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

- Safety Occurrence Reporting Systems
- Flight Data Monitoring (FDM)
- Safety Audits & Surveys
- Safety Studies & Reviews
- Accident / Incident Investigations

Introduction
SAFETY DATA CAPTURE & PROCESSING SYSTEMS (SDCPS)

FRAMEWORK FOR STATE SAFETY PROGRAMME (SSP)

2. RISK MANAGEMENT

- HAZARDS IDENTIFICATION AND SAFETY RISK ASSESSMENT
- MANAGEMENT OF SAFETY RISKS
- HAZARD IDENTIFICATION
- RISK ASSESSMENT AND MITIGATION

SDCPS (STATE)

- MORS
- VORS
- ACCIDENT INVESTIGATIONS
- SELF DISCLOSURE REPORTING SYSTEMS

3. SAFETY ASSURANCE

- STATE SAFETY PERFORMANCE

SDCPS (PROVIDER)

FRAMEWORK FOR SAFETY MANAGEMENT SYSTEMS (SMS)
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.

**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

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

<table>
<thead>
<tr>
<th>Question 2</th>
<th>Question 1</th>
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<tr>
<td>What was the effectiveness of the remaining barriers between this event and the most credible accident scenario?</td>
<td>If this event had escalated into an accident outcome, what would have been the most credible outcome?</td>
</tr>
<tr>
<td>Effective</td>
<td>Limited</td>
</tr>
<tr>
<td>50</td>
<td>102</td>
</tr>
<tr>
<td>10</td>
<td>21</td>
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<tr>
<td>2</td>
<td>4</td>
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**Typical accident scenarios**

- Catastrophic Accident
- Loss of aircraft or multiple fatalities (3 or more)
- Major Accident
- 1 or 2 fatalities, multiple serious injuries, major damage to the aircraft
- Minor injuries or damage
- Minor injuries, minor damage to aircraft
- No accident outcome
- No potential damage or injury could occur

**Risk Estimation and Weight**

→ Investigate immediately and take action.
→ Investigate or carry out further Risk Assessment
→ Use for continuous improvement (flows into the Database).

**Worst Credible Accident Criteria**

**Remaining Effective Barriers including the one that stopped the escalation**
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*

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<td>Windshear Warning</td>
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Available information at Skybrary / ARMS
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?)
<table>
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<td><strong>Contributory Safety Factor</strong></td>
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<td><strong>Safety issue</strong></td>
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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.
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 in safety factors.

<table>
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<th>Safety Factors</th>
<th>Condition</th>
<th>Event</th>
<th>Contributing Safety Factor</th>
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<td>Approach</td>
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<td></td>
</tr>
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<td></td>
<td>Braking</td>
<td>Action</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Runway</td>
<td>Excursion</td>
<td></td>
</tr>
</tbody>
</table>

Brake anti-skid u/s and deferred by MEL

Unexpected snow conditions

Wind shear

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

- 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.
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- 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 in

<table>
<thead>
<tr>
<th>ICAO Metrics &amp; RCS</th>
<th>ARMS ERC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Severity</strong>&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Major</td>
</tr>
<tr>
<td><strong>Likelihood</strong></td>
<td>Occasional</td>
</tr>
<tr>
<td><strong>Risk Index</strong></td>
<td>4C (Tolerable)</td>
</tr>
<tr>
<td><strong>Safety Action:</strong></td>
<td>Schedule performance of a safety assessment to bring down the risk index to the low range if viable</td>
</tr>
<tr>
<td><strong>Risk Index</strong></td>
<td>500</td>
</tr>
<tr>
<td><strong>Safety Action:</strong></td>
<td>Investigate immediately and take action</td>
</tr>
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</table>
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)

BFA

Main Cause – Effect Relationships

Event

Barrier

Immediate Cause
Basic Cause
Management System Factor

ADREP Based

Barriers: Failed, Missing, Unreliable, Effective

Event

Barrier

Immediate Cause
Basic Cause
Management System Factor
Barriers Assessing

- **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

BowTie Risk Assessment

Outputs lessons learned to

Incident analysis

Provides input to
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:
- Strengthens hazard detection through bow tie updating.
- Provides an indication of barrier reliability.
THANK YOU!