



| ICAO | UNITING AVIATION

# SAFETY MANAGEMENT SYSTEM



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ICAO

UNITING AVIATION

# Safety Management-Aerodrome



## Module 2: Risk Assessment



## INTRODUCTION

SMS Framework  
Risk Management Principles

## HAZARD ANALYSIS

Objective  
BOW TIE Model  
BOWTIE XP

## RISK ASSESSMENT & MITIGATION

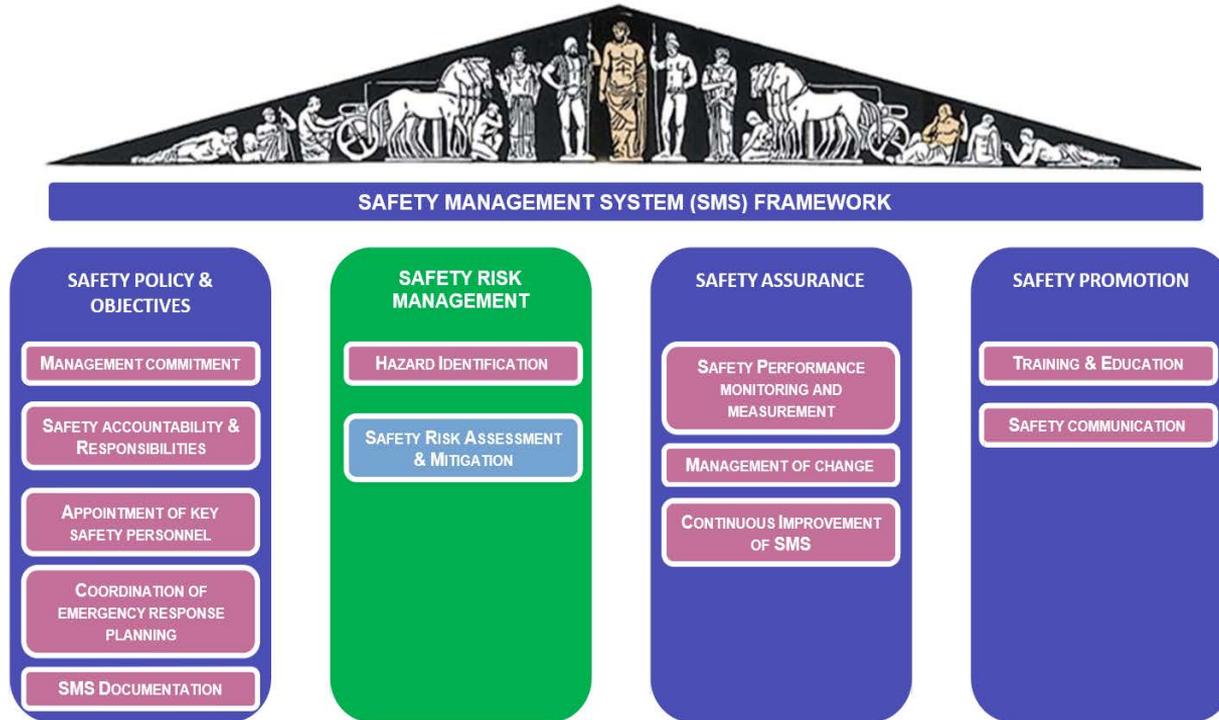
Risk Assessment Matrix  
Inherent & Residual risk  
Decisions on mitigations

## DOCUMENTATION

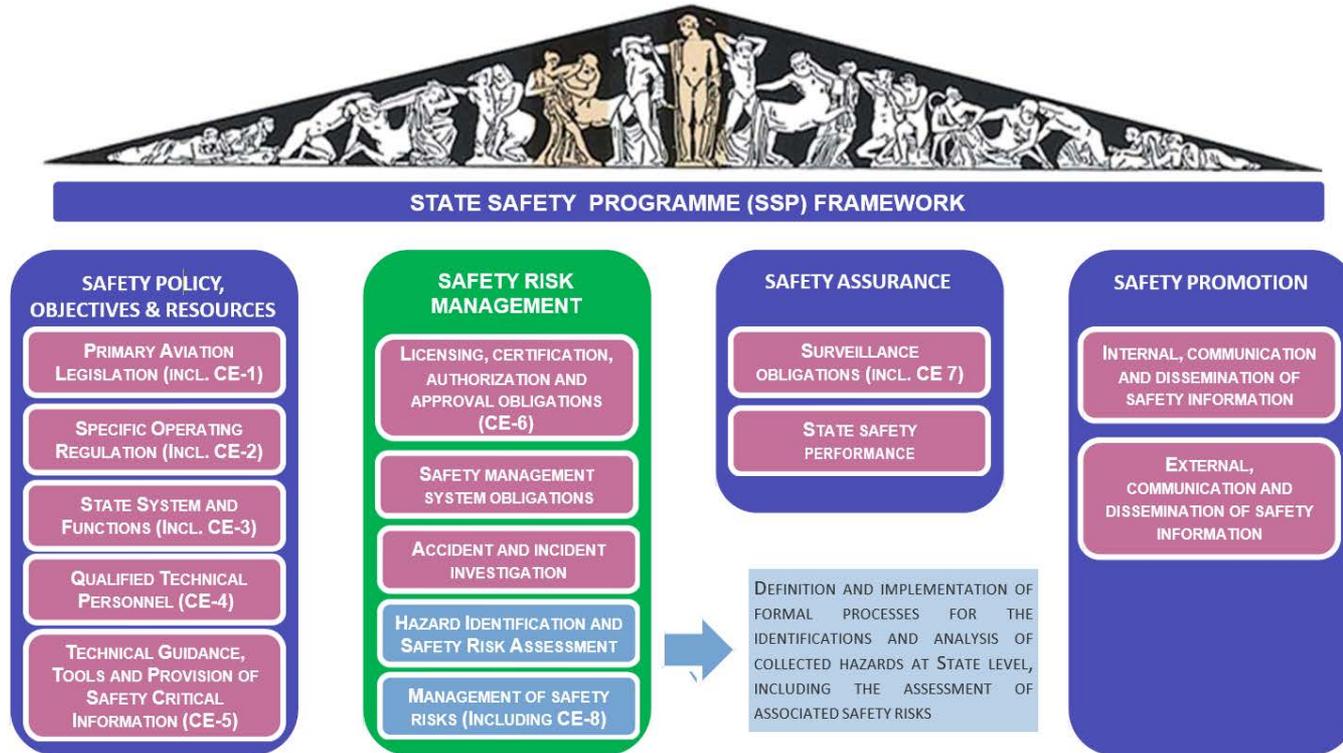
Hazard Log

## CONCLUSIONS

## SMS Framework



## SSP Framework



# Risk Management Process



**Probabilidad de eventos**

Definición de evento	Ejemplo	Nivel
Proceder	Realización de un evento que no debería ocurrir	5
Dañar	Evento que causa alguna lesión o pérdida irreparable	4
Perturbar	Evento que causa algún inconveniente	3
Interferir	Evento que causa algún inconveniente menor	2
Interferencia insignificante	Evento que causa algún inconveniente menor	1

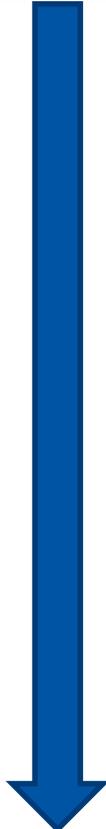
**Severidad del evento**

Definición de evento	Ejemplo	Nivel
Interferencia insignificante	Evento que causa algún inconveniente menor	1
Perturbar	Evento que causa algún inconveniente	2
Dañar	Evento que causa alguna lesión o pérdida irreparable	3
Proceder	Realización de un evento que no debería ocurrir	4
Interferencia insignificante	Evento que causa algún inconveniente menor	5

**Probabilidad de riesgo de seguridad operacional**

	Severidad del riesgo de seguridad operacional			
	Categoría I	Categoría II	Categoría III	Categoría IV
Frecuencia I	5A	5B	5C	5D
Dañar I	4A	4B	4C	4D
Perturbar I	3A	3B	3C	3D
Interferir I	2A	2B	2C	2D
Interferencia insignificante I	1A	1B	1C	1D



## Objective

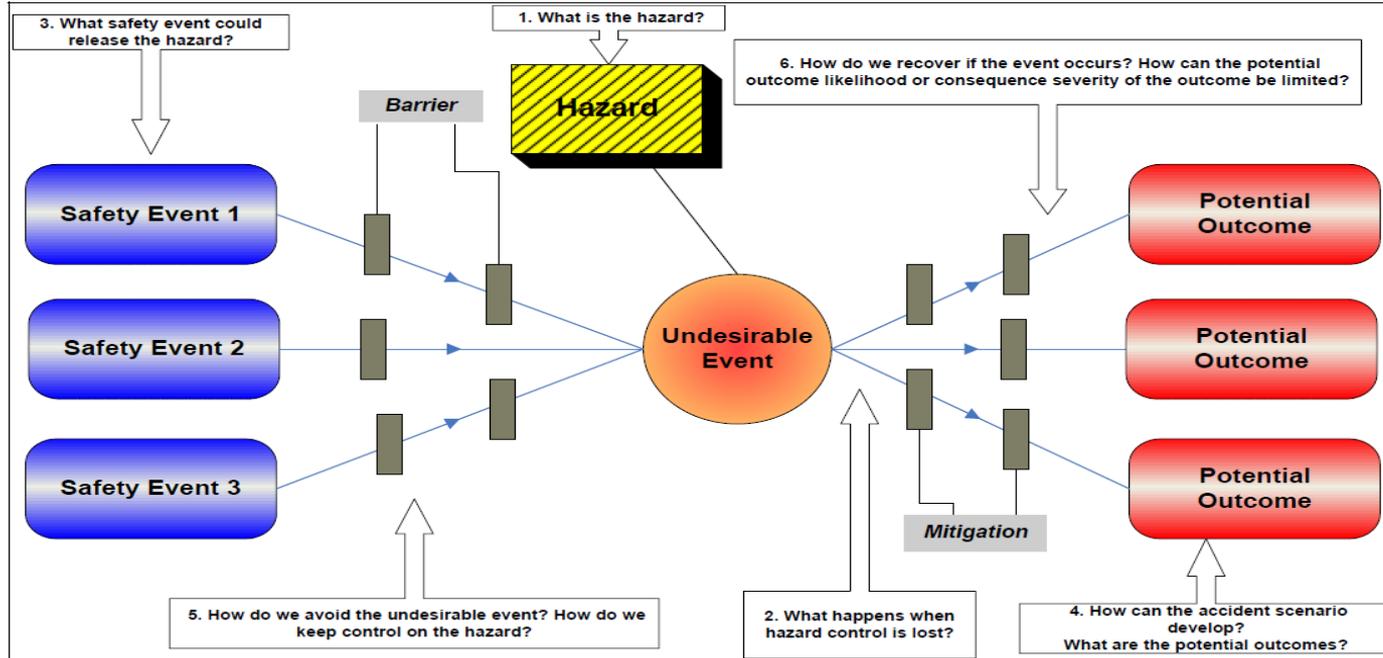
A structured hazard analysis should address these questions:

1. What is the hazard?
2. Which events can produce it?
3. What happens when hazard is released? how can we reverse the situation?
4. How can the system propagate into an accident?
5. How can we avoid such adverse outcome?



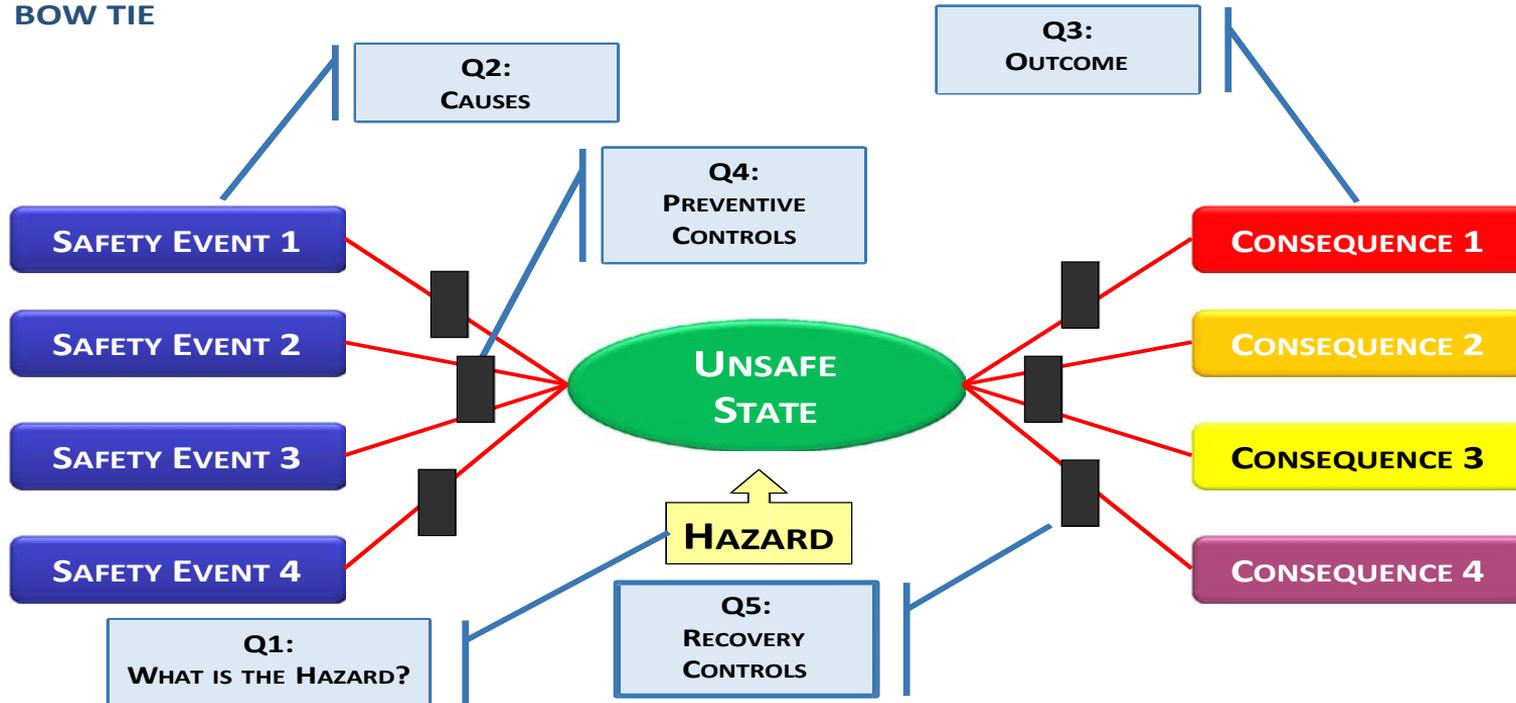
## Hazard Analysis

## Bowtie Model

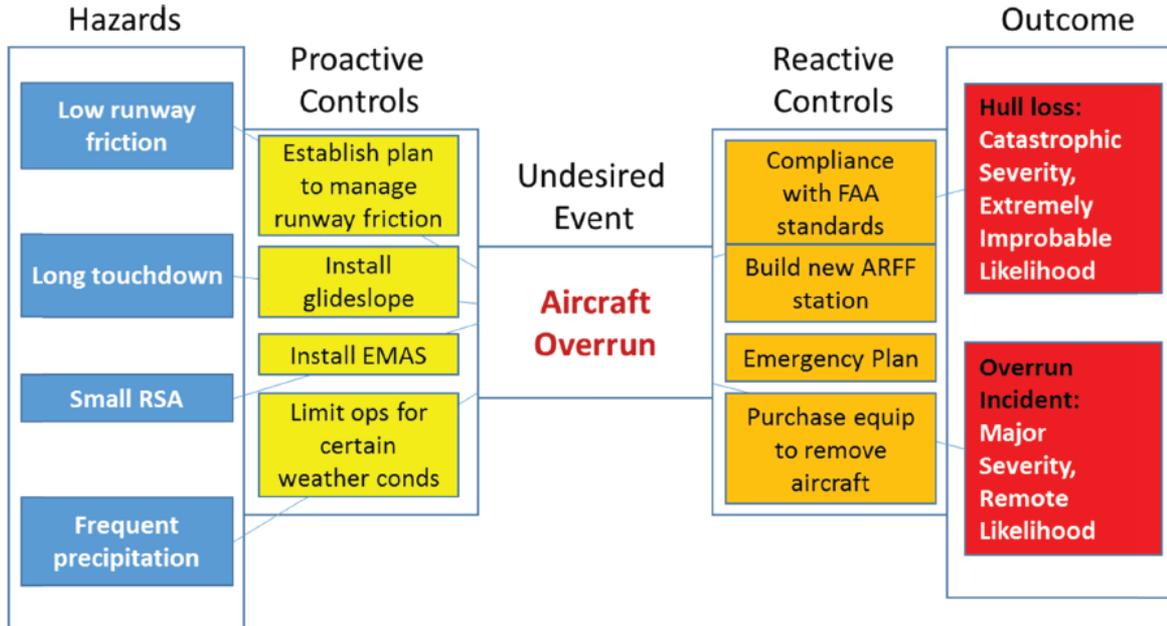


# Bowtie Model

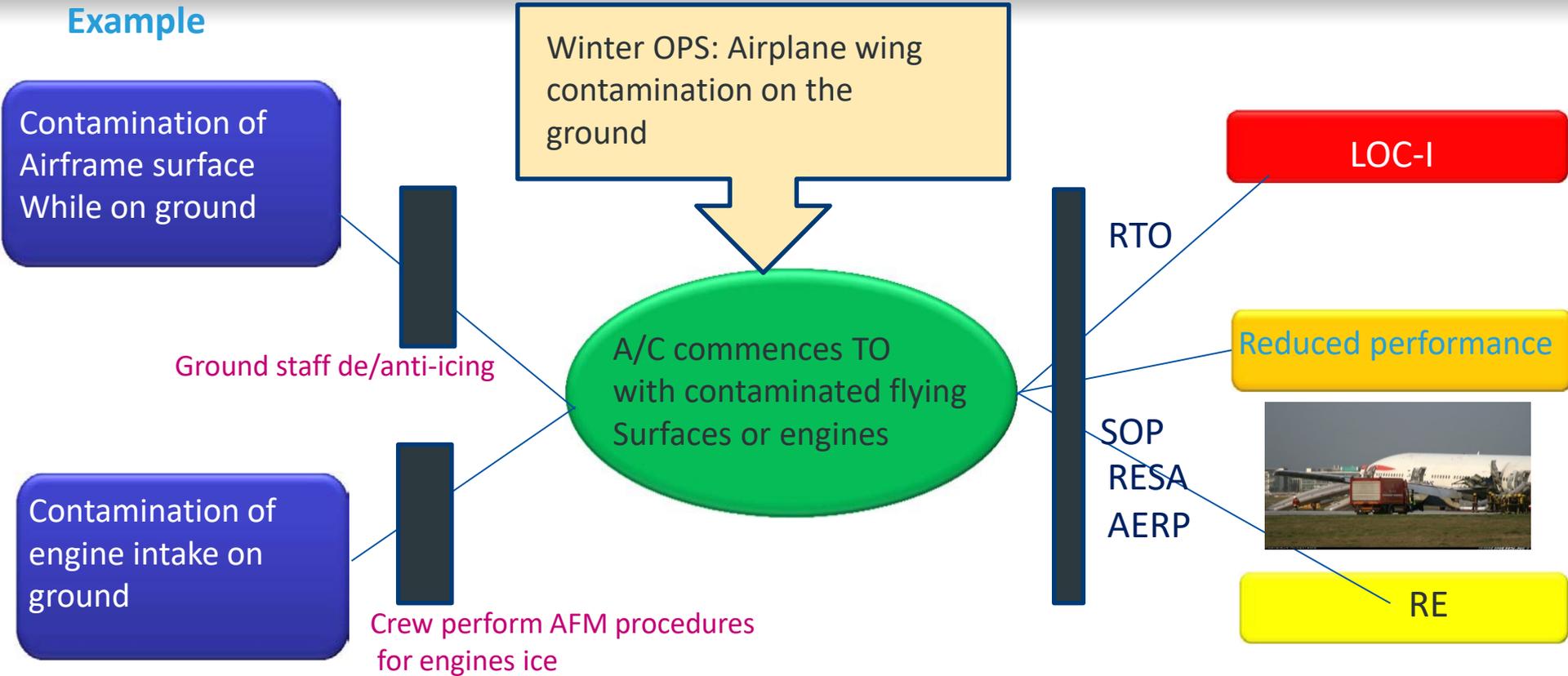
BOW TIE



## Bowtie model with examples

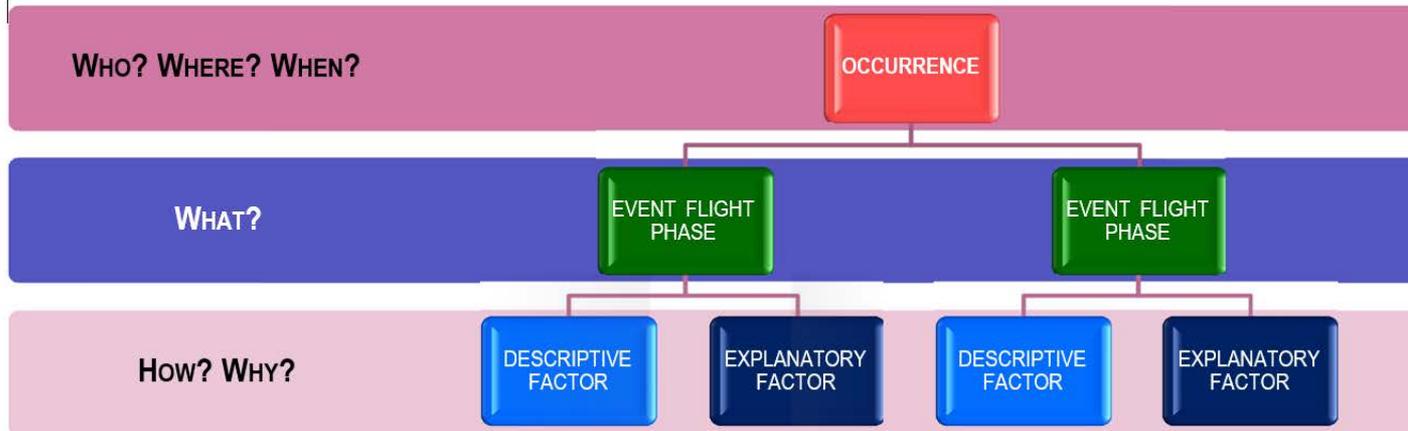


### Example



## Bowtie XP: ADREP Taxonomy

- ADREP is the name of a common reporting taxonomy, which is periodically updated by ICAO in cooperation with relevant parties
- ADREP is aimed to achieve international harmonization, and thereby enable the exchange and aggregation of safety occurrences data
- To achieve that goal, safety management software tools need to be compatible with ADREP



## Bowtie XP: Components

	TERM	MEANING
	HAZARD	SOMETHING IN, AROUND OR PART OF THE SYSTEM WHICH HAS THE POTENTIAL TO CAUSE DAMAGE
	UNSAFE STATE (TOP EVENT)	STATE WHEN CONTROL IS LOST OVER THE HAZARD
	SAFETY EVENT (TRIGGERING EVENT)	WHATEVER WILL CAUSE THE UNSAFE EVENT
	BARRIER/MITIGATION	ELEMENTS THAT INTERRUPT THE PROPAGATION SO THAT THE TRIGGERING EVENT DOES NOT RESULT IN A LOSS OF CONTROL OF THE HAZARD OR DO NOT ESCALATE INTO A POTENTIAL OUTCOME.
	CONSEQUENCE	RESULTS FROM THE UNSAFE EVENT
	ESCALATION FACTOR	FACTORS OR CONDITIONS WHICH MAKE A BARRIER/MITIGATION TO FAIL

## BOWTIEXP: TOP EVENT



**State when control is lost over the hazard**



Also known as **undesired state** or **unsafe event**:

- The **first event** in a chain of negative events **leading to unwanted consequences**
- It is not a catastrophe yet, but now there is exposure to the potential harm of the hazard
- However, it should be possible to bring the situation under control again

## BOWTIEXP: SAFETY EVENTS

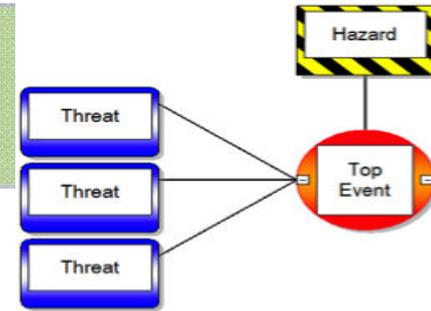


SAFETY  
EVENT

A possible cause that can release the hazard by producing the top event

Also known as *threats*, causes or triggering events:

- there can be **multiple safety events for one top event**
- each safety event represents **a single scenario that could independently lead to the top event.**
- direct means causally direct (not necessarily in terms of time)

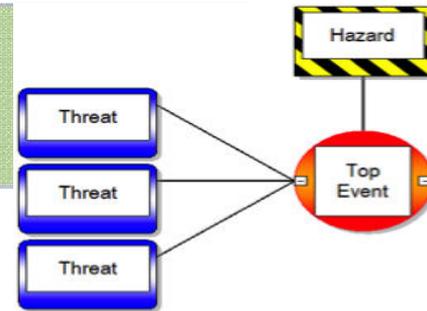


## BOWTIEXP: SAFETY EVENTS



SAFETY  
EVENT

A possible cause that can release the hazard by producing the top event



### Sufficiency and independency :

Each safety event (SE) itself, should in theory, be sufficient to directly cause the top event. If two SEs need to occur together for them to cause the top event, They need to be reformulated into one independent safety event

## BOWTIEXP: CONSEQUENCES



An unwanted event resulting from the release of the hazard



Also known as potential outcomes:

- Consequences are events that are caused by the top event
- What we ultimately want to prevent

## BOWTIEXP: CONSEQUENCES

### Ultimate Consequences:

- Making consequences specific for a top event will lead to more specific barriers later on, and help to get more out of the bowtie
- Try to classify events based in type of accidents or serious incidents (e.g. according ICAO ADREP occurrence category taxonomy), including scenario related details and consequences.



## BOWTIEXP: BARRIERS



**BARRIER**

Safety barriers are physical and/or non-physical means planned to prevent, control, or mitigate undesired events or accidents



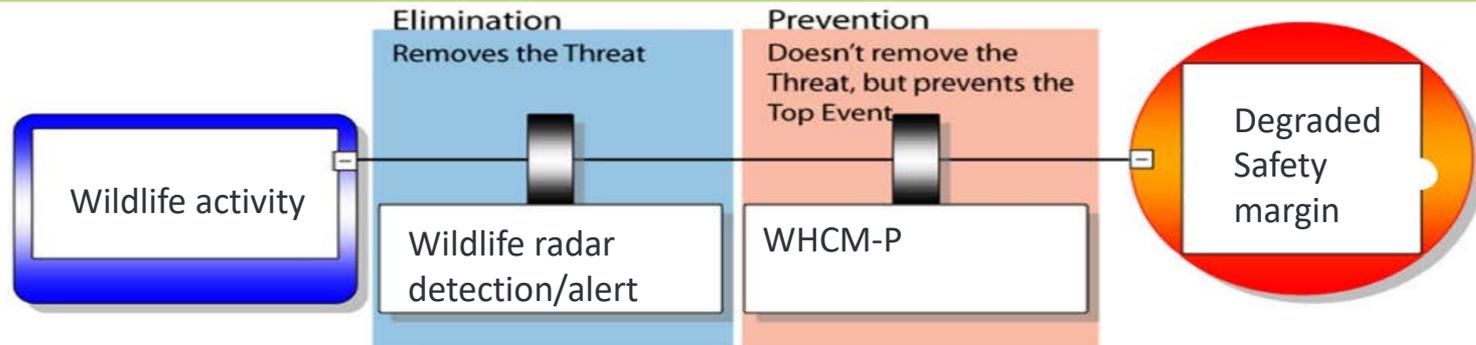
**Also known as controls or mitigations. There are three different places for barriers :**

- Between a safety event and the top event (**preventive barriers** – also known as **proactive barriers**)
- Between the top event and a consequence (**recovery barriers**, also known as **reactive or defense barriers**)
- Between a barrier and an escalation factor (**escalation factor barriers**)

## BOWTIEXP: BARRIERS

### Preventive barriers:

- act against a safety event/top event its effect takes place before the top event has happened (always present on the left side of the bowtie diagram). it can follow two strategies:
  - elimination. remove the safety event and make sure that there is nothing (or less) to cause the top event (they should appear to the left of the safety event, but for simplicity purposes they are located to the right)
  - prevention. stop the safety event from becoming a top event, either by blocking the causal effect of the safety event or directly stopping the top event from happening

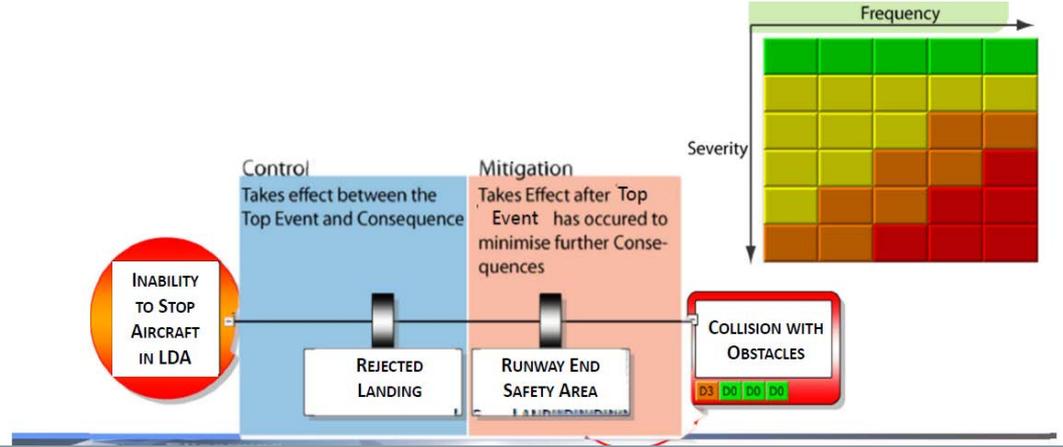


### BowtieXP: Recovery Barriers:

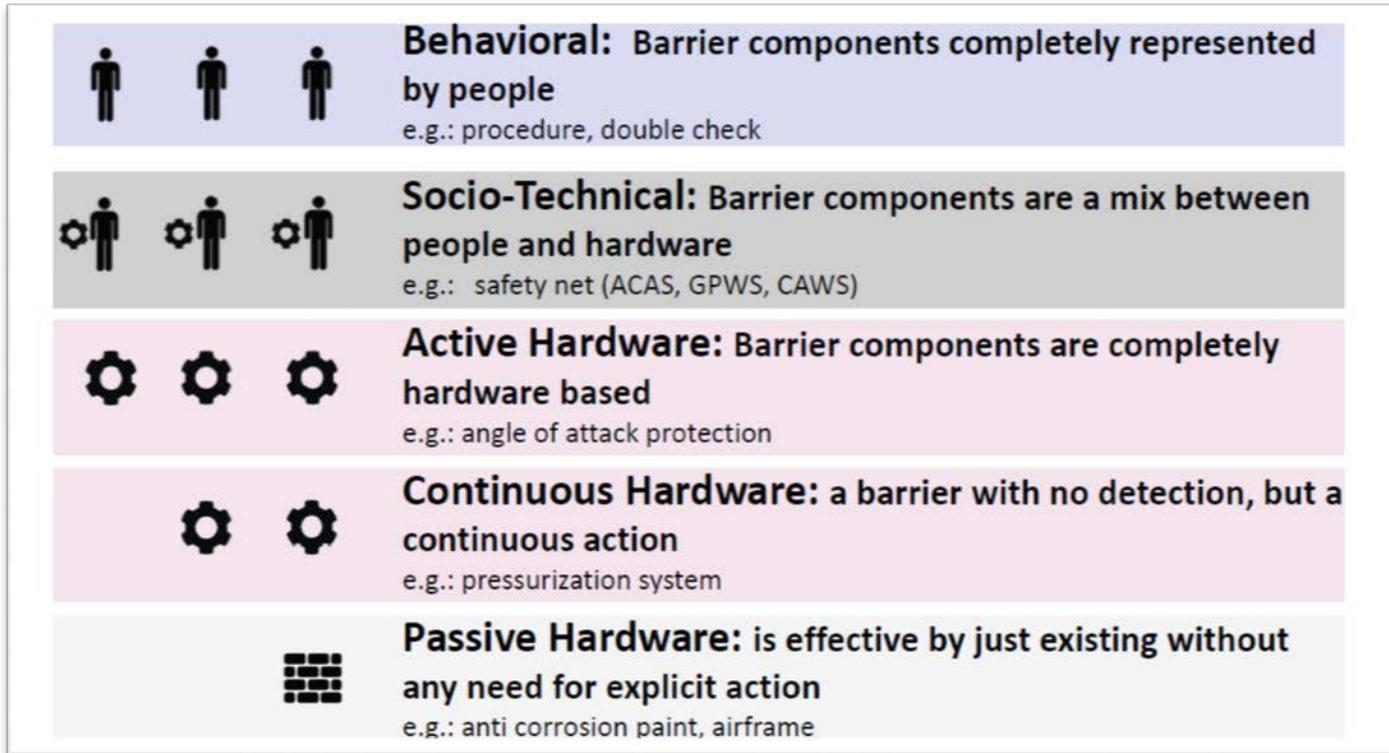
Aimed at regaining control once it is lost (top event has occurred). They act on the likelihood or severity of a potential consequence through:

**Control:** Prevents the consequence from happening

**Mitigation:** Does not prevent the consequence from happening, but lessens the severity of the consequence



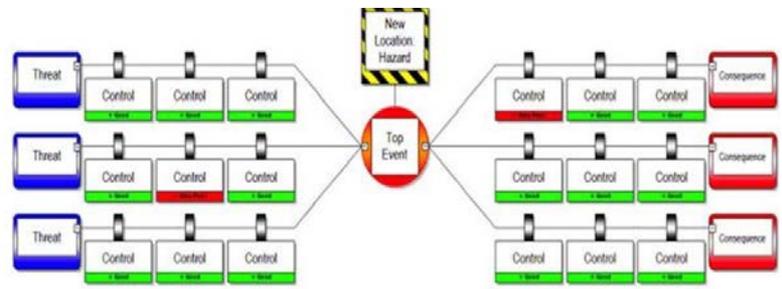
## Bowtie XP: Barriers Type



## BowtieXP: Barriers Effectiveness

**Barrier effectiveness** is a way to assess how well a barrier performs.

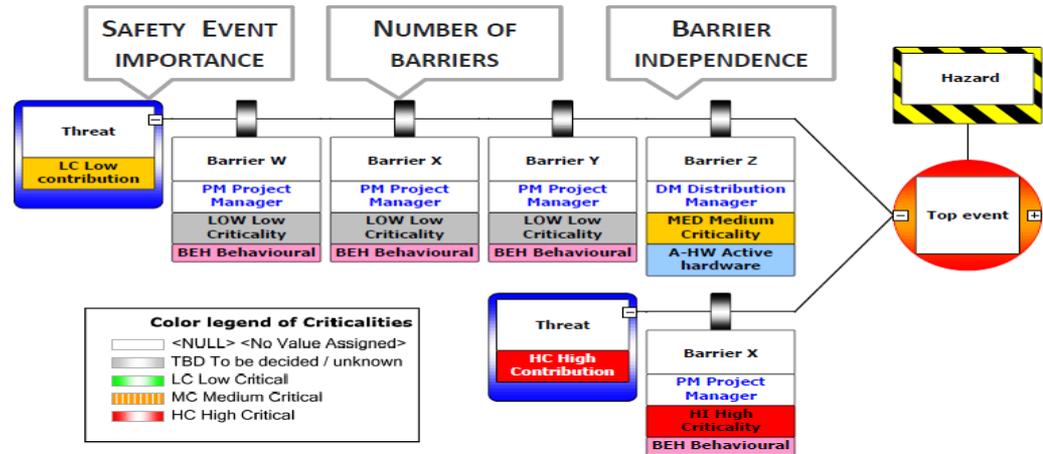
- The purpose of rating control effectiveness is to highlight areas of strength and weakness within the bowtie, potentially using this information as a basis for a matrix based risk assessment
- The results are typically displayed according to a color code (e.g. red for poor through to green at for good).
- when creating your effectiveness scale consider the usefulness of allocating “average” as a score



## BowtieXP: Barriers criticality

Not all controls will have the same importance with regard to the management of a specific event differentiating control significance according to criticality provides benefits such as:

- o focusing attention for the purpose of communication to stakeholders.
- o highlighting which controls require a greater depth of detail in terms of escalation factor consideration



- BARRIERS ON HIGH CONTRIBUTORY SAFETY EVENT LINES ARE USUALLY CONSIDERED MORE CRITICAL. SO, SAFETY EVENT CRITICAL, BARRIER CRITICAL.
- BARRIERS ON SAFETY EVENT LINES WITH ONLY A FEW BARRIERS ARE USUALLY CONSIDERED LESS CRITICAL COMPARED TO A BARRIER ON A LINE ON WHICH IT IS THE ONLY ONE. SO, MORE BARRIERS LESS CRITICAL AND VICE VERSA.

## BowtieXP: Escalation factors



ESCALATION  
FACTOR

A condition that leads to increased risk by defeating or reducing the effectiveness of a barrier

The following three escalation factor categories can be used :

Human factors: anything a person does to make a barrier less effective

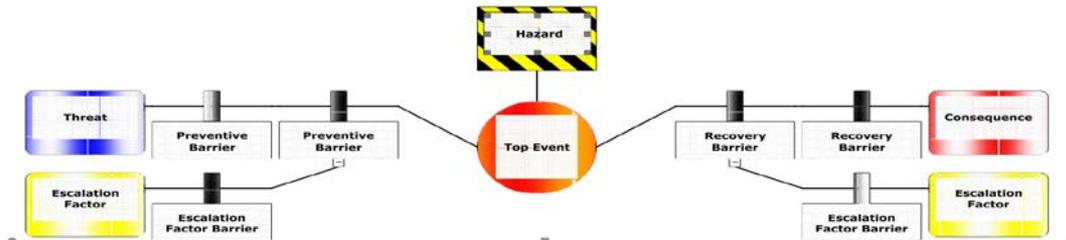
Abnormal conditions: anything in the environment that causes a barrier to be put under strain

Loss of critical services: if a barrier relies on an outside service, losing that service might cause it to lose effectiveness

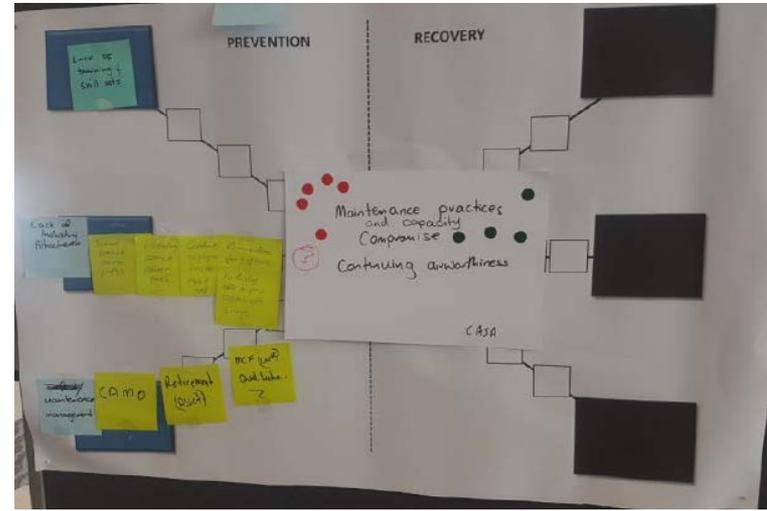
## BowtieXP: Escalation factors barriers

### ESCALATION FACTORS BARRIERS:

- Barrier that manages the conditions which reduce the effectiveness of other barriers
- Escalation factor barriers are the same concept as all the previously discussed barriers, but now they do not prevent/mitigate a top event or consequence from happening, but they prevent a barrier from failing.
- The same principles that apply to normal barriers also apply to escalation factor barriers



## Bowtie in simple way during brainstorming sessions





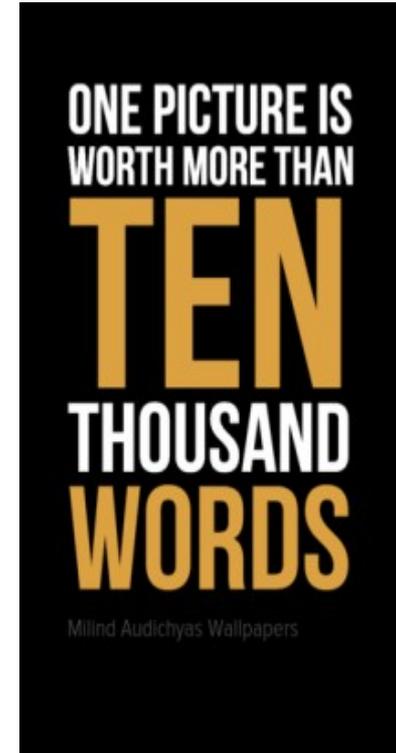
**HAZARD: Human Error:** Delay pilot recognition of RI by departure pilot because the departure Pilot mistakes the incurring aircraft for one safely on the EAT

SAFETY EVENTS	PREVENTIVE CONTROLS/BARRIERS	UNSAFE (TOP) EVENT	RECOVERY CONTROLS/BARRIERS	POTENTIAL OUTCOME / ULTIMATE CONSEQUENCES	
<p><b>Flight crew do not comply with procedures</b></p>	<ul style="list-style-type: none"> <li>- ATCO MONITORS &amp; SOLVES POTENTIAL CONFLICT</li> <li>- CRM</li> <li>- SOP</li> </ul>	<p>Conflict between aircraft taking off and aircraft taxiing on the EAT</p>	<ul style="list-style-type: none"> <li>- Compliance with procedures</li> <li>- AERP</li> </ul>	<ul style="list-style-type: none"> <li>. High severity of RI on the EAT</li> <li>. Collision with other aircraft on the EAT</li> </ul>	<p>Aircraft / equipment heavy damages, fatalities</p>
<p><b>Ineffective Flight crew communications</b></p>					

## BOWTIE: Added value

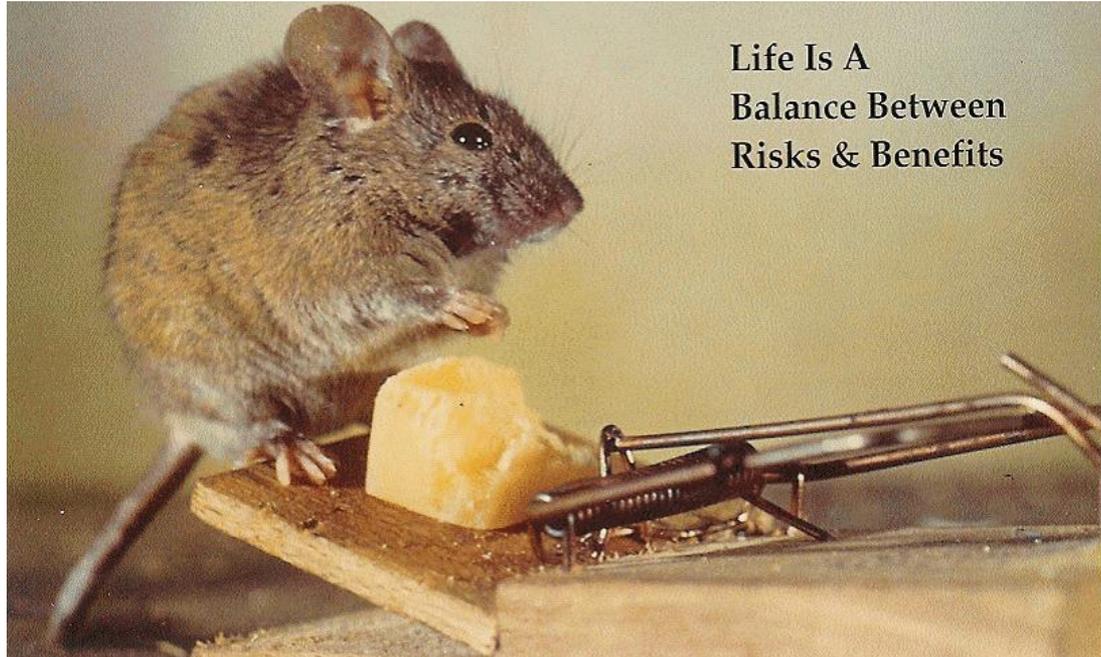
Bowtie provide benefits to safety management processes due to:

- **Effective**, visual depiction of hazard components
- **Balanced overview** for internal and external stakeholders (including third party risks)
- **Increased awareness** and understanding of the hazards leading to accident scenarios.
- **Best practice guidance** material for safety risk management at an operational and regulatory level.
- **Identification of critical risk controls** and an assessment of their effectiveness





# Risk Assessment and Mitigation



Life Is A  
Balance Between  
Risks & Benefits

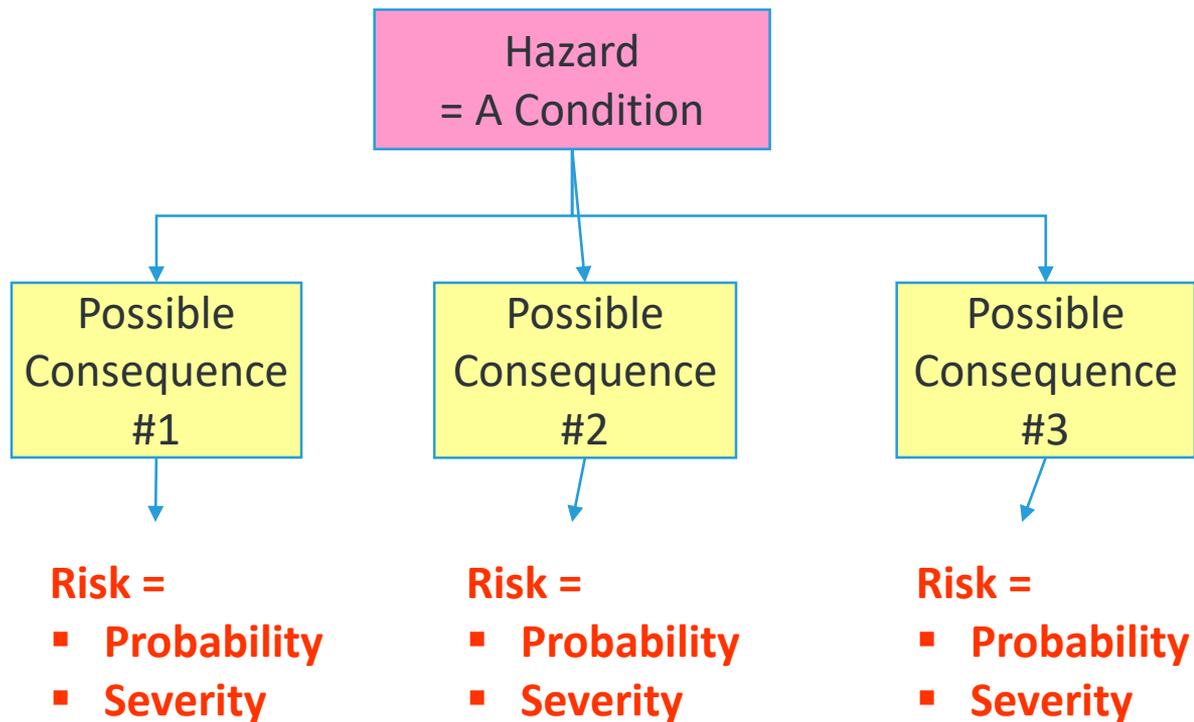


# Risk Assessment and Mitigation

Risk is the composite of the predicted probability (or likelihood) and severity of each possible consequence.

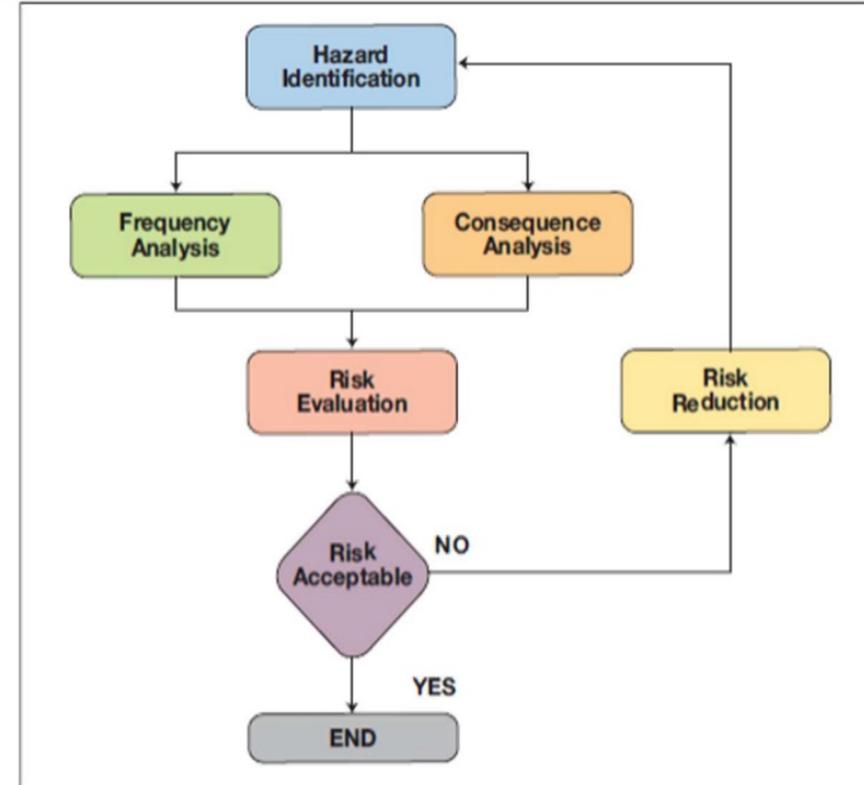


# Risk Assessment



## Risk Concept

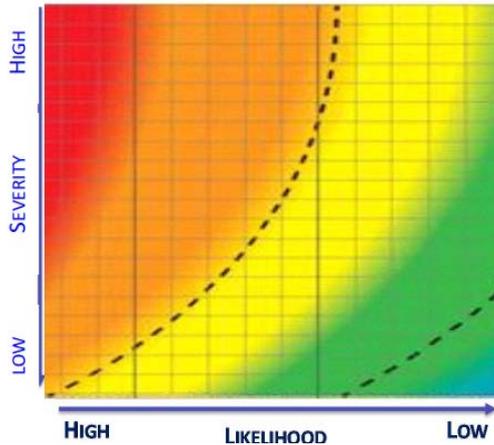
- SAFETY IS ASSOCIATED TO THE CONCEPT OF RISK, DEFINED AS A COMBINATION OF THE ANALYSIS OF TWO TERMS:
  - LIKELIHOOD
  - CONSEQUENCES
- RISK IS SUBJECT TO AN OBJECTIVE EVALUATION PROCESS THAT ALLOWS FURTHER DECISION MAKING (ACCEPTANCE OR REJECTION)



## RISK ASSESSMENT MATRIX

A risk matrix is just used for ranking events and decide whether you need to accept the risk or reduce it through mitigations

Decisions need to be based on an underlying analysis (such as a bowtie diagram), that will tell what will cause the unsafe event and what an organization is already doing to control it.



Safety Risk Severity

	5A	5B	5C	5D	5E
	4A	4B	4C	4D	4E
	3A	3B	3C	3D	3E
	2A	2B	2C	2D	2E
	1A	1B	1C	1D	1E
Safety Risk Probability					

## RISK ASSESSMENT MATRIX

FAA

Risk Matrix

Severity \ Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A	Green	Yellow	Yellow	Red	Red
Probable B	Green	Yellow	Yellow	Red	Red
Remote C	Green	Green	Green	Red	Red
Extremely Remote D	Green	Green	Green	Yellow	Red
Extremely Improbable E	Green	Green	Green	Green	Yellow

The risk matrix may be customized to reflect the context of each service provider, and aviation activities, and may be subject to the agreement with its regulatory authority

Elements to be considered for customization are Qualitative and quantitative criteria to define:

- Likelihood depending on the availability of the historical data series
- Severity, depending on the nature of the supplied service

ECAST ARMS EVENT RISK CLASSIFICATION (ERC)

Question 2				Question 1	
What was the effectiveness of the remaining barriers between this event and the most credible accident scenario?				If this event had escalated into an accident outcome, what would have been the most credible outcome?	
Effective	Limited	Minimal	Not effective		
90	102	102	2000	Catastrophic Accident	Loss of aircraft or multiple fatalities (3 or more)
10	21	101	100	Major Accident	1 or 2 fatalities, multiple serious injuries, major damage to the aircraft
2	4	20	100	Minor injuries or damage	Minor injuries, minor damage to aircraft
1				No accident outcome	No potential damage or injury could occur



VALUE	SEVERITY	ICAO SMM (Fig 2.12)	FAA ARP Internal Order 5200.11
A	CATASTROPHIC	<ul style="list-style-type: none"> <li>• Equipment destroyed</li> <li>• Multiple deaths</li> </ul>	<ul style="list-style-type: none"> <li>- Complete loss of aircraft and/or facilities or fatal injury in passenger(s)/worker(s);</li> <li>- or Complete unplanned airport closure and destruction of critical facilities; or</li> <li>- Airport facilities and equipment destroyed</li> </ul>
B	HAZARDOUS	<ul style="list-style-type: none"> <li>• 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</li> <li>• Serious injury</li> <li>• Major equipment damage</li> </ul>	<ul style="list-style-type: none"> <li>- Severe damage to aircraft and/or serious injury to passenger(s)/worker(s); or</li> <li>- Complete unplanned airport closure, or</li> <li>- Major unplanned operations limitations (i.e. runway closure), or</li> <li>- Major airport damage to equipment and facilities</li> </ul>
C	MAJOR	<ul style="list-style-type: none"> <li>• A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency</li> <li>• Serious incident</li> <li>• Injury to persons</li> </ul>	<ul style="list-style-type: none"> <li>- Major damage to aircraft and/or minor injury to passenger(s)/worker(s), or</li> <li>- Major unplanned disruption to airport operations, or</li> <li>- Serious incident, or</li> <li>- Deduction on the airport's ability to deal with adverse conditions</li> </ul>
D	MINOR	<ul style="list-style-type: none"> <li>• Nuisance</li> <li>• Operating limitations</li> <li>• Use of emergency procedures</li> <li>• Minor incident</li> </ul>	<ul style="list-style-type: none"> <li>- Minimal damage to aircraft or</li> <li>- Minor injury to passengers, or</li> <li>- Minimal unplanned airport operations limitations (i.e. taxiway closure), or</li> <li>- Minor incident involving the use of airport emergency procedures</li> </ul>
E	NEGLIGIBLE	<ul style="list-style-type: none"> <li>• Few consequences</li> </ul>	<p>No damage to aircraft but minimal injury or discomfort of little risk to passenger(s) or workers</p>



VALUE	PROBABILITY	ICAO SMM (Fig 2.11)	FAA ARP Internal Order 5200.11
1	EXTREMELY IMPROBABLE	<ul style="list-style-type: none"><li>Almost inconceivable that the event will occur</li></ul>	Expected to occur < every 100 years
2	IMPROBABLE/ Extremely Remote	<ul style="list-style-type: none"><li>Very unlikely to occur (not known to have occurred)</li></ul>	Expected to occur once every 10-100 years or 25 million departures, whichever occurs sooner
3	REMOTE	<ul style="list-style-type: none"><li>Unlikely to occur, but possible (has occurred rarely)</li></ul>	Expected to occur about once every year or 2.5 million departures, whichever occurs sooner
4	OCCASIONAL	<ul style="list-style-type: none"><li>Likely to occur sometimes (has occurred infrequently)</li></ul>	Expected to occur about once every month or 250,000 departures, whichever occurs sooner
5	FREQUENT	<ul style="list-style-type: none"><li>Likely to occur many times (has occurred frequently)</li></ul>	Expected to occur more than once per week or every 2500 departures, whichever occurs sooner

## RISK ASSESSMENT

Safety risk is the projected likelihood and severity of the consequence or outcome from an existing hazard or situation:

- **severity** is defined as the extent of harm that might reasonably occur as a consequence or outcome of the identified hazard. the severity assessment should consider all possible consequences related to an unsafe condition or object, taking into account **the worst foreseeable situation**
- **probability** is defined as the likelihood or frequency that a safety consequence or outcome might occur



5A	5B	5C	5D	5E
4A	4B	4C	4D	4E
3A	3B	3C	3D	3E
2A	2B	2C	2D	2E
1A	1B	1C	1D	1E

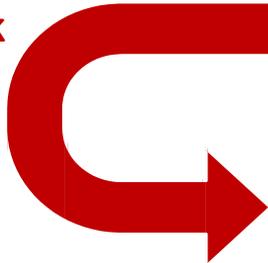
## INHERENT & RESIDUAL RISK

Two possible types of risk can be estimated during the assessment of a particular system:

- ✓ **Inherent risk** is associated to the worst foreseeable (or credible) situation subject to analysis
- ✓ **Residual risk** that takes into account the effect of the safety actions that could be implemented to improve system's safety performance by bringing down risk to an acceptable level

### Decision making at management level

**Inherent risk**



**Residual risk**

- Barriers have brought the risk down to an acceptable level but
- **Additional effort may be required to obtain further risk**



## Safety risk mitigation strategies

- ❑ Safety risk mitigation is often referred to as a **safety risk control**.
- ❑ Safety risks should be managed to an acceptable level by mitigating the safety risk through the application of appropriate safety risk controls.
- ❑ This should be balanced against the time, cost and difficulty of taking action to reduce or eliminate the safety risk.
- ❑ The level of safety risk can be lowered by **reducing the severity** of the potential consequences, **reducing the likelihood** of occurrence or **by reducing exposure** to that safety risk. It is easier and more common to reduce the likelihood than it is to reduce the severity.



## Safety risk mitigation strategies

- ❑ **Avoidance**: The operation or activity is cancelled or avoided because the safety risk exceeds the benefits of continuing the activity, thereby eliminating the safety risk entirely.
- ❑ **Reduction**: The frequency of the operation or activity is reduced, or action is taken to reduce the magnitude of the consequences of the safety risk.
- ❑ **Segregation**: Action is taken to isolate the effects of the consequences of the safety risk or build in redundancy to protect against them.



## Tolerability

A risk mitigation strategy may include multiple approaches and it is important to consider them to find an optimal solution. each proposed safety risk mitigation alternative should be examined from the following perspectives: (SMM doc. 9859. 4<sup>th</sup> ED) :

- **effectiveness**: the extent to which the alternatives reduce or eliminate the safety risks can be determined in terms of the technical, training and regulatory defenses that can reduce or eliminate safety risks
- **cost-benefit**: the extent to which the perceived benefits of the mitigation outweigh the costs
- **practicality**: the extent to which mitigation can be implemented and how appropriate it is in terms of available technology, financial and administrative resources, legislation and regulations, political will, etc..
- **acceptability**: the extent to which the alternative is consistent with stakeholder paradigms



## Tolerability

A risk mitigation strategy may include multiple approaches and it is important to consider them to find an optimal solution. Each proposed safety risk mitigation alternative should be examined from the following perspectives: (SMM doc. 9859. 4<sup>th</sup> ED) :

- **enforceability**: the extent to which compliance with new rules, regulations or operating procedures can be monitored.
- **durability**: the extent to which the mitigation will be sustainable and effective
- **Residual safety risks**. The degree of safety risk that remains subsequent to the implementation of the initial mitigation and which may necessitate additional safety risk control measures
- **Unintended consequences**. The introduction of new hazards and related safety risks associated with the implementation of any mitigation alternative.
- **Time**. Time required for the implementation of the safety risk mitigation alternative





## SRM Documentation

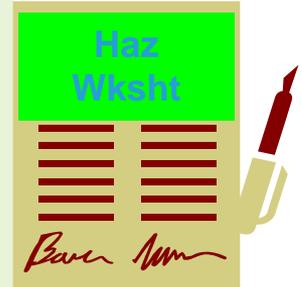
- Findings/results of each safety risk assessment must be documented.
- Both the results of the assessments and the decisions made when determining if safety assessments are required are documented and kept on file for the life of the proposed change.



## Suggested Hazard Worksheet Contents

### A Hazard Worksheet contains, at a minimum:

- description of the proposed change
- identified hazards
- estimation of risk
- description of existing and planned mitigation
- description of methodology for tracking hazards and verifying effectiveness of mitigation controls throughout the lifecycle of the system or change
- method for monitoring operational data to ensure hazards are controlled
- identification of the organization responsible for the conduct of the analysis and tracking of the resolution, if any
- a recommendation concerning the implementation decision



## Hazard Log

- Each risk mitigation exercise will need to be documented as necessary.
- This may be done on a basic spreadsheet or table For risk mitigation or by risk mitigation software t Facilitate the documentation process

Operation / System		
Hazard No.		
Hazard Description		
Safety Events (Causes or Threats)		
Potential Outcomes (and Associated Consequence Magnitudes)		
<b>Risk Controls (Barriers and Mitigations)</b>		
No.	Description	Responsible
1		
2		
3		
4		
5		
<b>Risk Assessment (Worst Foreseeable Scenario – i.e. Highest Risk)</b>		
Hazard Frequency		
Outcome Likelihood		
Consequence Severity		
Risk		
Management Approval	Name:	Post:                      Signature:
Relevant Previously Reported Incident Data		
<b>Safety Performance Monitoring Requirements</b>		
No.	Description	Responsible
1		
2		
3		



## SRA Triggers

The Safety Risk Assessment (SRA) is a safety assessment performed by a panel of stakeholders and subject matter experts (SMEs) to analyze a safety issue, run the SRM process to establish risk mitigation actions, and document the process. The SRA is a formal application of the SRM process to study an airport condition, either planned or discovered.

The SRA is **triggered by conditions or events** at the airport; follows the SRM process in a formal, proactive manner; is facilitated by a person well versed in the SRM process; and provides airport management with actionable knowledge to enhance effective, risk-informed decisions.



## Basic Principles

An SRA should be conducted any time the airport determines that a full safety analysis of an airport condition or event is warranted. Three rules of thumb can help in the determination:

- A change in the airport system is pending.
- The allocation of significant airport resources is required
- An undesirable trend in airport safety metrics is revealed

An SRA Trigger is a condition, a system change, or piece of information that prompts management to convene a panel to conduct the full SRM process or an event that automatically requires convening a panel. In most cases, SRA triggers are associated with safety issues that require a multidisciplinary team to perform the SRM process thoroughly.



## Common airport SRA triggers

SRA Trigger	Description	Example
<b>Construction</b>	Airfield improvement	Runway extension
	Airfield rehabilitation	Resurfacing Taxiway C
	Airfield maintenance (beyond day to day work)	Rubber removal
	Construction of tower	Construction of new ATC tower
	Terminal expansion	Additional gates and gate areas
	Landside roadway reconfiguration	Additional lanes into the terminal area
	Parking area modifications or rehab	Parking garage rehab or updating facilities
	Changes in access roads onto airport property	Adding or subtracting lanes and access points
<b>Standard Operating Procedures Changes</b>	New SOP	SOP for towing aircraft; SOP for mowing grass in safety areas
	Modification to existing SOP	Changes to SOP on snow removal due to new equipment
<b>Airport Organization</b>	Significant changes to airport organizational structure or key personnel	Rearranging the Department of Operations; creating an SMS Division



## Common airport SRA triggers

SRA Trigger	Description	Example
Safety Reports (Hazardous Condition Reports)	Safety issues reported by pilots or airport employees (including tenants)	Reports of pavement failure, blind spots, or hazardous conditions on the ramp
	Safety issues resulting from daily inspections	FOD generated by poor pavement conditions at the intersection of taxiways
	Accidents and incidents	Surface or ramp accident; birdstrikes
Special Event	Major sport events	Super Bowl; Olympic Games; Major College Football Game
New Equipment or Software	New aircraft brought in by a carrier	Starting operation of A380 or B787 aircraft
	New passenger boarding bridge	Installation of new bridges that have different capabilities
	New ramp equipment that requires special consideration	Introduction of towbar less tractor
	Changes to information management systems	Changes to reporting procedures during self inspections
Safety Assurance	Trends identified from safety performance indicators (e.g. birdstrikes, FOD, etc.)	Increase of birdstrikes with damage to aircraft
	Safety audits	Unsatisfactory SMS internal or external audit results



## Categories of SRA Triggers

### Hazard Reports

Hazard reports at airports are used to describe safety issues (e.g., presence of wildlife, damaged NAVAID, and FOD) identified during routine procedures. The diverse sources may include:

- Daily inspections by airport staff
- PIREPs
- Observations from airfield workers (e.g., Maintenance, ARFF, and FBO)
- Observations from ATCT personnel



## Categories of SRA Triggers

### Accident and Incident Reports

Accident and incident reports constitute an important category of triggers. In most cases, these reports lead to an accident or incident investigation. The purpose of an investigation is to determine causal and contributing factors to the event so such factors can be prevented or mitigated. Airport staff can augment and complement investigations by performing an SRA and identifying risk mitigation actions and staff responsibilities to reduce the chances of a similar incident or accident.

The most common types of accidents and incidents in this category are:

- Surface incidents/accidents
- Wingtip collisions and incidents
- Runway incursions and excursions
- FOD (damage)
- Wildlife strikes



## Categories of SRA Triggers

### Trend Analysis

With the implementation of SMS comes the introduction of safety performance indicators. These could be new measures of safety developed to support the SMS and its SRA component. Data for these indicators are collected and trends are followed to determine the need for new actions if an undesirable trend is identified. Examples of indicators in this category are the frequency of wildlife strikes at the airport, the number of FOD incidents in movement areas, or the number of specific incidents on the ramp (e.g., frequency of vehicle/equipment speeding reports).



## Categories of SRA Triggers

### Major System Changes

Major system changes at the airport are sources of risks. Some typical examples of such changes include:

- Airfield improvements: runway rehabilitation and extension, construction of new taxiway, renovation of terminals
- Operation of a new large aircraft: B747-800, A380
- Changes to airport management: reorganization of Dept. of Operations, new Director at a small airport
- Introduction of new snow control equipment
- Special events: Super Bowl, college football game, air show
- Introduction of new systems: new NAVAID, new IT system for work orders
- Development of new operational or administration procedures
- Financial priority adjustments
- Rapid airport growth: aircraft operations increases, passenger increases

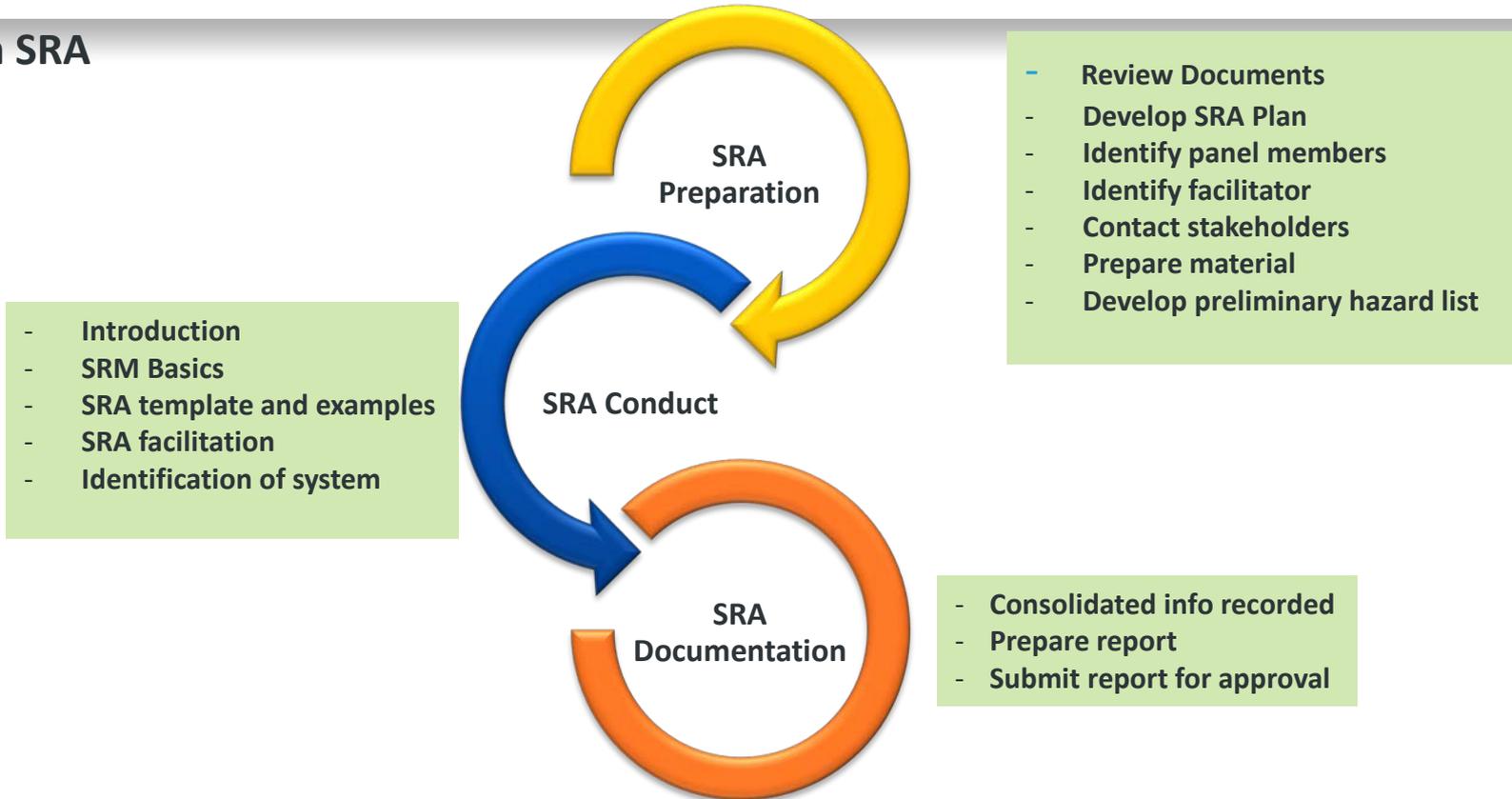


## Categories of SRA Triggers

### New SOPs

In most cases, the introduction of a new SOP will not represent a major system change. However, SOPs that focus on procedures used in the airfield can substantially affect safety. Conducting an SRA may enhance the safety effect of the changes and enable stakeholders to examine fully how the change affects their operations.

## Conducting an SRA





## Key points to remember

- Risk assessment based decisions are founded upon:
  - customized risk classification schemes for the provided service or operation
  - an underlying analysis (such as a bowtie diagram) to explore incident/accident causal chains and what organizations are doing to control
- Risk can be expressed as inherent and residual. both estimations will determine the need for mitigations
- Risk mitigation strategies may include multiple approaches and it is important to consider them to find an optimal solution
- Each risk mitigation exercise needs to be documented as necessary
- SRA triggers needs to be conducted thoroughly



THANK YOU!