SAFETY MANAGEMENT SYSTEM

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Safety Management-Aerodrome

Module 3: Safety Reporting & Investigation

❑ **INTRODUCTION**

        Background

        SMS framework

❑ **SAFETY SCREENING**

        Event classification

        Risk classification

❑ **INTERNAL INVESTIGATIONS**

        Process

        Analysis

        Actions

❑ **CONCLUSIONS**

SOURCES OF SAFETY INFORMATION

Introduction

SAFETY OCCURRENCE REPORTING SYSTEMS

FLIGHT DATA MONITORING (FDM)
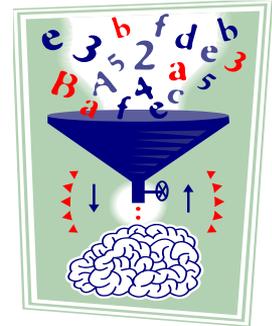
SAFETY AUDITS & SURVEYS
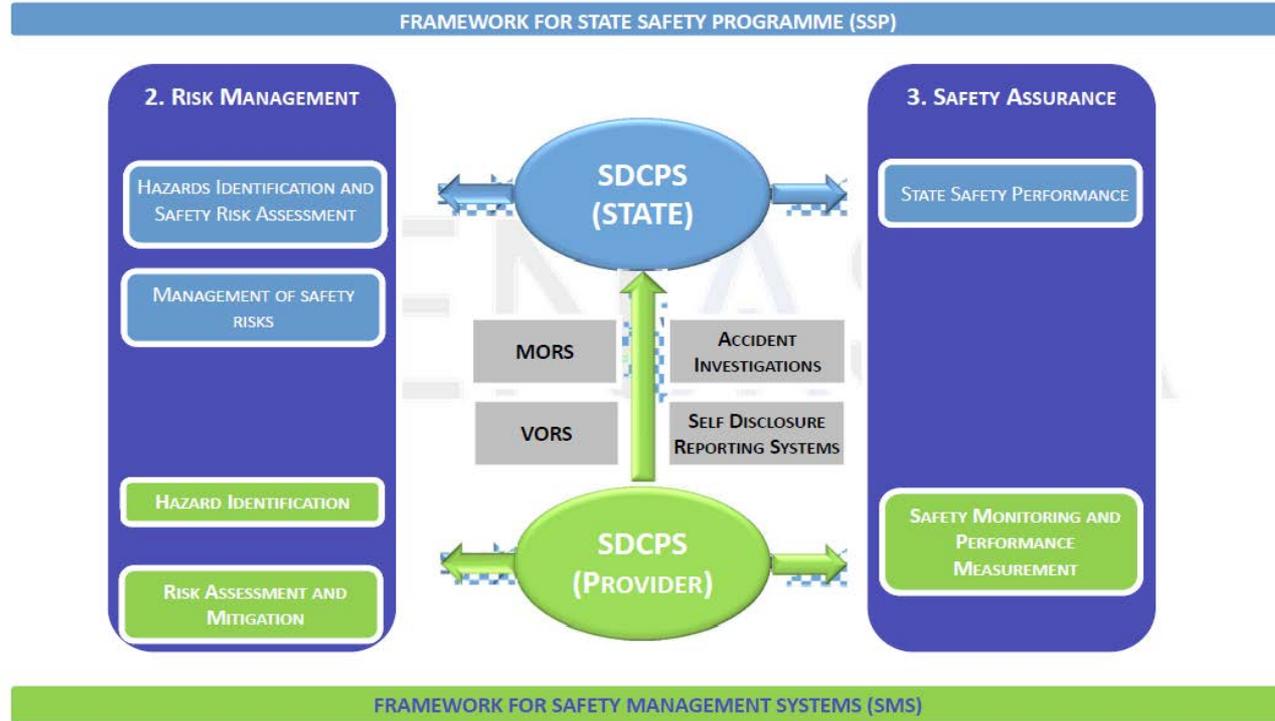
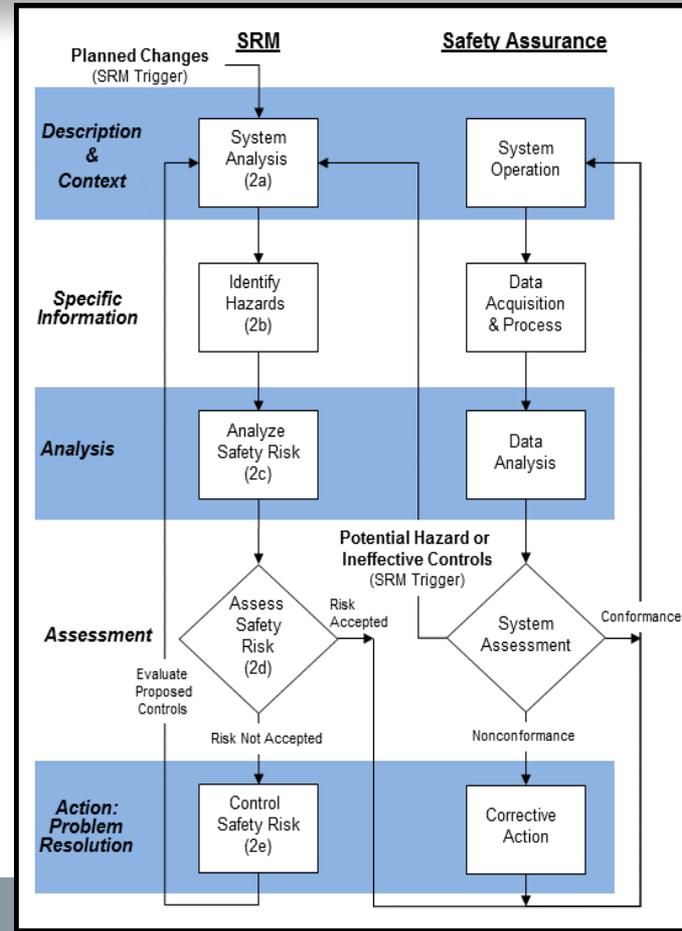SAFETY STUDIES & REVIEWS

ACCIDENT / INCIDENT INVESTIGATIONS

SAFETY PERFORMANCE MONITORING & MEASUREMENT

SAFETY DATA CAPTURE & PROCESSING SYSTEMS (SDCPS)

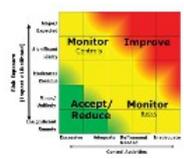# Safety Risk Management and Safety Assurance

PROCESSES

Safety screening:

Reports needs to be reviewed within an acceptable timeframe so that there can be an adequate and/or immediate action

Coding Taxonomy

REPORT COLLECTION

Safety Screening

EVENT CATEGORISATION

RISK CLASSIFICATION

Loading into database

Internal Investigation

Internal Investigation:
Systematic process whereby all of the possible causes of an adverse event are evaluated and eliminated until the remaining causes are identified as applicable to that investigation

Event Classification & Categorization

Safety Screening

Classify the event in terms of the ADREP Aviation occurrence categories.
Several types may apply to same event

AVIATION OCCURRENCE CATEGORIES

DEFINITIONS AND USAGE NOTES

October 2011 (4.2)

CONTROLLED FLIGHT INTO OR TOWARD TERRAIN *(CFIT)*

Inflight collision or near collision with terrain, water, or obstacle without indication of loss of control.

Usage Notes:

- CFIT is used only for occurrences during airborne phases of flight.

- CFIT includes collisions with those objects extending above the surface (for example, towers, trees, power lines, cable car support, transport wires, power cables, telephone lines and aerial masts).

- CFIT can occur during either Instrument Meteorological Conditions (IMC) or Visual Meteorological Conditions (VMC).

- Includes instances when the cockpit crew is affected by visual illusions or degraded visual environment (e.g., black hole approaches and helicopter operations in brownout or whiteout conditions) that result in the aircraft being flown under control into terrain, water, or obstacles.

- If control of the aircraft is lost (induced by crew, weather or equipment failure), do not use this category; use Loss of Control – Inflight (LOC–I) instead.

- For an occurrence involving intentional low altitude operations (e.g., crop dusting, aerial work operations close to obstacles, and Search and Rescue (SAR) operations close to water or ground surface) use the Low Altitude Operations (LALT) code instead of CFIT.

- Do not use this category for occurrences involving intentional flight into/toward terrain. Code all collisions with obstacles during take-off and landing under TOL. Code all suicides under Security Related (SEC) events.

- Do not use this category for occurrences involving runway undershoot/overshoot, which are classified as Undershoot/Overshoot (USOS).

- Includes flying into terrain during transition into forward flight.

- For helicopter operations, not to be used for take-off and landing phases, except when the occurrence involves flying into terrain without indication of loss of control during transition into forward flight.

CFIT   LOC-I   MAC   RI   RE   RAMP

Risk Classification

Based on the severity and likelihood estimation, risk index is mapped as a single plot (severity vs probability) in the risk matrix.

Best practices to be applied are:

➢ Plot into matrix corresponding to worst credible scenario

➢ Event Risk Classification developed by ARMS methodology

➢ Risk assessment tools

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 Classification

❑ Airline risk management solutions (ARMS) is a methodology aimed to produce a useful and cohesive operational risk assessment method for airlines and other aviation organizations.

❑ Event Risk Classification (ERC) is an arms deliverable, aimed at the preliminary review of reported events in terms of prioritization and a risk allocation.

❑ ERC value based on the answer to two questions:

• Q1 looks to identify the accident outcome that is of most concern when this type of event occurs.

• Q2 only considers remaining barriers to estimate the probability of further escalation into the most credible accident outcome

❑ ERC application is a 4x4 matrix, where risk estimation corresponds to the area of intersection of the two questions

ARMS Event Risk Classification

It can be applied to all safety data which describes individual events. This step called Event Risk Classification (ERC): The objective is twofold:

❑ First, to understand what was the risk involved in a specific historical event and;

❑ Second, being able to treat a large number of events through their cumulated risk rather than only counting numbers of events.

ERC-a matter of three steps

EVENT RISK CLASSIFICATION- Example

An A320 aircraft experienced an almost total loss of thrust in both engines after encountering a flock of birds and was subsequently ditched on the River The aircraft had departed about 2 minutes before the in-flight event occurred

The 150 passengers, including a lap-held child, and 5 crewmembers evacuated the airplane via the forward and over wing exits. One flight attendant and four passengers received serious injuries, and the airplane was substantially damaged.

Q1: Potential accident outcome in this case is a catastrophic accident (most likely outcome)

Q2: total loss of thrust in both engines subsequently ditched on the river. Decision-making of the flight crewmembers and their crew resource management during the accident sequence and a/c was equipped for an extended overwater flight. Barriers were minimal

What are we achieving?

- Rapid risk assessment of aviation occurrences

- Focusing proactive activities such as trend monitoring and research investigation

- Identifying low frequency and high risk occurrences

- Documenting all likely situations that increase risk

What are we achieving?

- ERC will produce a numerical Risk index value for each event

- Summing together the event risk values from different events gives cumulative event risk value which can be very useful in identifying threats and safety issues

- Graphical "risk picture" for occurrence type

- Pick out high risk occurrences at glanced

What we can do with ERC?

Example: Bird strike rate risk per months period:
It's clear that the bird-strike risk is not always a one-to-one relationship with the number of occurrences as there periods of higher risk which can not explained by frequency alone.
In fact, the last 6 months shows higher risks even though the frequency count is lower.

What we can do with ERC?

EVENT RISK CLASSIFICATION (ARMS)

The ARMS Methodology for

Operational Risk Assessment

in Aviation Organisations

Developed by the ARMS Working Group, 2007-2010

Developing a Guideline for ERC   MSc Air Transport Management

This is a guideline to optimize the Event Risk Classification for common events in the Air Berlin ARMS Tool.

Please note: All standardized accident outcomes, remaining barriers and classifications below should be deemed to be just a guideline. Additional barriers or another accident outcome could be adjusted with regard to the circumstances.
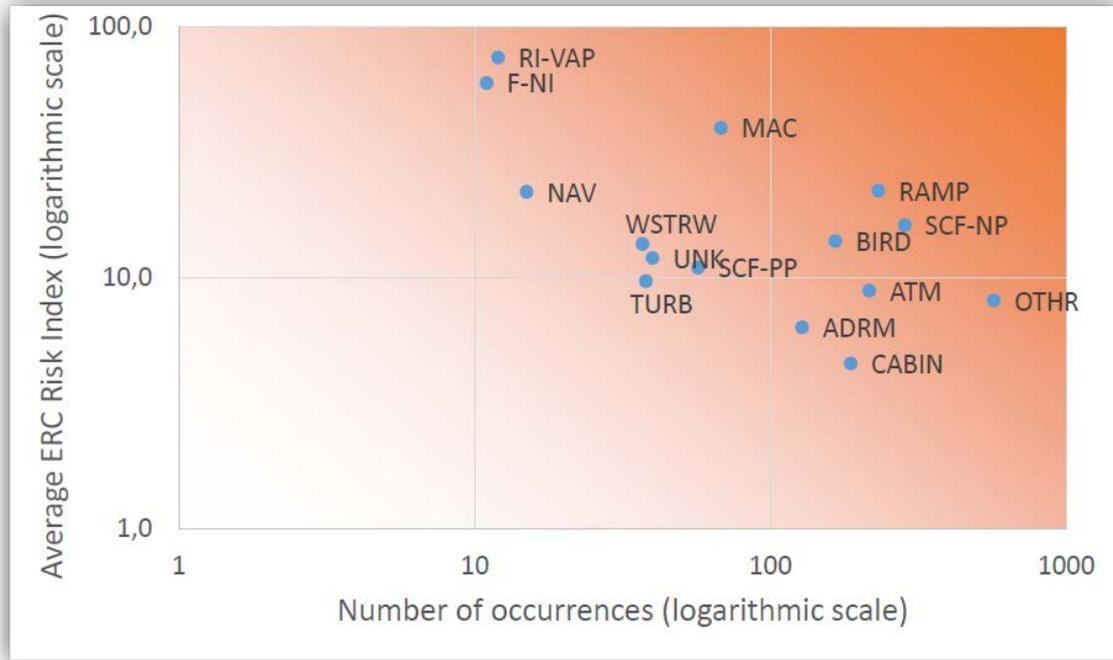Any event which could impossibly escalate into an accident is graded with 1.

Index

Common Event Title	Page
Bird Strike	2
Cabin Crew Reduced	2
Cracked Windshield	2
EGPWS Warning	3
Flap Asymmetry / Flap Disagree	3
Fuel Spillage	3
Hard Landing	3
Laserpointer Attack	4
Level Bust	4
Lightning Strike	4
Long Flare / Late Landing	5
Loss of Cabin Pressure	5
Low Fuel Status	5
Overspeed Warning	5
Rejected Take Off	6
Stall Warning	6
Tail Strike	6
TCAS RA	7
Unstable Approach / Late Landing Configuration	7
Windshear Warning	7

Caroline Gröll   1   ERC GUIDELINE

available information at Skybrary / ARMS

PROCESS

Internal Investigation

FACTS	→	ANALYSIS	→	SAFETY ACTIONS
WHAT?		WHY? HOW?		WHAT NOW?

❑ Facts are the evidences found (what happened?)

❑ Analysis explains why the facts were there and how they turned into the outcome (why and how happened?)

❑ Safety actions indicate what to do to avoid future repetitions (what now?)

FACTS GLOSSARY

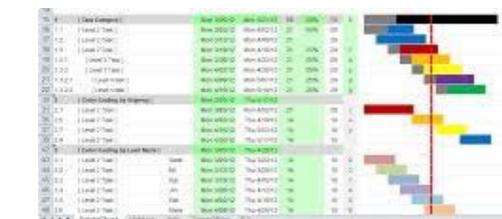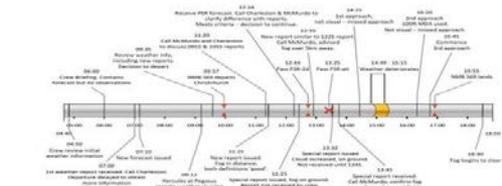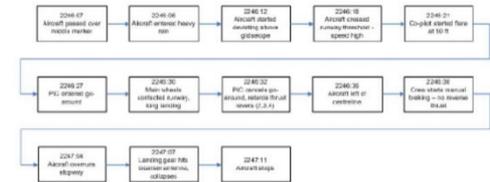|	
Event	Something that happens at a specific point or points in time
Condition	Something that exists for a period of time rather than occurs at a specific point in time (state, situation or circumstance)
Safety Factor	Event or condition that increases safety risk
Contributory Safety Factor	Safety factor that, if it had not occurred or existed at the relevant time, then the occurrence would probably not have happened
Safety issue	Safety factor that is a characteristic of an organization or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time

ANALYSIS

- ❑ **Structured process to determine which events and conditions were safety factors, with an emphasis on determining contributing safety factors (for occurrence investigations) and safety issues**

- ❑ **It is important that the investigation identifies what happened before trying to identify why it happened.**

- ❑ **The process of developing a sequence of events will achieve this goal, but it also helps to do the following:**

- review available information about the occurrence in a structured manner
- identify potential relationships between events
- identify gaps and discrepancies in the collected data
- understand the nature of the occurrence and the aspects to consider when conducting interviews and collecting other types of data
- identify occurrence events and individual actions associated with the occurrence, which provides a platform for the safety factors analysis

ANALYSIS

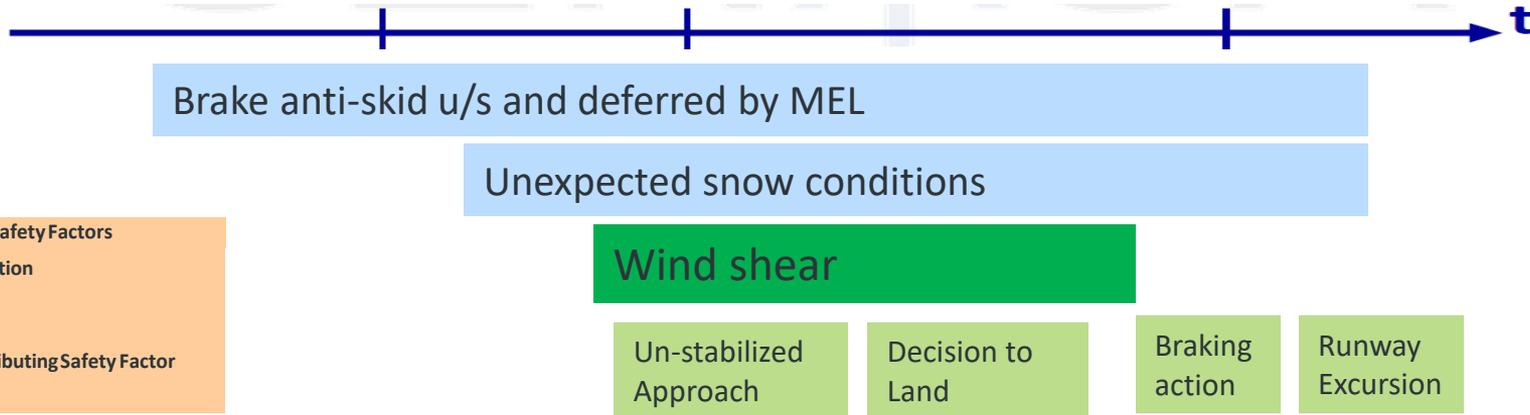Sequence of events: there are different ways of graphically presenting a sequence of events, the most common are:

➢ Events chart showing each event as a rectangular box, with the time and title in each box. arrows connect each box in a sequence.

➢ Timeline chart depicting the events and showing the duration between events

➢ Gantt chart showing each event on one line, with a graph showing the start point and end point

Sequence of Events- Example

- ❑ During a previous flight, our aircraft suffered a "brake anti-skid" failure which was deferred according MEL.
- ❑ In the following flight, during approach, we found (unexpectedly) a snow storm and wind shear.
- ❑ The flight turned unstable, however i recovered the control and continued with the approach.
- ❑ After touchdown, braking action was partially applied, however the runway was covered by snow and the aircraft started to slide towards a runway excursion resulted i

t

Brake anti-skid u/s and deferred by MEL

Unexpected snow conditions

Wind shear

Safety Factors
Condition
Event
Contributing Safety Factor

| Un-stabilized Approach | Decision to Land | Braking action | Runway Excursion |

Safety Actions

❑ structured process to facilitate the design of the safety action by relevant units or organizations

❑ **Safety action:** tasks that organizations and individuals do in response to the identification of safety issues in order to prevent accidents and incidents.

❑ depending on the "ownership" of the risk, there are several types of safety actions:

✓ For organizations that "own" the risk, safety actions are integrated in the cycle of safety risk management and change management (**mitigations**)
✓ Organizations that do not own the risk (e.g: a CAA or an AIB) may raise **safety recommendations** to address specific safety issues.

• Safety recommendations focus on stating the problem without identifying specific solutions (that is the role of the organization that owns the risk)
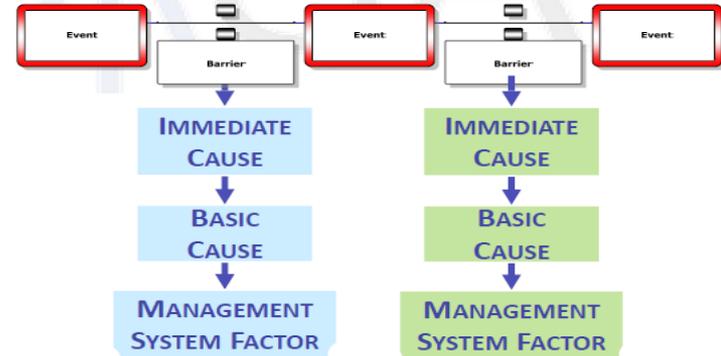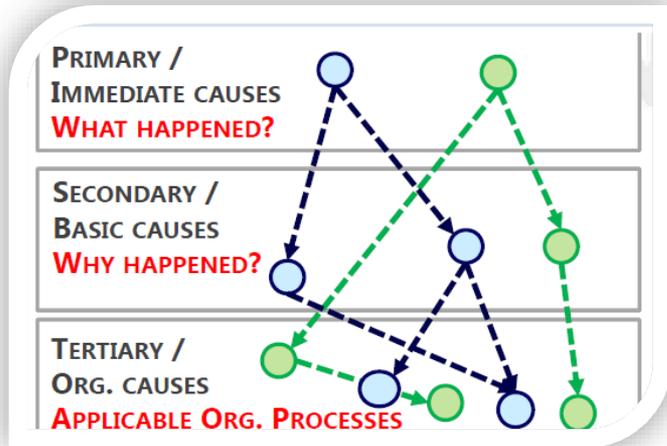
SAFETY SCREENING- Example

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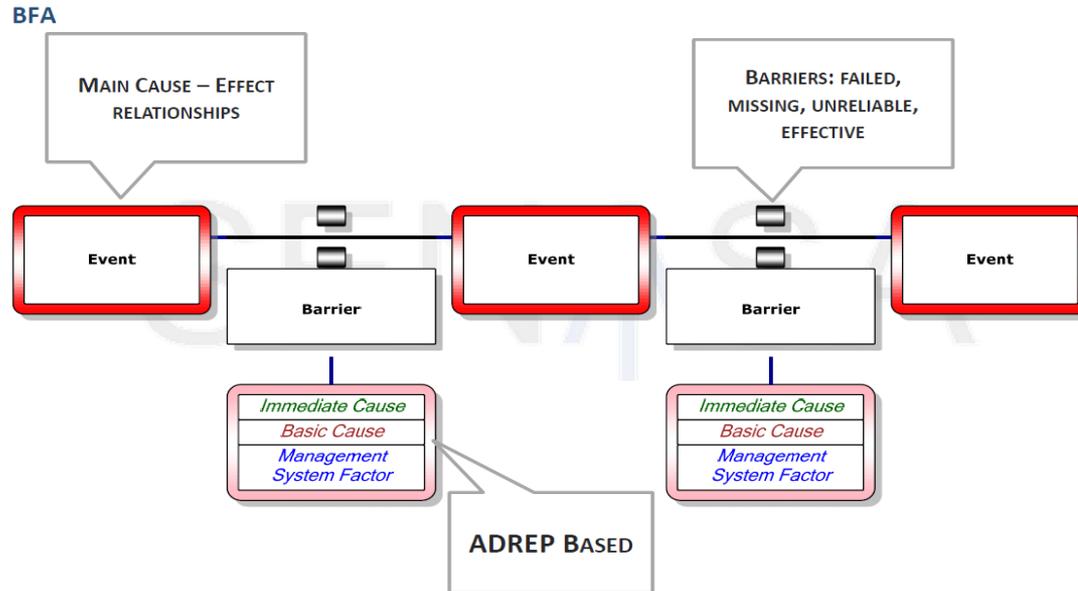| ICAO Metrics & RCS	
Severity$_1$	**Major**
Likelihood	**Occasional**
Risk Index	**4C (Tolerable)**
Safety Action:	Schedule performance of a safety assessment to bring down the risk index to the low range if viable

ARMS ERC	
Q1	Major
Q2	Not effective
Risk Index	500
Safety Action:	Investigate immediately and take action

BARRIER FAILURE ANALYSIS (BFA)

❑ **Barrier Failure Analysis (BFA**) is one of the various analysis methods available in incident XP

❑ By applying BFA, the performance of barriers can be assessed during an incident investigation.

❑ the BFA supports in particular (complex) incident investigations that are characterized by a variety of events that went wrong.
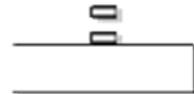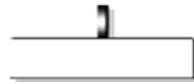
BARRIER FAILURE ANALYSIS (BFA)

Barriers Assessing

Unstabilized Approach with Snow in RWY → Go Around → Loss of Control during Landing Run → Anti Skid System → Runway Excursion
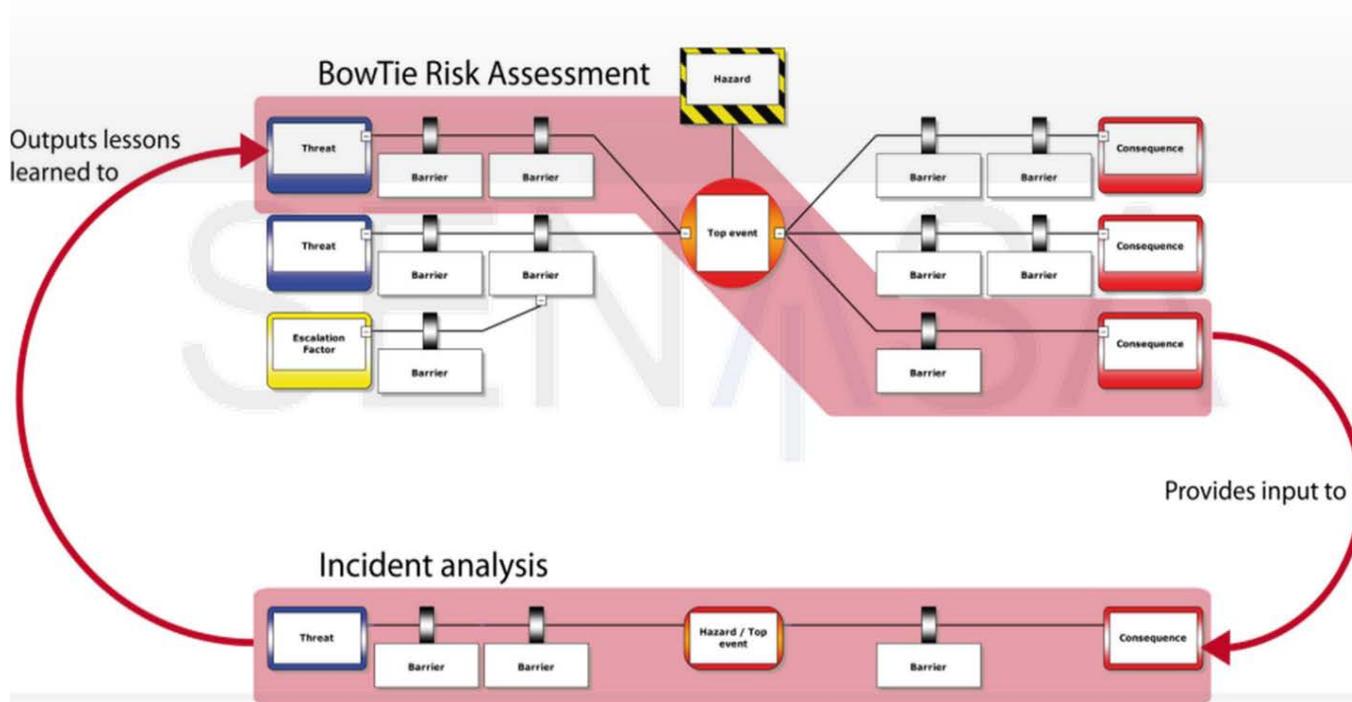
Failed   The barrier is in place, but is not effective.

Missing   The barrier should be in place but has never been implemented.

Effective   The barrier worked as a planned

Inadequate   The barrier functioned partially

Linking with Bowtie

Key Points to remember

Conclusion

☐ Safety reports need to be reviewed through safety screening process so that there can be an adequate action

☐ Risk classification provides with the basis to decide upon the type of action to follow

☐ Internal investigation is the process oriented to identify contributory safety factors and safety issues

☐ 'Safety action' is the term used to describe the things that organizations and individuals do in response to the identification of safety issues in order to prevent accidents and incidents.

☐ Linking hazard analysis with internal investigation provides an added value to the SMS processes:

   o   strengthens hazard detection through bow tie updating

   o   provides an indication of barrier reliability

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THANK YOU!