Strategic Risk Management using Bow-Tie Risk Models

SMICG Industry Day
RIO – December 12th

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Air France key figures 2013
Worldwide network

- 78 millions passengers
- 800 flights per day
- 69 000 employees
- 242 aircraft
- 243 airports (AF/KL)
36 000 Reports

15 000 Safety Reports

Count Ratio per Risk Area

- Flight Safety: 15,840 (41%)
- Security: 4,248 (11%)
- Quality and performance: 15,676 (41%)
- Customer: 1,701 (4%)
- Environment: 143,000 (0%)
- Food security: 203,000 (1%)
- Safety and Health at Work: 412,000 (1%)
- Uncategorised: 185,000 (1%)
All involved (Safety Culture)
- IMS or SMS

Participative dimension
- One common reporting tool

Be reactive
- Investigation, analysis, corrective action, feedback

Be proactive
- Safety barriers
- Risk model

Risk factors – Safety Issues,

Be Predictive
- How to anticipate them?
Time boxing project and now on

2 years…
AF only Safety model
Training
Too rich…
Reactive, not enough proactive
Transversal
IMS orientated

Coming soon…
Aviation Industry approach : Bow tie Barrier performances monitoring (KPI)
Extend data register to Audits, FDM, ATQP, LOSA…
Risk Management Process

Continuous Improvement

Barrier management with Bow Ties (leading indicators)…coming soon
Safety surveys considering Safety Issues with actual hazard
Proactive action plans

Occurrence Management

Event analysis
Significant failure of a barrier
Event Risk Classification (lagging indicators)
Immediate action or conservatory measure

Change Management

Change is a potential hazard
Predictive risk analysis with experts round tables
Predictive action plans

Decision of change? Economical, strategical reasons

How is the new reality after the change?
Occurrence management process

One tool: reporting, dispatching, analyzing, investigating, reacting, anticipating…

VIDEO
### ERC: ARMS Methodology

#### 2D Vision (scenario of accident and remaining barriers)

**Event Risk Classification (ERC)**

<table>
<thead>
<tr>
<th>Question 1</th>
<th>Question 2</th>
</tr>
</thead>
<tbody>
<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>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

- **Risk unacceptable**: Immediate action, conservatory measures and safety issue risk assessment
- **Risk tolerable**: Risk analysis necessary
- **Risk acceptable**: Data register

**Safety expert round table**

**Corporate weekly meeting (RX2)**
Process summary – simplified schematic

- Safety Events
  - Event Risk Classification
    - Urgent Actions?
      - Database Analysis
        - Risk Assessment of Safety Issues
      - Risk Reduction
Event register and global risk assessment

- Unsafe state
- Control Barriers
- Undesired event
- Recovery Barriers
- Consequence
- Systemic Risk Level (estimated)
Global Risk assessment eCARE

3D Vision

Risk Assessment Flight Safety

- DG concerned
- DG OA

Unsafe state - ENS (Flight Safety)

- ENS est. frequency
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent

- ENS Calc. Frequency (average nb per year)
- 2.55

- Rate of Ei occurred for selected Unsafe states
- 0.10

Controls

- ENS may cause Ei
- Very Unlikely
- Unlikely
- Possibly
- Likely
- Certainty

Undesirable Event - Ei (Flight Safety)
- El Occurred?
- Yes
- No

Recovery

- Ei may cause accident
- Very Unlikely
- Unlikely
- Possibly
- Likely
- Certainty

- Calculated on document save:

Risk Level

- Consequence

Systemic Risk Level

Threat frequency

Probability of control barrier failure

Probability of recovery barrier failure
SMS automation with eCARE*

* ETQ reliance = AF eCARE

**eCARE New Generation 2015**

- Bow Tie
- Barrier management
- Facilitated analysis
- Flight safety lagging and leading indicators
- Fully integrated ERC
- Full cooperation (Arms, ETQ, Bow Tie XP and you !!! …)
What does all this “small stuff” tell you about the risk of the “big stuff”?
A Strategic Approach to Risk

**Strategic Risk Management**
- Timeframe annual
- Major Risks – Safety, Quality, Compliance
- Update BowTie Models

**Tactical Risk Management**
- Timeframe months
- Risk Dashboard Trends
- Focussed action

**Event Risk Management**
- Response – investigate or add to data?
- What does this event add to the picture?
Global Experience (Big Stuff)

Organisational Learning Engine

Global picture

Internal Data (Small Stuff)

Data Taxonomy Engine

BowTie Risk Models

Risk Dashboards
Other Sources:
- Audit, Flight Data Monitoring, LOSA, ATQP...

20% Significant events => reactive process
80% Precursors, weak signals (black one) => Data Input only

Air France
15 000 Safety Reports per Year

Safety Issues => Safety Survey and recommendation

Investigations Action plans

Safety Issues => Safety Survey and recommendation

monitoring leading indicators (barriers)

investigate or add to data?
Air France project: “Safective”

- Project team structure
- 2 consultants + 1 full time trainee
- 5 operational division and the Corporate level involved
- More than 1 year project to go from actual Risk model to Bow Tie
- IT needs, CGE/ETQ/Aloft help, Industry (Arms and SMiCG…)
- Process review
- Training, testing…
Flight Safety Risk Management is mainly focused on significant 7

1st idea : Flight Ops culture

Generic Bow-Ties

Fine but not enough :
Flight Safety depends on all operational departments in Flight Ops, Cabin, Ground Ops, Cargo, Maintenance, Operations Control Center

Each department shall describe its own operational processes in the Bow-Ties

Operational Division BOW-Ties
2014 Bow-Ties set up: coordinate operational divisions

- Help divisions describe their own risk-based processes
- Coordinate the bow-ties at the corporate level to make sense

Ground Ops process

Flight Ops process

LDS / NOTOC not reflecting actual loading at doors closed

Take Off misconfiguration or outside performance assumption
Facilitate safety culture and safety communication

and Risk Assessment !!
AF Ground Ops 9.5: Load sheet / NOTOC incorrect at doors closed: not reflecting actual load or not taking into account aircraft operational limits
Data Taxonomy Based on BowTie Models

Data Inputs

Risk Register

Threat Rates  Control Failures  UOS  Recovery Activation  Consequence Rates

Safety System and Culture Threats
## Risk Classification

### Threats and Preventive Controls

<table>
<thead>
<tr>
<th>Hazard : Threat : Control</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working at Heights : Unsafe mobile work platform : <strong>Certification</strong></td>
<td>Failed</td>
</tr>
<tr>
<td>Working at Heights : Unsafe mobile work platform : <strong>Inspection by Contractor</strong></td>
<td>Failed</td>
</tr>
<tr>
<td>Working at Heights : Unsafe mobile work platform : <strong>Inspection by Company</strong></td>
<td>Failed</td>
</tr>
</tbody>
</table>

### Consequences and Recovery Controls

<table>
<thead>
<tr>
<th>Hazard : Consequence : Control</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working at Heights : Serious Injury : <strong>Personal Awareness</strong></td>
<td>Failed</td>
</tr>
<tr>
<td>Working at Heights : Serious Injury : <strong>Use of Correct PPE</strong></td>
<td>Failed</td>
</tr>
</tbody>
</table>
Event Risk Classification

Safety, Security or Safety Issue

Event document

Event description and classification

Effectiveness of Controls

Hazard : Threat : Preventive Control

Hazard : Consequence: Recovery Control

Risk Assessment

Severity of Most Credible Consequence

Overall Effectiveness of Remaining Controls

Likelihood of reaching consequence

Corrective Action

Risk Level

Alert

ERC Arms Methodology

Air France participation
Risk Dashboards (Leading and Lagging indicators)

Threats

- Mid-Air Collision
- Controlled Flight Into Terrain
- Runway Excursion - TO
- Runway Excursion - Landing
- Turbulence Injury
- Loss of Control in Flight
- In-Flight Fire

Threat Drivers

- Weight and Balance
- ATC
- Weather
- Runway State
- AC Malfunction
- Bird Hazard
- Distraction

Risk Trends

Barriers Management
Continuous monitoring with all operational data

Outputs lessons learned to

BowTie Risk Assessment

Provides input to

Incidents reports analysis

FDM
Investigations
LOSA

EDS
Audits
ATQP
Perspective 2015

Bow-Ties Model
Our expectations...

- Air France Corporate risk model: Bow-Ties
- Shared and Spread with the industry (SMICG, Webinar...)
- Tool for investigation and event analysis
- Easier risk assessment
- Barrier management (KPI), leading indicators
- Integrate Audits, LOSA, FDM, ATQP, Reports with HF
- Training and comprehensive material
- Collaborative work with editors and consultants
- Full SMS Dashboard
Great but let’s not forget …

Safety Culture
Just and Fair
Collective Memory