



SMS INDUSTRY WORKSHOP GAUTENG

From Insight to Action: Advancing Aviation
Safety with SMS & RBO



SAFETY CULTURE VALUES



RISK PERFORMANCE
BASED OVERSIGHT



Content:

- The Risk Profile
 - Components
 - Data Collection and SMS Inputs
 - Data
 - Key SMS Inputs and Examples
 - Data Analysis
 - Bow Tie
 - Influence of CAPs on Oversight Decisions
 - Organisations risk Profile Audit
 - Calculations
 - Determine Surveillance Intervals





The Risk Profile



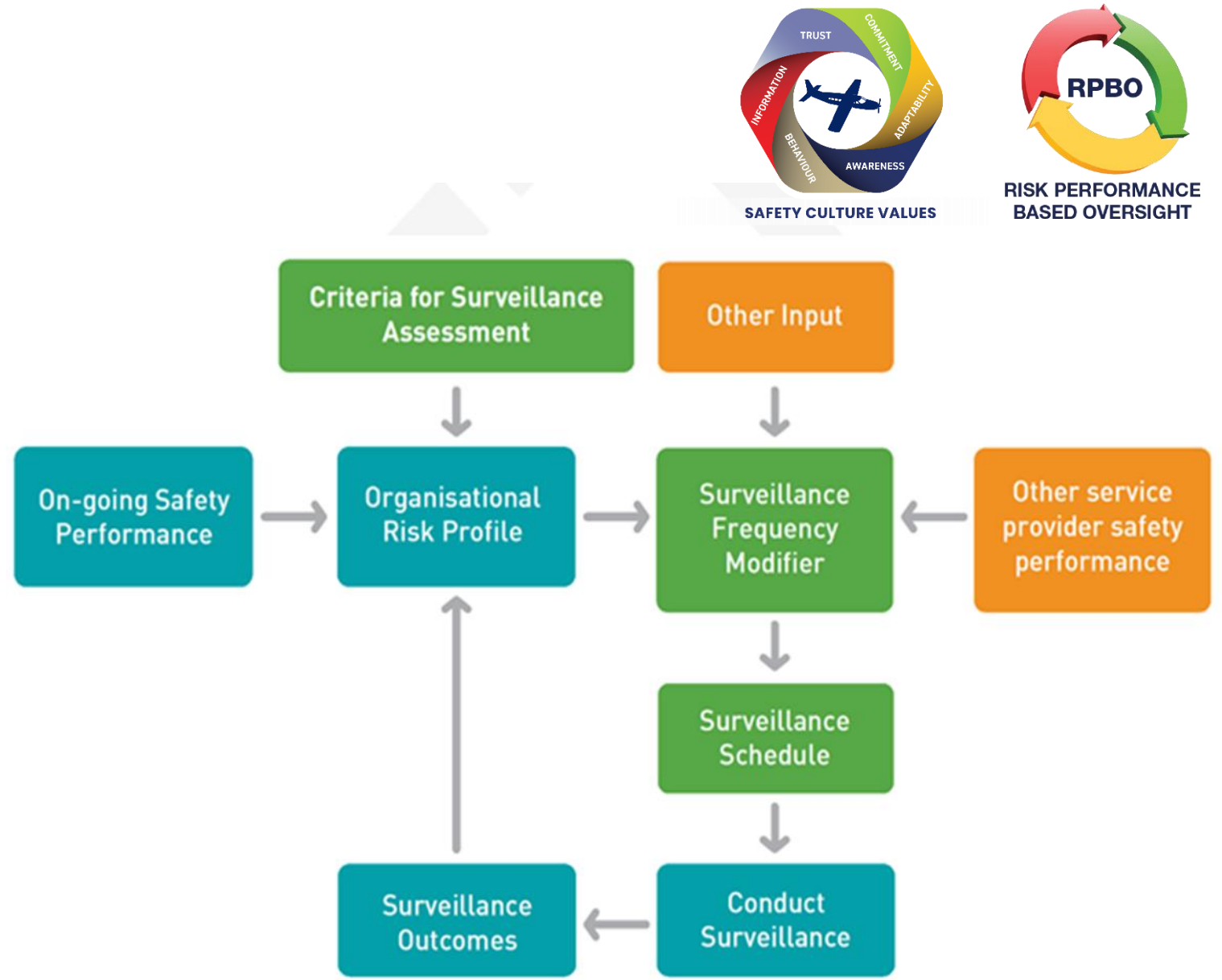
Components

Step 0: Data collection and analysis

Step 1: Organisation Risk Profile Audit

Step 2: Size and Complexity Calculation

Step 3: Determine Surveillance Intervals



Data Collection and SMS Inputs

- Data
 - Occurrence Reports
 - Audit Reports
 - Exemptions
 - Enforcement Actions
 - RPBO Checklist(Base line)

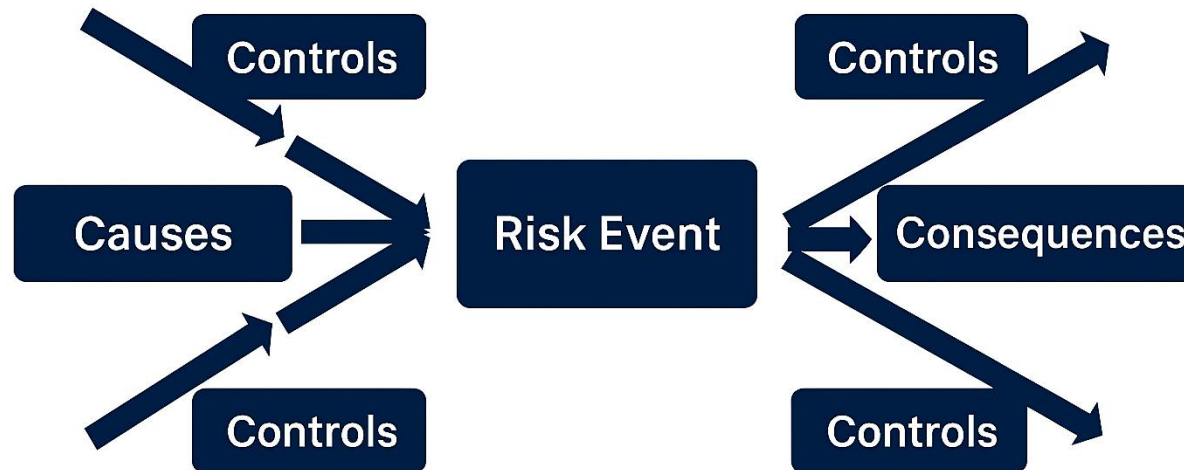
Key SMS Inputs and Examples

SMS INPUT	EXAMPLE
Safety Performance Indicators (SPIs)	Unstable approach rate, maintenance error rate
Hazard Reports & Risk Assessments	Bird strike reports, runway incursions
Audit & Investigation Outcomes	Findings from internal audits or incident investigations
Corrective & Preventive Actions (CAPAs)	Procedural changes after audit findings
Safety Culture Indicators	Safety survey results, reporting rates

Data Analysis

Bow Tie Method

THE BOW TIE METHOD USED IN AVIATION DATA ANALYSIS



BOW-TIE DIAGRAM

A specific measure related to the risk that shows a change in the likelihood or consequence (*Bird Strike; Fuel Spillage; Training*)

This should be the relevant Organisation

04-Nov-25

[illegible]

RESIDUAL RISK RATING--See risk matrix to complete

Score = Average of
all controls x 0.7

What is the scale of the impact

Score = Average of all controls x 0.3	
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	What is the risk left
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Data Analysis Scenario

 **Case Study Title: Lithium Battery Fire Incident at Midrand International Airport**

 **Top Event: Fire in Cargo Hold Due to Lithium Battery Ignition**

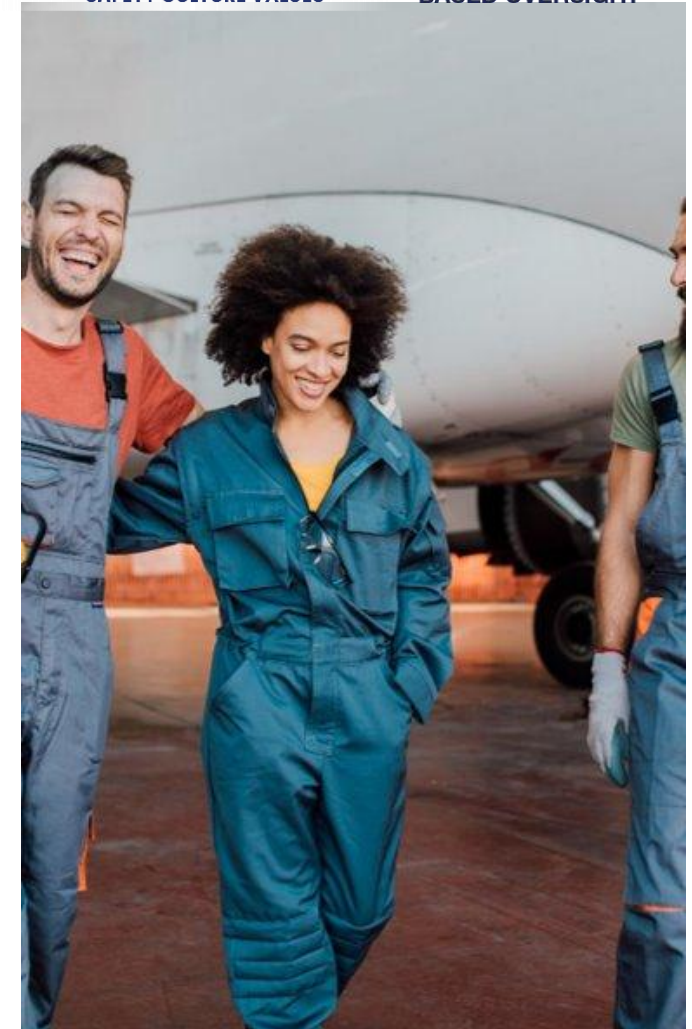


Data Analysis Scenario

On 12 September 2025, a SkyLink Cargo freighter landed at Midrand International Airport following a routine cargo flight from Lusaka. During post-landing operations, ground crew observed smoke emanating from the forward cargo hold. Emergency services were immediately dispatched, and the fire was contained within 15 minutes. Subsequent investigation revealed that the fire originated from a shipment of lithium-ion batteries transported as dangerous goods. The batteries were improperly packaged and declared with incomplete documentation. The aircraft had recently undergone scheduled maintenance at AeroTech AMO, which included inspection and sign-off of the cargo hold fire suppression system. However, the system failed to activate promptly due to a sensor calibration fault. No injuries were reported, but the aircraft sustained minor damage, and airport operations were disrupted for approximately three hours.



IDENTIFYING KEY STAKEHOLDERS





Primary Stakeholders Identified

Four key stakeholders were involved: operator, airport, shipper, and maintenance organization.

Critical Roles in Incident

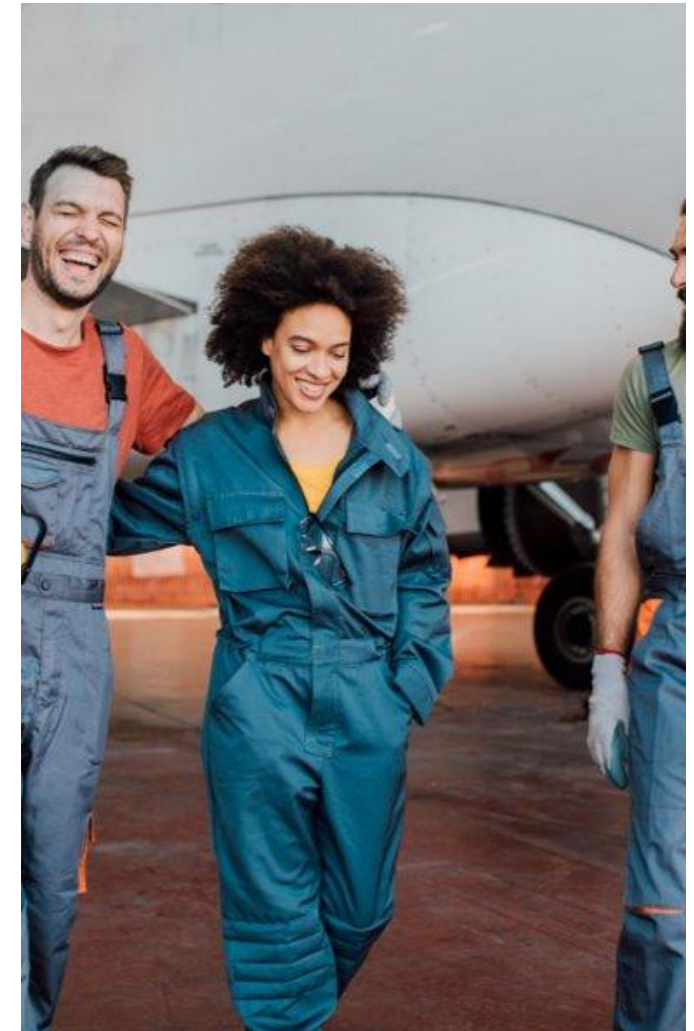
Each stakeholder played a vital role in events before and after the fire incident.

Responsibilities and Interactions

Understanding stakeholder responsibilities is key to analysing risk pathways and controls.

Foundation for Risk Analysis

Stakeholder roles set the stage for detailed risk and control breakdown using Bow Tie Method.





Stakeholder Breakdown

Operator: SkyLink Cargo

Shipment of lithium-ion batteries arrived with incomplete dangerous goods documentation. Cargo handlers and flight crew missed compliance and risk details.

Root Cause Analysis

Inadequate acceptance procedures and insufficient staff training caused failure to verify packaging and risk awareness.

Sequence of Events:

- Accepted shipment of lithium-ion batteries.
- Dangerous goods declaration was incomplete.
- Cargo handlers loaded the shipment without verifying packaging compliance.
- Flight crew were unaware of the specific risks associated with the cargo.



Breakdown:

KRI % of DG shipments with incomplete documentation
Cause Inadequate DG acceptance procedures and training
Impact Fire risk, aircraft damage, potential loss of life



Controls and Indicators:

Control Type	Control Indicator	
Preventative	DG acceptance checklist	Manual – Reviewed weekly
Preventative	Staff DG training and certification	Automated – LMS tracking
Preventative	Automated DG documentation validation system	Automated – Real-time alerts
Mitigation	Fire suppression system Monitored –	Monthly system test logs
Mitigation	Crew emergency response training	Manual – Annual simulation drills
Mitigation	Real-time cargo monitoring sensors	Automated – Sensor health dashboard

Data Analysis

Determining Control effectiveness



1. Addition of Risk to the Risk Register
BOW -TIE DIAGRAM

RISK OWNER: SkyLink Cargo

% of DG shipments with incomplete documentation

DATE: 12-Sep-25

CAUSES	EXISTING PREVENTATIVE CONTROLS	LINK TO CAUSE	Fail? +Score	RISK	EXISTING MITIGATION CONTROLS	LINK TO IMPACT	Fail? + Score	IMPACTS
1. Inadequate DG training	DG acceptance checklist	2		Fire in Cargo Hold Due to Lithium Battery Ignition	Fire suppression system	1,2,3		1. Fire risk
2. Inadequate DG acceptance procedures	Staff DG training and certification	1			Crew emergency response training	1,2,3		2. Aircraft damage
	Automated DG documentation validation system	2			Real-time cargo monitoring sensors	1,2,3		3. Potential loss of life

Add MATRIX TO THIS PAGE

CONTROL EFFECTIVENESS		SCORE
EXCELLENT	The system is effective in managing the risk. Systems and processes exist to manage the risk and management accountability is assigned. The systems are well documented and regular monitoring and review indicates high compliance. There is no convincing cost benefit justification to change management approach.	1
GOOD	Systems and processes exist which manage the risk. Some improvement opportunities have been identified, but not yet actioned.	2
FAIR	Systems and processes exist which partially manage the risk. There is scope for improvement. Inadequacies in the control environment have been identified.	3
POOR	The system and process for managing the risk has been subject to major change or is in the process of being implemented and its effectiveness cannot be confirmed. The control environment is inadequate or inappropriate to manage the identified risk. There is clear cost/benefit advantages to implement improvement opportunities.	4
UNSATISFACTORY	No system or process exists to manage the risk. The control environment is inappropriate or inadequate to manage the identified risk. There is an immediate need for corrective and/or improvement actions to be undertaken.	5

CAUSES	EXISTING PREVENTATIVE CONTROLS	LINK TO CAUSE	Fail? +Score
1. Inadequate DG training	DG acceptance checklist	2	
2. Inadequate DG acceptance procedures	Staff DG training and certification	1	
	Automated DG documentation validation system	2	

Sequence of Events:

- Accepted shipment of lithium-ion batteries.
- Dangerous goods declaration was incomplete.
- Cargo handlers loaded the shipment without verifying packaging compliance.
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CAUSES
1. Inadequate DG training
2. Inadequate DG acceptance procedures

EXISTING PREVENTATIVE CONTROLS	LINK TO CAUSE	Fail? +Score
DG acceptance checklist	2	3
Staff DG training and certification	1	4
Automated DG documentation validation system	2	4



CONTROL EFFECTIVENESS	2.56
See control effectiveness ratings	Score = Average of all controls x 0.7

Data Analysis Scenario

On 12 September 2025, a SkyLink Cargo freighter landed at Midrand International Airport following a routine cargo flight from Lusaka.

During post-landing operations, ground crew observed smoke emanating from the forward cargo hold. Emergency services were immediately dispatched, and the fire was contained within 15 minutes. Subsequent investigation revealed that the fire originated from a shipment of lithium-ion batteries transported as dangerous goods. The batteries were improperly packaged and declared with incomplete documentation.

The aircraft had recently undergone scheduled maintenance at AeroTech AMO, which included inspection and sign-off of the cargo hold fire suppression system. However, the system failed to activate promptly due to a sensor calibration fault. No injuries were reported, but the aircraft sustained minor damage, and airport operations were disrupted for approximately three hours.

EXISTING MITIGATION CONTROLS	LINK TO IMPACT	Fail? + Score
Fire suppression system	1,2,3	
Crew emergency response training	1,2,3	
Real-time cargo monitoring sensors	1,2,3	

IMPACTS
1. Fire risk
2. Aircraft damage
3. Potential loss of life

CONTROL EFFECTIVENESS		SCORE
EXCELLENT	The system is effective in managing the risk. Systems and processes exist to manage the risk and management accountability is assigned. The systems are well documented and regular monitoring and review indicates high compliance. There is no convincing cost benefit justification to change management approach.	1
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EXISTING MITIGATION CONTROLS	LINK TO IMPACT	Fail? + Score
Fire suppression system	1,2,3	
Crew emergency response training	1,2,3	
Real-time cargo monitoring sensors	1,2,3	

IMPACTS
1. Fire risk
2. Aircraft damage
3. Potential loss of life

Sequence of Events:

- Observed smoke emanating from the forward cargo hold. .
- Cargo hold fire suppression system failed.
- Emergency services were immediately dispatched
- The aircraft sustained minor damage

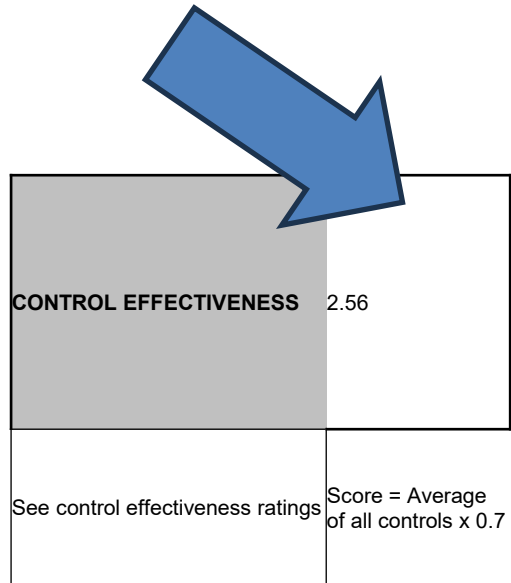
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EXISTING MITIGATION CONTROLS	LINK TO IMPACT	Fail? + Score
Fire suppression system	1,2,3	4
Crew emergency response training	1,2,3	2
Real-time cargo monitoring sensors	1,2,3	5

IMPACTS
1. Fire risk
2. Aircraft damage
3. Potential loss of life

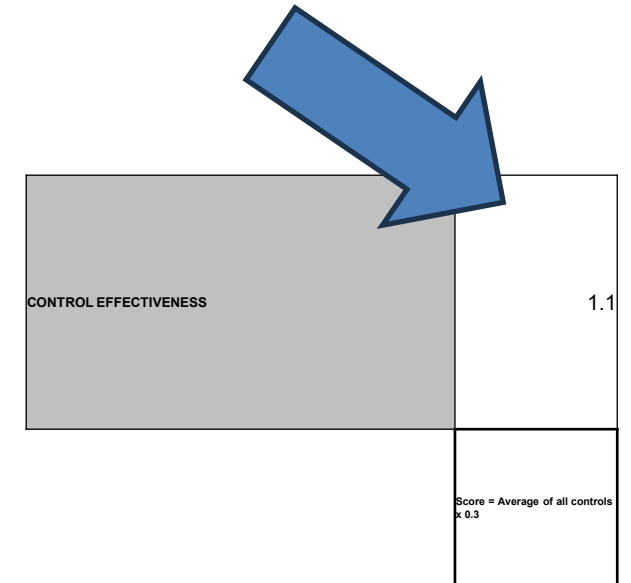


CONTROL EFFECTIVENESS	1.1
	Score = Average of all controls x 0.3



Taking all controls into account

RESIDUAL RISK RATING--See risk matrix to complete	
LIKELIHOOD	
CONSEQUENCE	
RESIDUAL RISK RATING	



Data Analysis

Risk Log – Control Effectiveness

- **Preventative Control Effectiveness:** Average score of controls $\times 0.7$
- **Mitigation Control Effectiveness:** Average score of controls $\times 0.3$
- **Control effectiveness = Combined score**

Risk No	Category	Risk Event and Impac	Risk Cause	Preventative Control Score	Mitigation Control score	Control Effectiveness
1	Equipment	Fire in Cargo Hold Due to Lithium Battery Ignition	Inadequate DG acceptance procedures and training	2.56	1.1	3.66

Data Analysis Determining Risk



SAFETY CULTURE VALUES



RISK PERFORMANCE
BASED OVERSIGHT



Data Analysis

Determining Risk

Taking all controls into account

RESIDUAL RISK RATING--See risk matrix to complete	
LIKELIHOOD	
CONSEQUENCE	
RESIDUAL RISK RATING	

RISK RATING CRITERIA			LIKELIHOOD OF RISK OCCURRING					
			RARE	UNLIKELY	OCCASIONALLY	LIKELY	CERTAIN	
			May occur but only in exceptional circumstances	Could occur during a 12 month period but not likely	May occur at some time during a 12 month period	Will probably occur during a 12 month period	Is expected to occur during a 12 month period	
CONSEQUENCE/ IMPACT OF RISK OCCURRING			1	2	3	4	5	
INSIGNIFICANT	Safety	Incident with minimal or no injury.	1	Low Risk	Low Risk	Low Risk	Low Risk	Medium Risk
	Business Performance	Neglible impact on efficiency or effectiveness.						
	Reputation & Image	Minor, one off (local) negative media attention						
	Stakeholders	Stakeholder dissatisfaction is minimal						
	Financial	Single risk event resulting in unanticipated costs or losses<=50,000						
	Regulatory/legal	Regulatory breaches are insignificant with no disruption to performance of duties						
MINOR	Safety	Incidents or health effects requiring medical attention or short term negative e health effects on one of more individual	2	Low Risk	Low Risk	Medium Risk	Medium Risk	High Risk
	Business Performance	Efficiency and effectiveness of isolated elements are impaired						
	Reputation & Image	Potential negative media attention that can be easily managed						
	Stakeholders	Has an impact on stakeholder lasting for a period of days						
	Financial	Single risk event resulting in unanticipated costs or losses 50,000 to 200,00						
	Regulatory/legal	Regulatory breaches require attention or corrective actions						
MODERATE	Safety	One serious injury. Long term negative effects on one or more individuals	3	Low Risk	Medium Risk	High Risk	High Risk	Extreme Risk
	Business Performance	Efficiency and effectiveness of major elements are impaired						
	Reputation & Image	Consistent broad negative media attention for > one week						
	Stakeholders	Major impact on stakeholders lasting for several weeks						
	Financial	Single risk event resulting in unanticipated cost or losses of 200,000 to 1,000,000						
	Regulatory/legal	Regulatory breaches require significant attention or corrective actions						
MAJOR	Safety	An incident resulting in a single fatality. Long term health effects on multiple individuals	4	Medium Risk	Medium Risk	High Risk	Extreme Risk	Extreme Risk
	Business Performance	The continued capability of the organisation is threatened						
	Reputation & Image	Consistent broad negative media attention for a period of several weeks						
	Stakeholders	Has a major impact on stakeholders lasting several months						
	Financial	Single risk event resulting in unanticipated cost or losses of \$1,000,000 to \$5,000,000						
	Regulatory/legal	Limitations placed on ability to operate which compromises operations and service delivery						
CATASTROPHIC	Safety/Security	An incident resulting in major fatalities. Long term health impact on a significant number of staff, donors or patients	5	High Risk	High Risk	Extreme Risk	Extreme Risk	Extreme Risk
	Business Performance	The ongoing operation as a supplier of blood and blood products in threatened						
	Reputation & Image	Consistent broad negative national media attention for greater than one month. Regulatory or public enquiry						
	Stakeholders	Extreme impact on stakeholder lasting for many months with continuing long term consequences						
	Financial	Financial loss of greater than 5,000,000						
	Regulatory/legal	Regulatory breaches result in any loss in license that significantly impacts service delivery and/or reputation						

Data Analysis Determining Risk

 **Top Event: Fire in Cargo Hold Due to Lithium Battery Ignition**

1. Operator: SkyLink Cargo

Scenario:

Accepted improperly declared dangerous goods; fire suppression system activated late.

Risk Analysis:

- **Likelihood: Likely** – DG documentation issues and system faults are known risks in cargo operations.
- **Consequence: Major** – Aircraft damage, operational disruption, and potential safety hazard.
- **Risk Rating: Extreme Risk**



Taking all controls into account

RESIDUAL RISK RATING--See risk matrix to complete	
LIKELIHOOD	
CONSEQUENCE	
RESIDUAL RISK RATING	

Data Analysis

Determining Risk without the controls

1. Initial Risk Calculation

[{Initial Risk} = {Likelihood} x {Severity}]

Risk No	Category	Risk Event and Impac	Risk Cause	Preventative Control Score	Mitigation Control score	Control Effectiveness	Likelihood	Consequence	Risk Score	risk level
1	Equipment	Fire in Cargo Hold Due to Lithium Battery Ignition	Inadequate DG acceptance procedures and training	2.56	1.1	3.66	4	4	16	High

Data Analysis

Determining Risk taking the controls into consideration

Apply Control Effectiveness

1. Calculate Residual Risk

$$[\{ \text{Residual Risk} \} = \{ \text{Residual Likelihood} \} \times \{ \text{Residual Severity} \}]$$

Preventative controls reduce **likelihood**

$$\text{Residual Likelihood (L}_r\text{)} = \text{Preventative Control Effectiveness} / \text{Initial Likelihood (L}_0\text{)}$$

Mitigative controls reduce **severity**

$$\text{Residual Consequence (C}_r\text{)} = \text{Mitigation Control Effectiveness} / \text{Initial Consequence (C}_0\text{)}$$

Data Analysis

Determining Risk taking the controls into consideration

Risk No	Category	Risk Event and Impac	Risk Cause	Preventative Control Score	Mitigation Control score	Control Effectiveness	Likelihood	Consequence	Risk Score	risk level	Residual Likelihood	Residual Severity	Residual Risk	Risk Level
1	Equipment	Fire in Cargo Hold Due to Lithium Battery Ignition	Inadequate DG acceptance procedures and training	2.56	1.1	3.66	4	4	16	High	1.5625	3.6364	5.6818	5 to 10 - Medium

Data Analysis



Taking all controls into account

CONTROL EFFECTIVENESS	2.56
See control effectiveness ratings	Score = Average of all controls x 0.7

RESIDUAL RISK RATING--See risk matrix to complete	
LIKELIHOOD	1.56
CONSEQUENCE	3.68
RESIDUAL RISK RATING	5.68

CONTROL EFFECTIVENESS	1.1
	Score = Average of all controls x 0.3



Data Analysis

Exemptions
Enforcement
Audit findings



SAFETY CULTURE VALUES



RISK PERFORMANCE
BASED OVERSIGHT

Data Analysis

Influence of Root Cause Analysis

✓ What RCA Does:

- **Identifies the underlying causes** of a failure or incident—not just the symptoms.
- **Helps distinguish between proximate causes** (what happened) and **systemic causes** (why it happened).
- **Enables organizations to prevent recurrence** by addressing the true source of risk.

Data Analysis

Influence of Root Cause Analysis

In the Bow Tie Context:

- RCA informs the left side of the Bow Tie (Threats and Causes).
- It ensures that **preventative controls** are designed to target **actual vulnerabilities**, not superficial fixes.
- RCA supports **data-driven decision-making** for control design and prioritization.

Data Analysis

Influence of Root Cause Analysis

Example:

In the lithium battery fire case, RCA revealed:

- **The sensor calibration fault (AMO issue) was a root cause of delayed fire suppression.**
- **The non-compliant packaging (shipper issue) was a root cause of battery ignition.**

Data Analysis

Influence of Corrective Action Plans

✓ What CAPs Do:

- Define **specific actions** to eliminate or reduce the risk identified in RCA.
- Assign **responsibility, timelines, and measurable outcomes**.
- Ensure **continuous improvement** and regulatory compliance.

Data Analysis

Influence of Corrective Action Plans

In the Bow Tie Context:

- CAPs strengthen or introduce **preventative and mitigation controls**.
- They are tracked using **control indicators** to measure effectiveness.
- CAPs help close the loop between **audit findings** and **operational safety enhancements**.

Data Analysis

Influence of Corrective Action Plans

Example:

From the audit findings:

- CAP for the AMO: Implement dual-verification for sensor calibration.
- CAP for the operator: Automate DG documentation validation.
- CAP for the shipper: Mandatory DG training and packaging audits.

Organisation Risk Profile Audit

- Done as baseline
- Done on Amendment
- When Risk increase or decrease significantly
- Prepopulated checklist

COMPLIANCE (30%)

ORGANIZATION (30%)

SAFETY MANAGEMENT (25%)

OPERATIONAL RISKS (15%)

Organisation Risk Profile Occurance, Findings, Exemption, Enforcement

- Done as baseline
- Annually
- Done on Amendment

ASSESSMENT RESULT 2		
Area	OPERATOR RISK PROFILE SCORES	Score Range
A. OCCURRENCE/ACCIDENTS	60	50-63
B. ENFORCEMENT	0	33-49
C. EXEMPTIONS	33	33-49
D. FINDINGS	33	33-49
Overall	35	33-49

Size and Complexity Calculations

- Size – Number of personnel
- Complexity– Determined by operation scope



Size and Complexity Calculations

TOPICS BENDINGS		SCORE
Number of aircraft operated over 5700 KG	4-5 aircraft	2
Number of aircraft operated below 5700 KG	0 aircraft	0
Fleet Composition	Same A/C type	1
Type of operation	Non-schedule Domestic/International	2
Number of staff	51-200	2
Cabin Crew carried	Yes	3
Dangerous good approval	Yes	3
PBN/Special approvals	RNP-AR Approach + En-route oceanic/remote (RNP 4 & 10) + En-route Continental (RNAV 5,2,1) + RVSM	4
LVO	CAT IIIB a decision height lower than 50ft	3
EDTO	No	0
Route Networks	<6 (domestic and International)	1
Contracted Services	Ground Handling	3
Total Complexity Score		48
LEVEL CODE		1

Calculations

- ORP– Risk profile Audit Results + Analyzed Data Results
- Size +Complexity Results

Area	SCORE RANGE	LEVEL CODE
Current ORP Result	33-49	A
Overall Complexity	30-60	1

Determine Surveillance Intervals

Table B: Next Surveillance Interval Criteria

ORP-Surveillance Index Bands	Next surveillance interval
1A	30 mths
1B, 2A	24 mths
1C, 2B, 3A	18 mths
1D, 1E, 2C, 2D, 2E, 3B, 3C, 3D, 4A, 4B, 4C, 5A, 5B	12 mths
3E, 4D, 4E, 5C, 5D	6 mths
5E	3 mths