Runway Safety Hazards and Mitigation

Hazards and Consequences

- Hazard: Condition or object with potential of causing:
  - Injuries to personnel
  - Damage to equipment or structures
  - Loss of material
  - Reduction of ability to perform prescribed function

Hazards and Consequences

- Wind of 15 knots blowing directly across runway is a hazard
- Pilot may not be able to control aircraft during landing is one of consequences of hazard

Hazards and Consequences

- Consequence: Potential outcome(s) of hazard
- Risk: Assessment, expressed in terms of predicted probability and severity, of consequence(s) of a hazard taking as reference worst foreseeable situation

Hazard Identification

- Design factors
- Policy & Procedures
- Operating practices
- Communications
- Organizational factors
- Work environment factors
- Regulatory factors
- Human performance

Objective: Remove hazards and minimize the residual risk

Runway Safety

Hazards

Air Traffic Control

- Lack of awareness of the importance of stabilized approaches
- Lack of awareness of stabilized approach criteria
- Late descent clearance for the approach
- Assignment of inappropriate approach speeds
- Runway selection not based on best length or wind conditions
- Late runway changes (takeoff or landing runway changes)
- Lack of a precision approach procedure

Runway Safety

Hazards

Communications

- Failure to provide timely, accurate and relevant information to Pilots
- Lack of standardized runway condition reporting to flight crews
- The misinterpretation of a given instructions

Resource: Pilot Phraseology Report

Runway Safety

Hazards

Operations

- Unstable Approaches
- Fatigue: performance decrease – impaired decision making
- Inaccurate performance calculations
- Ineffective braking
- Non-compliance with SOP
- Pilot training and techniques

Runway Safety

Hazards

Airports

- Lack of adequate identification of runways and taxiways
- Inadequate signage/markings and illumination/lighting
- Inadequate runway end safety area (RESA)
- Inadequate snow and ice control plan
- Runways not constructed and maintained to maximize effective friction and drainage
- Airport environment charts lacking such as RESA and Arresting Beds
- Runways not constructed and maintained to maximize effective friction and drainage

Runway Safety

Hazards

Airports

- Inadequate, outdate, or wrong NOTAMs regarding runway construction or condition
- Noise restrictions over-riding safety
  - reverse thrust limits,
  - use of short runways/tailwind runways instead of best runway
- Lack of continuous friction measuring devices for contaminated runways
- Stop Bars

Risk Analysis

- Probability: likelihood that unsafe event or condition might occur
- Severity: possible effects of unsafe event or condition, taking as reference worst foreseeable situation

Types of Data Sources

- Reactive: Responds to events that happened, such as incidents/accidents
- Proactive: Identifies safety risks through analysis of organizational activities
- Predictive: Captures system performance in normal ops to identify potential future problems

Probability of occurrence		
Qualitative definition	**Meaning**	**Value**
Frequent	Likely to occur many times *(has occurred frequently)*	**5**
Occasional	Likely to occur some times *(has occurred infrequently)*	**4**
Remote	Unlikely, but possible to occur *(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**

Source: ICAO SMS Course

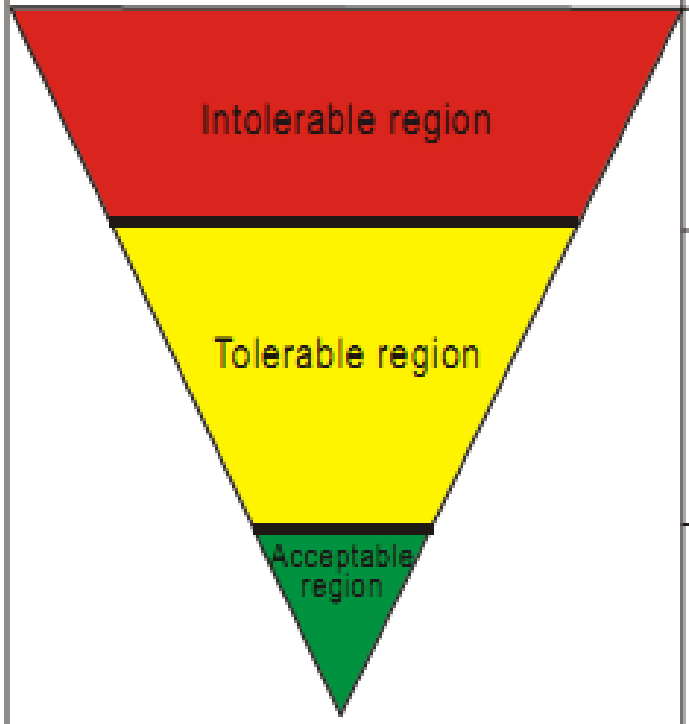
Severity of occurrences		
Aviation definition	**Meaning**	**Value**
Catastrophic	➢Equipment destroyed. ➢Multiple deaths.	**A**
Hazardous	➢A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely. ➢Serious injury. ➢Major equipment damage.	**B**
Major	➢A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency. ➢Serious incident. ➢Injury to persons.	**C**
Minor	➢Nuisance. ➢Operating limitations. ➢Use of emergency procedures. ➢Minor incident.	**D**
Negligible	➢Little consequences	**E**

Source: ICAO SMS Course

Safety risk assessment 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

Safety risk tolerability matrix

Tolerability description	Assessed 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, 1A	Acceptable based on risk mitigation. It may require management decision.
	3E, 2D, 2E, 1B, 1C, 1D, 1E	Acceptable

Safety risk tolerability matrix

Risk index range	Description	Recommended action
5A, 5B, 5C, 4A, 4B, 3A	High risk	Cease or cut back operation promptly if necessary. Perform priority risk mitigation to ensure that additional or enhanced preventive controls are put in place to bring down the risk index to the moderate or low range.
5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	Moderate risk	Schedule performance of a safety assessment to bring down the risk index to the low range if viable.
3E, 2D, 2E, 1B, 1C, 1D, 1E	Low risk	Acceptable as is. No further risk mitigation required.

RISK MITIGATION

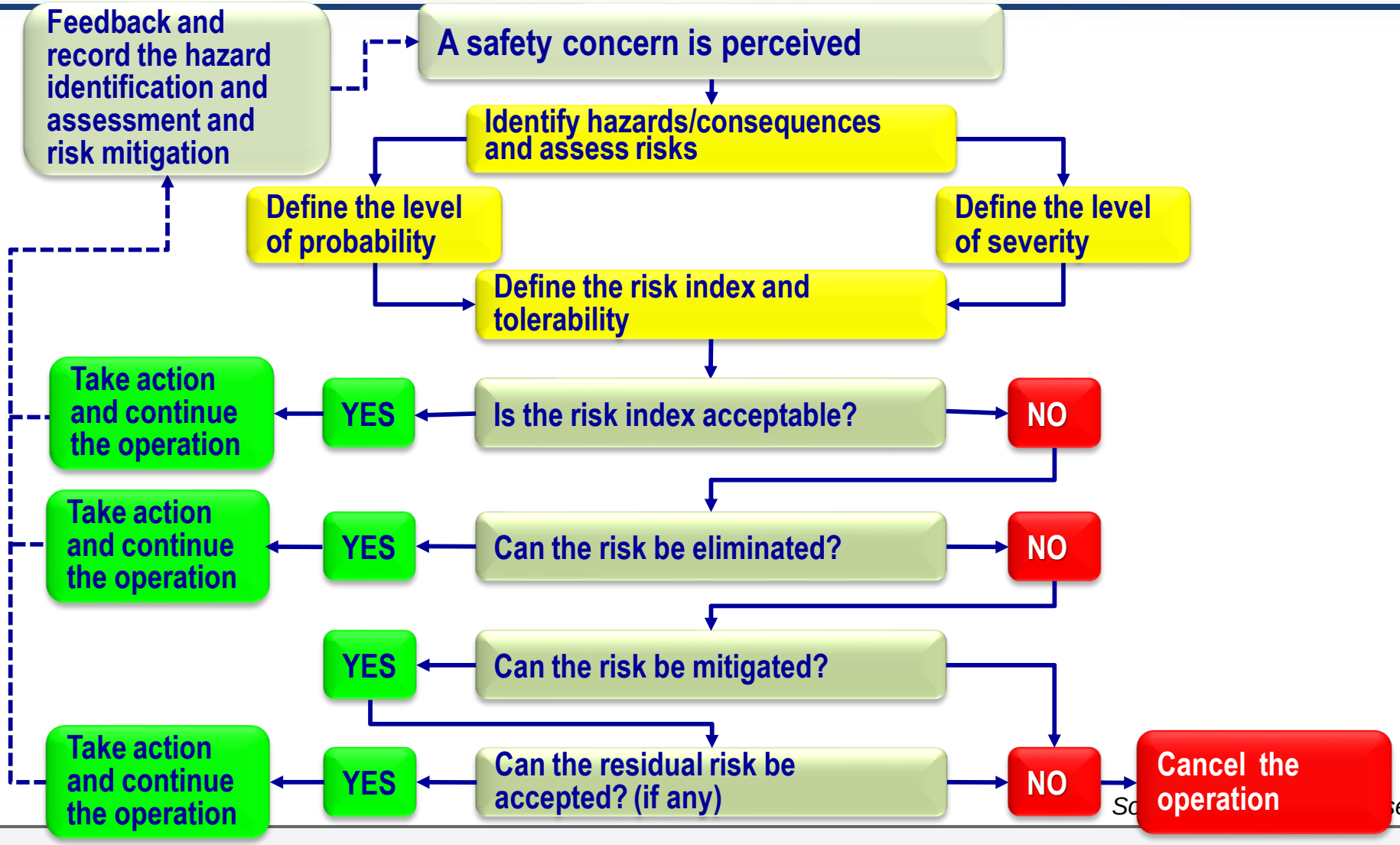
Risk Mitigation

- Measures to address potential hazard or to reduce risk probability or severity

Objective: Remove hazards and minimize the residual risk

Risk Mitigation Strategies

- Avoidance: operation or activity is cancelled because risks exceed benefits of continuing.
  - Ops into aerodrome surrounded by complex geography and without the necessary aids are cancelled
- Reduction: operation or activity is subject to limitations, or action is taken to reduce the magnitude of consequences of accepted risks
  - Ops into aerodrome surrounded by complex geography and without necessary aids are limited to day-time, visual conditions
- Segregation of exposure: Action is taken to isolate effects of consequences of hazard or build-in redundancy to protect against it
  - Ops into aerodrome surrounded by complex geography are limited to aircraft with specific/performance navigation capabilities

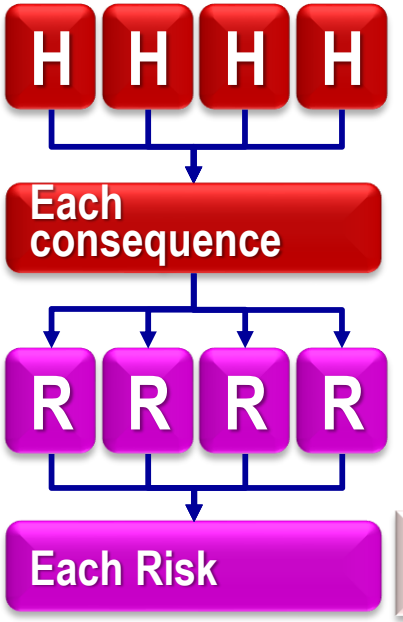

Feedback and record the hazard identification and assessment and risk mitigation
A safety concern is perceived
Identify hazards/consequences and assess risks
Define the level of probability
Define the level of severity
Define the risk index and tolerability
Is the risk index acceptable?
YES
Take action and continue the operation
NO
Can the risk be eliminated?
YES
Take action and continue the operation
NO
Can the risk be mitigated?
YES
Can the residual risk be accepted? (if any)
YES
Take action and continue the operation
NO
Cancel the operation

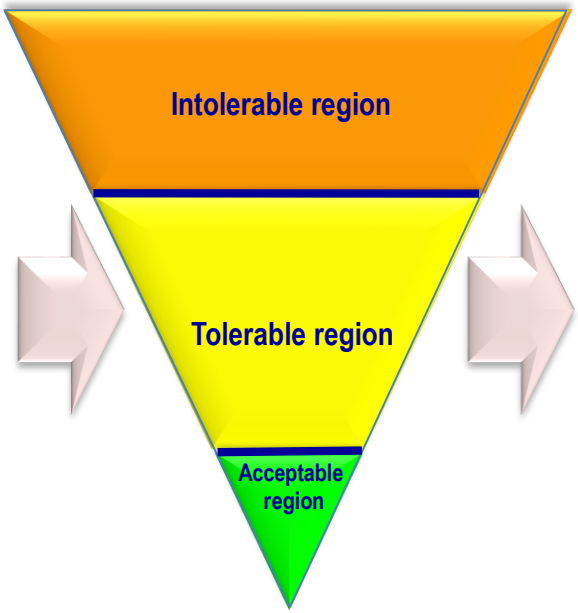
Hazard/consequence identification and risk assessment

Assessment of the defences within the safety system

Control and mitigation of the risk(s)

Accepting the mitigation of the risk(s)





- Does it address the risk(s)?
- Is it effective?
- Is it appropriate?
- Is additional or different mitigation warranted?
- Do the mitigation strategies generates additional risk(s)

Feedback (Safety assurance)

Source: ICAO SMS Course

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Risk Mitigation Strategies

Multiple Risk Factors

- The risk of a runway excursion increases when more than one risk factor is present.
- Multiple risk factors create a synergistic effect (i.e., two risk factors more than double the risk).

Risk Mitigation Strategies

- Safety Management System (SMS) methodology could effectively identify increased-risk operations created by multiple risk factors.
- Applying proper mitigation strategies could reduce the risk of a runway excursion.