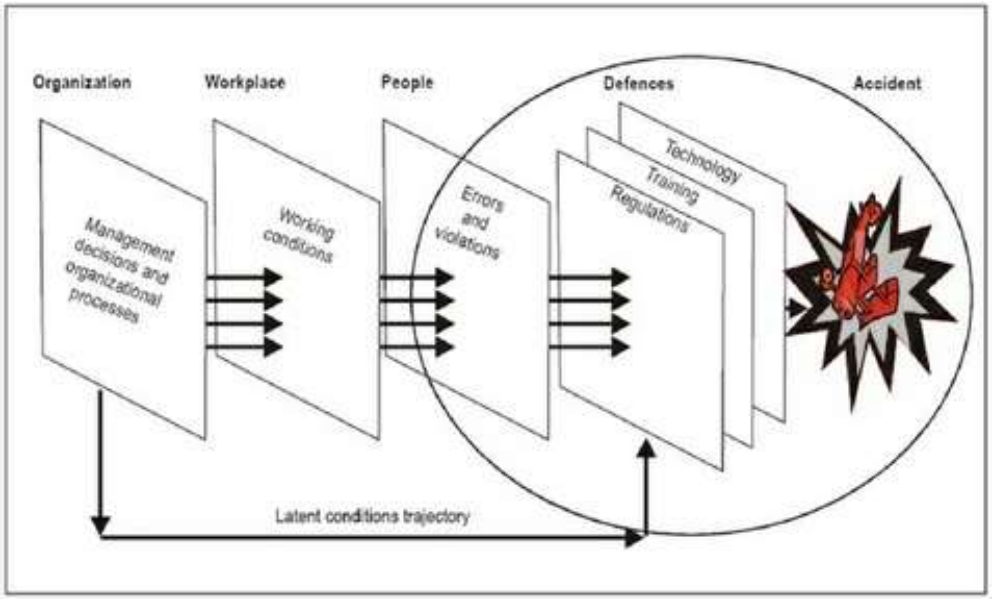
The **corresponding areas of concern are identified before proceeding with the remaining steps of the safety assessment**, with all relevant stakeholders.

If a safety assessment was conducted previously for similar cases in the same context at an aerodrome where similar characteristics and procedures exist, **the aerodrome operator may use some elements from that assessment as a basis for the assessment to be conducted**.

Nevertheless, as **each assessment is specific to a particular safety concern** at a given aerodrome the suitability for reusing specific elements of an existing assessment is to be carefully evaluated.

# Hazard identification

Hazards related to infrastructure, systems or operational procedures are initially identified using methods such as **brain-storming sessions, expert opinions, industry knowledge, experience and operational judgement**.




The identification of hazards is conducted by considering:

a) **accident causal factors and critical events** based on a simple causal analysis of available accident and incident databases;

# Hazard identification

b) **events that may have occurred in similar circumstances** or that are subsequent to the resolution of a similar safety concern; and

c) **potential new hazards that may emerge during or after implementation of the planned changes**.

# Hazard identification

Following the previous steps, all potential outcomes or consequences for each identified hazard are identified.

The appropriate safety objective for each type of hazard should be defined and detailed.

This can be done through:

a) **reference to recognized standards** and/or codes of practices;

b) **reference to the safety performance** of the existing system;

c) **reference to the acceptance of a similar system elsewhere**; and

d) **application of explicit safety risk levels**.

Safety objectives are specified in either **quantitative terms** (e.g. identification of a numerical probability)or **qualitative terms** (e.g. comparison with an existing situation).

The selection of the safety objective is made **according to the aerodrome operator's policy with respect to safety improvement and is justified for the specific hazard**.

# Risk assessment and development of mitigation measures

The **level of risk** of each identified potential consequence is estimated by **conducting a risk assessment**.

This **risk assessment will determine the severity of a consequence** (effect on the safety of the considered operations) **and the probability of the consequence** occurring and will be based on experience as well as on any available data (e.g. accident database, occurrence reports).


Understanding the risks is the basis for the **development of mitigation measures, operational procedures and operating restrictions** that might be needed to ensure safe aerodrome operations.

# Risk assessment and development of mitigation measures

The method for risk evaluation is strongly dependent on the **nature of the hazards**.

The risk itself is evaluated by **combining the two values for severity of its consequences and probability of occurrence**.

Once each hazard has been identified and analysed in terms of causes, and assessed for severity and probability of its occurrence, it **must be ascertained that all associated risks are appropriately managed**.

An **initial identification of existing mitigation measures** must be conducted **prior to the development of any additional measures**.

**All risk mitigation measures**, whether currently being applied or still under development, **are evaluated for the effectiveness of their risk management capabilities**.

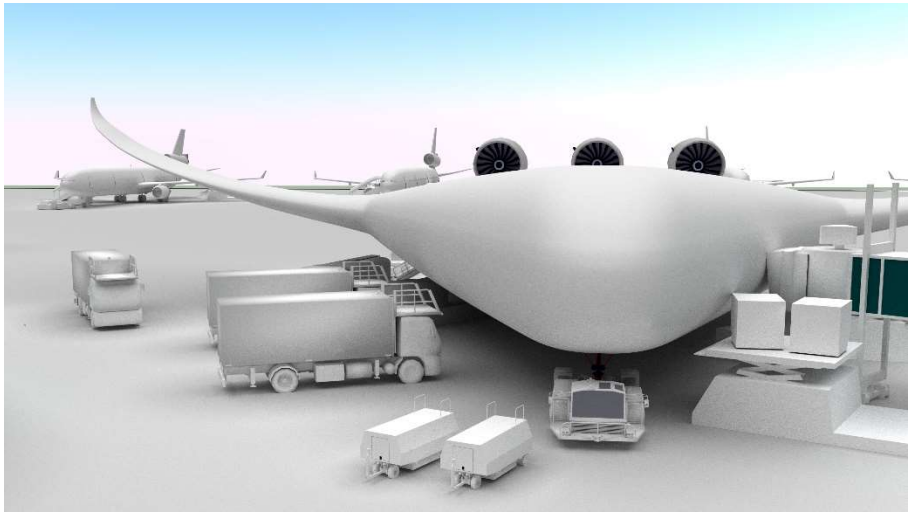
# Risk assessment and development of mitigation measures

In some cases, a **quantitative approach** may be possible, and numerical safety objectives can be used.

In other instances such as **changes to the operational environment or procedures**, a qualitative analysis may be more relevant.

**States should provide suitable guidance on risk assessment models for aerodrome operators.**

In some cases, the result of the risk assessment may be that the safety objectives will be met without any additional specific mitigation measures.



# Implementation plan and conclusion of the assessment

The last phase of the safety assessment process is the **development of a plan for the implementation of the identified mitigation measures**.

The implementation plan includes **time frames, responsibilities for mitigation measures as well as control measures** that may be defined and implemented to monitor the effectiveness of the mitigation measures

# Approval or acceptance of a safety assessment

The State may, for specific reasons, require the **submission of the specific safety assessment for approval/acceptance**.

The State establishes **the type of safety assessments that are subject to approval or acceptance and determines the process used for that approval/acceptance**.

Where required a safety assessment subject to approval or acceptance by the State **shall be submitted by the aerodrome operator prior to implementation**.

# Approval or acceptance of a safety assessment

The State analyses the safety assessment and verifies that:

a) **appropriate coordination has been performed** between the concerned stakeholders;

b) **the risks have been properly identified and assessed, based on documented arguments** (e.g. physical or Human Factors studies, analysis of previous accidents and incidents);

c) **the proposed mitigation measures adequately address the risk**; and

d) the **time frames for planned implementation are acceptable**.

# Approval or acceptance of a safety assessment

On completion of the analysis of the safety assessment, the State:

a) either **gives formal approval or acceptance** of the safety assessment to the aerodrome operator or,

b) if some risks have been underestimated or have not been identified, **coordinates with the aerodrome operator to reach an agreement on safety acceptance**; or

c) if no agreement can be reached, **rejects the proposal for possible resubmission** by the aerodrome operator; or

d) may choose to impose **conditional measures to ensure safety**.

The State should ensure that the **mitigation or conditional measures are properly implemented and that they fulfil their purpose**.

# Promulgation of safety information

The aerodrome operator determines the **most appropriate method for communicating safety information to the stakeholders and ensures that all safety-relevant conclusions of the safety assessment are adequately communicated**.

In order to ensure adequate dissemination of information to interested parties, information that affects the current integrated aeronautical information package (IAIP) or other relevant safety information is:

a) **promulgated in the relevant section of the IAIP** or automatic terminal information service (ATIS); and

b) **published in the relevant aerodrome information communications through appropriate means**.

# Safety assessment methodologies for aerodromes

Depending on the nature of the risk**, three methodologies can be used to evaluate whether it is being appropriately managed**:

a) ***Method type "A".*** For certain hazards, the risk assessment strongly depends on **specific aeroplane and/or system performance**.

The risk level is dependent upon **aeroplane/system performance** (e.g. more accurate navigation capabilities), handling qualities and infrastructure characteristics.

Risk assessment, then, can be based on **aeroplane/system design and validation, certification, simulation results and accident/incident analysis**;

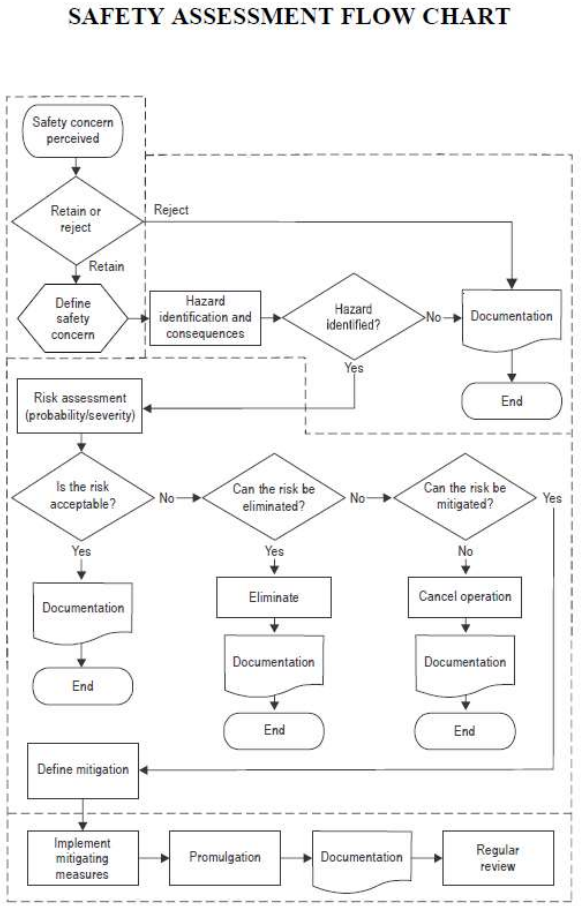



**Figure 3-Att A-1. Flow chart to be used for the conduct of a safety assessment**

# Safety assessment methodologies for aerodromes

b) ***Method type "B"***.

For other hazards, risk assessment is not really linked with specific aeroplane and/or system performance but can be **derived from existing performance measurements**.

Risk assessment, then, can be based **on statistics** (e.g. deviations) **from existing operations or on accident analysis**; development of generic quantitative risk models can be well adapted;

c) ***Method type "C".*** In this case, a "**risk assessment study" is not needed**.

**A simple logical argument may be sufficient** to specify the infrastructure, system or procedure requirements, without waiting for additional material, e.g. **certification results for newly announced aeroplanes or using statistics from existing aeroplane operations**.

# Risk assessment method

The risk assessment takes into account the **probability of occurrence of a hazard and the severity of its consequences**; the risk is evaluated by **combining the two values for severity and probability of occurrence**.

Each identified hazard must be **classified by probability of occurrence and severity of impact**.

This process of risk classification will **allow the aerodrome to determine the level of risk posed by a particular hazard**.

The classification of probability and severity refers to **potential events**.

# Risk assessment method

The severity classification includes five classes ranging from **“catastrophic” (class A) to “not significant” (class E).**

The classification of the severity of an event should be based on a “**credible case**” but not on a “worst case” scenario.

A credible case is **expected to be possible under reasonable conditions** (probable course of events). A worst case may be expected under extreme conditions and combinations of additional and improbable hazards.

If worst cases are to be introduced implicitly, it is necessary to **estimate appropriate low frequencies**.

| 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 |

# Risk assessment method

The classification refers to the **probability of events per a period of time**. This is reasoned through the following:

a) many hazards at aerodromes are **not directly related to aircraft movements**; and

b) the assessment of hazards occurrence probabilities can be **based on expert judgement without any calculations**.

The aim of the matrix is to provide a **means of obtaining a safety risk index**.

| *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 |

# Risk assessment method

The index can be used to determine **tolerability of the risk and to enable the prioritization** of relevant actions in order to decide about risk acceptance.

Given that the prioritization is dependent on both probability and severity of the events, **the prioritization criteria will be two-dimensional**.

**Table Att-4. Risk index matrix (severity × likelihood)**

| *Likelihood* | *Severity* | | | | |
|---|---|---|---|---|---|
| | *1. Insignificant* | *2. Minor* | *3. Moderate* | *4. Major* | *5. Catastrophic* |
| A. Certain/frequent | Moderate (1A) | Moderate (2A) | High (3A) | Extreme (4A) | Extreme (5A) |
| B. Likely/occasional | Low (1B) | Moderate (2B) | Moderate (3B) | High (4B) | Extreme (5B) |
| C. Possible/remote | Low (1C) | Low (2C) | Moderate (3C) | Moderate (4C) | High (5C) |
| D. Unlikely/improbable | Negligible (1D) | Low (2D) | Low (3D) | Moderate (4D) | Moderate (5D) |
| E. Exceptional | Negligible (1E) | Negligible (2E) | Low (3E) | Low (4E) | Moderate (5E) |

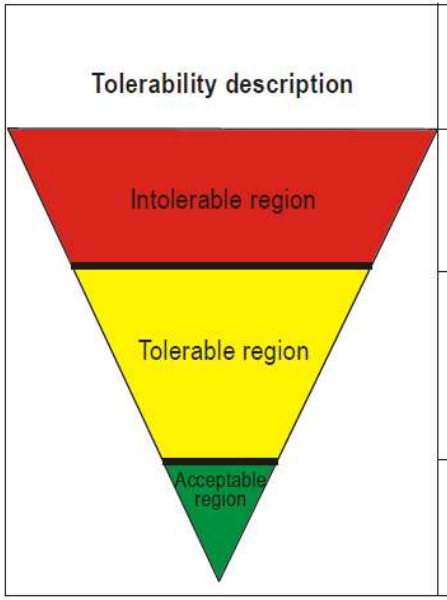
# Risk assessment method

Three main classes of hazard mitigation priority are defined:

a) hazards with **high priority — intolerable**;

b) hazards with **mean priority — tolerable**; and

c) hazards with **low priority — acceptable**.




| Tolerability description | Assessed risk index | Suggested criteria |
|---|---|---|
| Intolerable region | 5A, 5B, 5C, 4A, 4B, 3A | Unacceptable under the existing circumstances |
| Tolerable region | 5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A | Acceptable based on risk mitigation. It may require management decision. |
| Acceptable region | 3E, 2D, 2E, 1B, 1C, 1D, 1E | Acceptable |

# Risk assessment method

The risk assessment matrix has no fixed limits for tolerability but points to a floating assessment where risks are given risk priority for their risk contribution to aircraft operations.

For this reason, the priority classes are intentionally not edged along the probability and severity classes in order to take into account the imprecise assessment.

**Table Att-5. Risk acceptability (tolerability) table**

| *Risk Index* | *Tolerability* | *Action required (customize as appropriate)* |
|---|---|---|
| 5A, 5B, 4A | Extreme risk | Stop operation or process immediately. Unacceptable under the existing circumstances. Do not permit any operation until sufficient control measures have been implemented to reduce the risk to an acceptable level. Top management approval required. |
| 5C, 4B, 3A | High risk | Caution. Ensure that risk assessment has been satisfactorily completed and declared preventive controls are in place. Senior management approval of risk assessment before commencement of the operation or process. |
| 1A, 2A, 2B, 3B, 3C, 4C, 4D, 5D, 5E | Moderate risk | Perform or review risk mitigation as necessary. Departmental approval of risk assessment. |
| 1B, 1C, 2C, 2D, 3D, 3E, 4E | Low risk | Risk mitigation or review is optional. |
| 1D, 1E, 2E | Negligible risk | Acceptable as is. No risk mitigation required. |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# THANK YOU!