EAC
No. 19-00
Understanding SMS

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1. ABBREVIATIONS

AE: Accountable Executive	**RAT:** Risk Assessment Team
ALARP: As Low as Reasonably Practicable	**RRM:** Routinely Reportable Matter (voluntary)
ALOSP: Acceptable Level Of Safety Performance	**SAG:** Safety Action Group
AOC: Airoperator Cirtificate	**SHELL:** Software, Hardware, Environment, Liveware
ARMS: Airlines Risk Management Solutions	**SM:** Safety Manager
ATC: Air Traffic Control	**SMM:** Safety Management Manual
ATS: Air Traffic Services	**SMS:** Safety Management System
CAST: Commercial Aviation Safety Team	**SOP:** Standard Operating Procedure
CFIT: Controlled Flight Into Terrain	**SPI:** Safety Performance Indicator
CRM: Crew Resources Management	**SRB:** Safety Review Board
EAAID: Egyptian Aircraft Accident Investigation Directorate	**SRM:** Safety Risk Management
EAC: Egyptian Advisory Circular	**SSP:** State Safety Program
ECAA: Egyptian Civil Aviation Authority	**TECH:** Technical
ECAR: Egyptian Civil Aviation Regulation	
ENV: Environment	
ERC: Event Risk Classification	
ERP: Emergency Response Plan	
ESB: Effective Safety Behaviors	
FDA: Flight Data Analysis	
FDM: Flight Data Monitoring	
FOD: Foreign Object Debris	
FTL: Flight Time Limitation	
GPWS: Ground Proximity Warning System	
HF: Human Factors	
HUM: Human	
IATA: International Air Transport Association	
ICAO: International Civil Aviation Organization	
IRM: Immediately Reportable Matter (Mandatory)	
IRS: Internal Reporting System	
ISIM: Integrated Safety Investigation Methodology	
ISO: International Organization for Standardization	
LOSA: Line Operations Safety Audit	
MEL: Minimum Equipment List	
MOS: Manual of Standards	
MTOW: Maximum Take-off Weight	
NOTAM: Notice to Airmen	
ORG: Organization	
PPE: Personal protective equipment	
QMS: Quality Management System	

2. DEFINITIONS

Accident: An occurrence associated with the operation of an aircraft which takes place between the times any person boards the aircraft with intention of flight until such time as all such persons have disembarked, in which:
A person is fatally or seriously injured as a result of:

- Being in the aircraft, or
- Direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
- Direct exposure to jet blast,

except when the injuries are from natural causes, self-inflicted, or caused by other persons, or when injuries are to stowaways hiding outside the areas normally available to the passengers and crew, or the aircraft sustains damage or structural failure which,

- adversely affects the structural strength, performance or flight characteristics of the aircraft, and
- would normally require major repair or replacement of the affected component,

except for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories; or for damage limited to propellers, wing tips, antennas, tyres, brakes, fairings, small dents or puncture holes in the aircraft skin; or the aircraft is missing or is completely inaccessible.

ALARP: As Low as Reasonably Practical, means a risk is low enough that attempting to make it lower, or the cost of assessing the improvement gained in an attempted risk reduction, would actually be costlier than any cost likely to come from the risk itself.

Assessment: The process of observing, recording, and interpreting individual knowledge and performance against a required standard.

Change Management: is a systematic approach to controlling changes to any aspect of processes, procedures, products or services, both from the perspective of an organization and individuals. Its objective is to ensure that safety risks resulting from change are reduced to as low as reasonably practicable.

Competency: A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

Competency standards: Defined and expressed in outcome terms.

Competency-based training: Develops the skills, knowledge and behavior required to meet competency standards.

Competency assessment: The process of collecting evidence and making judgments as to whether competence has been achieved.

Consequence: Outcome or impact of an event.

Error: An action or inaction by an operational person that leads to deviations from organizational or the operational person's intentions or expectations.

Error management: The process of detecting and responding to errors with countermeasures that reduce or eliminate the consequences of errors, and diminish the probability of further errors or undesired states.

Hazard: A source of potential harm.

Human Factors (HF): The minimization of human error and its consequences by optimizing the relationships within systems between people, activities and equipment.
Incident: An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.

Just culture: An organizational perspective that discourages blaming the individual for an honest mistake that contributes to an accident or incident. Sanctions are only applied when there is evidence of a conscious violation or intentional reckless or negligent behavior.

Likelihood: Used as a general description of probability or frequency.
Note: Can be expressed qualitatively or quantitatively.

Management: Management comprises planning, organizing, resourcing, leading or directing, and controlling an organization (a group of one or more people or entities) or effort for the purpose of accomplishing a goal.

Operational safety-critical personnel: Persons performing or responsible for safety-related work, including those personnel performing roles that have direct contact with the physical operation of the aircraft or with those that have operational contact with personnel who operate the aircraft.

Quality Management System (QMS): A set of policies, processes and procedures required for planning and execution (production/development/service) in the core business area of an organization.

Risk: The chance of something happening that will have an impact on objectives.

Risk Assessment: The overall process of risk identification, risk analysis and risk evaluation.

Risk Identification: The process of determining what, where, when, why and how something could happen.

Risk Management: The culture, processes and structures that are directed toward realizing potential opportunities whilst managing adverse effects.

Safety: The state in which the probability of harm to persons or of property damage is reduced to, and maintained at, a level which is ALARP through a continuing process of hazard identification and risk management.

Safety Culture: An enduring set of beliefs, norms, attitudes, and practices within an organization concerned with minimizing exposure of the workforce and the general public to dangerous or hazardous conditions. In a positive safety culture, a shared concern for, commitment to, and accountability for safety is promoted.

Safety Management: May be described as managing the identification and reduction of hazards until they reach the ALARP criteria.

Safety Manager (SM): A person responsible for managing all aspects of the operation of the organization's safety management system.

Safety Management System (SMS): A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.

Stakeholders: Those people and organizations who may affect, be affected by, or perceive themselves to be affected by a decision, activity or risk.

Systemic: Relating to or affecting an entire system.

System Safety: The application of engineering and management principles, criteria and techniques to optimize safety by the identification of safety related risks and eliminating or controlling them by design and/or procedures, based on acceptable system safety precedence.

Threat: Events or errors that occur beyond the influence of an operational person, increase operational complexity and shall be managed to maintain the margin of safety.

Threat and Error Management (TEM): The process of detecting and responding to threats with countermeasures that reduce or eliminate the consequences of threats, and mitigate the probability of errors or undesired states.

Training: The process of bringing a person to an agreed standard of proficiency by practice and instruction.

Training Needs Analysis (TNA): The identification of training needs at employee, departmental, or organizational level, in order for the organization to perform effectively.

Chapter 1

Introduction

1. Purpose

The objective of this Advisory Circular is to provide guidance on how to apply the SMS in a resilient, sustainable, and efficient manner. At the same time, it helps in effectively establishing and maintaining the State Safety Program (SSP) in Egypt.The content of this Guidance Material comes in a form of guidance and safety promotion material in regards to SMS.

The organizational culture will have a significant impact upon the success of the SMS. Indeed, it is unlikely that the SMS will achieve its full potential for mishap prevention without full understanding and application of Human Factors (HF) principles by the entire organization's staff in support of a positive safety culture.

It is important to recognize that Safety Management System (SMS) are top down driven systems, which means that the Accountable Executive of the organization is responsible for the implementation and continuing compliance of the SMS. Without the wholehearted support of the Accountable Executive an SMS will not be effective.

There is no 'one size fits all' model of an SMS that will cater for all types of operators. Complex SMS are likely to be inappropriate for small operators, and such operators should tailor their SMS to suit the size, nature and complexity of the operations in their organization and allocate resources accordingly.

2. References

The Egyptian Civil Aviation Authority - Safety Management General Directorate - has developed this document to comply with ICAO Annex-19 (Safety Management), ICAO Document 9859 "Safety Management Manual", the requirements in the Egyptian Civil Aviation Regulations for Safety Management (ECAR Part 19), and other best practices in Safety Management System implementation.

Any Comments or suggestions concerning this document may be forwarded to the Safety Management General Directorate safety@civilaviation.gov.eg. It is the responsibility of the Egyptian Civil Aviation Authority (Safety Management General Directorate) to update this document as and when necessary.

3. Applicability

This Guidance Material applies to aviation organizations, that are required to have a safety management system under ECAR Part 19, and to ECAA as well.

1.2 MANAGEMENT SYSTEMS

An SMS goes beyond a traditional Quality Management System (QMS) by focusing on the safety, human and organizational aspects of an operation. Within an SMS,
There is a distinct focus on operational safety and the human element in the system. This underlines the importance of integrating HF through all parts of the SMS.

In civil aviation today, there are various control systems existing within an organization. Examples include:

- International Organization for Standardization (ISO) 9000 system;
- QMS;
- Human Factors (HF) and Error Management System;
- Fatigue Risk Management System (FRMS);
- Occupational Health and Safety Management System; and
- Security Management System.

There may be organizational benefits in coordinating some/all of these systems.
These include:

- Reducing resource duplication, and therefore, cost;
- Integration and processing of cross-functional safety related data; and
- Reducing potentially conflicting objectives and relationships.

Although the co-ordination and integration process may be a challenging task for many organizations, and could impact on the ability to successfully implement an SMS program in the short to medium term, an alternative would be to plan for integration once the SMS is established within the organization (a phased approach).

If there is a strategy to integrate some or all of these programs, then the SMS should provide the organizational overview of all the various organizational systems from the operational safety perspective.

The role of the QMS is to monitor compliance with and the adequacy of procedures required to ensure safe operational practices. The QMS and SMS have complementary but independent functions with the QMS monitoring the SMS.

Chapter 2

SAFETY MANAGEMENT SYSTEM

SMS is an organized approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.
The complexity of the SMS should match the organization's requirements for managing safety.
At the core of the SMS is a formal Risk Management process that identifies hazard and analyses and mitigates risk.

2.1 SAFETY MANAGEMENT SYSTEM IMPLEMENTATION PLAN

The first step, when introducing SMS into an organization, is to develop an implementation plan. This will be a realistic strategy for the implementation of SMS that meets the needs of the organization and defines the approach taken for managing safety. The contents of the plan should include but not be limited to:

(a) Safety policy;
(b) Safety planning objectives and goals;
(c) System description;
(d) Gap analysis;
(e) SMS components;
(f) Safety roles and responsibilities;
(g) Safety reporting policy;
(h) Means of employee involvement;
(i) Safety communication;
(j) Safety performance measurement;
(k) Management review of safety performance; and
(l) Safety training.

2.2 THE COMPONENTS OF A SAFETY MANAGEMENT SYSTEM

An SMS shall comprise at least the following four key components and elements:

1) Safety Policy, Objectives and planning
2) Safety Risk Management
3) Safety Assurance; and
4) Safety Training and Promotion.

2.3 DELIVERING AN EFFECTIVE SMS ORGANIZATIONAL PROGRAM

The aforementioned Key components and elements for delivering an effective SMS are outlined in the SMS Framework shown in Figure 1 below. The SMS framework in this Guidance Material is largely based on the ICAO SMS guidance which consists of the above four major components

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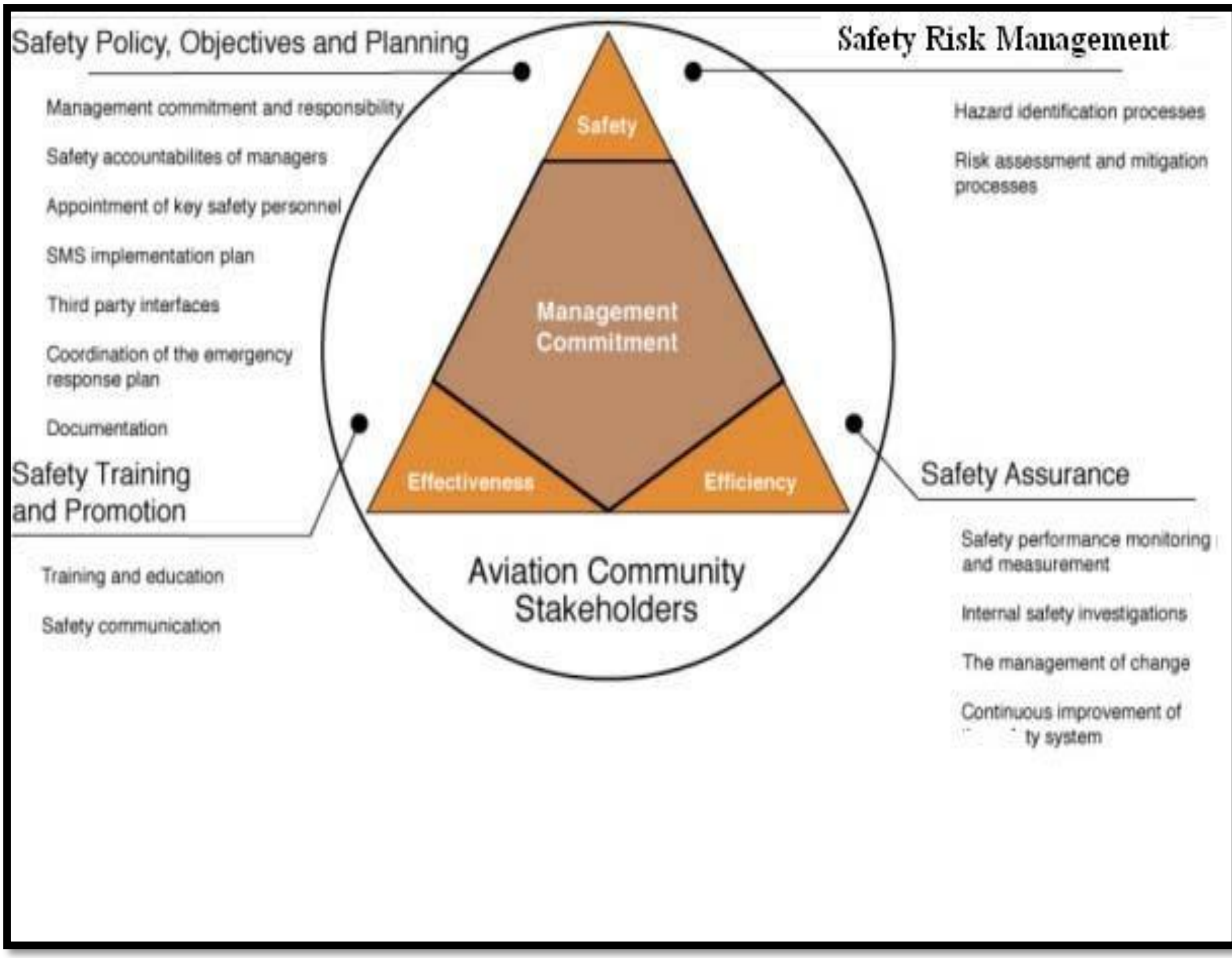

Figure 1: SMS framework

Chapter 3

SAFETY POLICY, OBJECTIVES AND PLANNING

3-1 GENERAL
This chapter covers these elements:
• Management commitment and responsibility;
• Safety accountabilities of managers;
• Appointment of key safety personnel;
• SMS implementation plan;
• Third-party interface – contracted activities;
• Coordination of the emergency response plan; and
• Documentation.

3-2 MANAGEMENT COMMITMENT AND RESPONSIBILITY
The Accountable Executive shall have full responsibility for the SMS and shall:

- Recruit a management team appropriate to the size and complexity of the organization;
- Develop and disseminate a safety policy and safety objectives;
- Create and adequately resource the SMS program;
- Specify roles, responsibilities and accountabilities of every member in the management team in relation to aviation safety and to be reflected on each individual's job description.
- Have the authority to make decisions on behalf of the organization
- Have the final authority for the resolution of all safety issues; and
- Have final authority over operations under the certificate, authorization or approval of the organization, including the authority to stop the operation or activity.

Senior management in the organization shall develop an organizational structure that has the responsibility, authority and accountability assigned to it to assure the SMS will function as planned. This would include an organization chart that depicts the organization structure, inclusive of the SMS, and that establishes a clear line of communication from the Safety Manager (SM) directly to the Accountable Executive.

The authority of acceptability of risks and of making safety risk tolerability decisions may be assigned to an individual, a management position or a committee. A lower level manager (or management group) may be authorized to make tolerability decisions up to a certain level. Risk levels that exceed the manager's authority should be escalated for consideration to a higher management level with greater authority.

The accountability for implementation and maintenance of an effective SMS can never be delegated by the Accountable Executive. However, the Accountable Executive may elect to delegate some of his responsibilities to other personnel for the day-to-day operation of the SMS, the Accountable Executive can not delegate accountability for the system nor can decisions regarding safety risks be delegated. The following safety accountabilities cannot be delegated:

- ensuring safety policy and safety objectives are established, appropriate and communicated;
- ensuring necessary allocation of resources (financing, personnel, training, acquisition);
- ensuring that the acceptable safety risk limits are set (the SRB may help setting these limits);
- resourcing of necessary controls;
- promoting a positive safety culture;
- ensuring appropriate actions are taken to address safety issues and safety risks;
- ensuring accidents and incidents are responded;
- ensuring the SMS is properly implemented and performing to requirements; and
- ensuring the continuous improvement of the SMS.

3-3 SAFETY POLICY

Management commitment to safety needs to be clearly expressed in a statement of the organization's safety policy.
A Safety Policy outlines what the organization will do to achieve the desired safety outcomes. It serves as a reminder as to 'how we do business around here'.
Safety policy statement may take different forms but will typically include:

- The overall safety objective of the organization;
- The commitment of senior management to the goal of ensuring that all aspects of the operation meet safety performance targets;
- Determination by the organization to provide the resources necessary for the effective safety management;
- The organization's policies concerning responsibility and accountability for safety at all levels of the organization; and
- Management's explicit support of a 'just culture', as part of the overall safety culture of the organization.

A 'just culture' provides clear boundaries about confidentiality, reporting requirements, and individual responsibilities in relation to the SMS as far as management and staff are concerned. However, in a 'just culture' policy, a clear distinction is required between what is acceptable behavior and what is unacceptable, and that people are treated accordingly. 'Just culture' is a necessary evolution from the 'blame free' culture of the past.

3-4 Safety objectives:

a) Safety objectives provide direction to the organization's activities and should therefore be consistent with the safety policy that sets out the organization's high-level safety commitment. Safety objectives are also useful to communicate safety priorities to personnel and the aviation community as a whole.
b) Establishing safety objectives provides strategic direction for the safety performance management process and provides a sound basis for safety related decision-making. The management of safety performance should be a primary consideration when amending

policies or processes or allocating the organization's resources in pursuit of improving safety performance.

c) Safety objectives may be:
    1. process-oriented: stated in terms of safe behaviors expected from operational personnel or the performance of actions implemented by the organization to manage safety risk; or
    2. outcome-oriented: encompass actions and trends regarding containment of accidents or operational losses.

d) Safety Objectives should be defined and established after answering the following questions regarding safety management:
    1. what are the organizations top safety risks? Derived from a review of aviation accident and incident data as well as emerging risks.
    2. what does the organization want to achieve in terms of safety and what are the top safety risks that need to be addressed?

e) Safety objectives on their own do not have to be specific, measurable, achievable, relevant and timely (SMART), provided the safety objectives and accompanying SPIs and SPTs form a package, that allows an organization to demonstrate whether it is maintaining or improving its safety performance, in a manner towards achieving its safety objectives. The relationships are as follows:
    - One safety objective to one SPI, or
    - One safety objective to many SPIs.

Examples of safety objectives

Process oriented	• increase number of hazard reporting. • hold x number of safety meetings. • train employees on hazard identification.
Outcome oriented	• reduce the number of fatigue incidents. • reduce the annual number of adverse apron safety events from the previous year.

3-5 SAFETY ACCOUNTABILITIES OF MANAGERS

1. The Accountable Executive is ultimately held responsible for the SMS and shall ensure the provision of resources necessary to implement and maintain the program.
2. The roles, responsibilities and accountabilities of the positions outlined on the organizational chart shall be explicit with respect to the SMS.
3. All management and supervisory positions in addition to the Safety Manager (SM) would be expected to show leadership and have included in their responsibilities/accountabilities a requirement to:

• Actively support and promote the SMS;
• Ensure that they and their staff comply with the SMS processes and procedures;
• Ensure resources are made available to achieve the outcomes of the SMS; and

• Continually monitor their area of responsibility, as outlined in the SMS Manual.

3-6 APPOINTMENT OF KEY SAFETY PERSONNEL

A large organization have a dedicated Safety Department, led by a Head of Safety Management. There would be scope within the department to appoint a deputy SM, and additional personnel (safety personnel) as required.

3-7 Safety Manager (SM) - ROLES and RESPONSIBILITIES

Depending on the size of the organization, the SM shall possess operational management experience and an adequate technical background to understand the systems that support operations.
Operational skills alone will not be sufficient. The SM shall have a sound understanding of safety management principles, typically acquired through formal training and practical experience.

1. Depending on the size of the organization, senior management shall appoint a SM who, irrespective of other duties, will have responsibilities and authority that includes:
    - Ensuring that processes needed for the SMS are established implemented and maintained;
    - Reporting to the Accountable Executive on the performance of the SMS and the areas where improvement is required; and
    - Ensuring the promotion of awareness of safety requirements throughout the organization.
2. The SM shall be the catalyst to develop and mature the SMS over time, through engagement with the organization's executive management at all levels and operational staff.
3. The SM is responsible for accomplishing tasks and functions of the SMS. The role and responsibilities of the SM should be specified in the SMS Manual.
4. The SM reports directly to senior management. The SM may have staff to assist in the role.
5. The SM needs to be 'independent' from operational areas, and have the ability to report directly to the Accountable Executive. Formal reporting lines direct to the Accountable Executive gives the SM the 'authority' to look across the organization from the safety perspective.
6. Where possible, the SM shall be assisted by safety representatives from each department or functional area.
7. The SM is not the sole person responsible for safety. Specific safety activities and functional or operational safety performance outcomes are the responsibility of the relevant operational or functional managers, and senior management shall not hold the SM accountable for line managers' responsibilities. The SM shall monitor all cross functional or departmental SMS activities to ensure their relevant integration. While the SM may be held accountable for the satisfactory administration and facilitation of the SMS itself, he shall not be held accountable for the safety performance of the organization — the Accountable Executive alone is accountable.
8. The SM responsibilities include, but are not limited to:
    - managing the operation of the safety management system;
    - collecting and analyzing safety information in a timely manner;
    - administering any safety-related surveys;
    - monitoring and evaluating the results of corrective actions;
    - ensuring that risk assessments are conducted when applicable;
    - monitoring the industry for safety concerns that could affect the organization;
    - being involved with actual or practice emergency responses;
    - being involved in the development and updating of the emergency response plan and procedures; and
    - Ensuring safety-related information, including organizational goals and objectives, are made available to all personnel through established communication processes.

3.8 Safety Manager Authority

A Safety Manager must have the appropriate authority to be able to perform all aspects of the role properly. This goes beyond just having direct access to the Accountable Executive and appropriate senior and middle management but also the authority to:

- The safety manager is authorized under the direction of the Accountable Executive to conduct safety audits, surveys and inspections of any aspect of the operation and direct other areas of the organization to provide any required information in accordance with the procedures specified in the organization's Safety Management System documentation.
- The safety manager is authorized under the direction of the Accountable Executive to conduct investigations of internal safety events and be able to access and speak to all involved parties in accordance with the procedures specified in the organization's SMS documentation.
- Liaise as appropriate with regulatory authorities and other parties in safety matters, on behalf of the organization,

The safety manager should not hold other positions or responsibilities that may conflict or impair his role as an SMS/safety manager. The position of Safety Manager should be a senior management position not lower than or subservient to the production or operational functions of the organization.

3.9 Deputizing the SM

Importantly, operators need to give due consideration to deputizing the SM's role during periods of absence or depending on the size and complexity of the organization.

3.10 SAFETY COMMITTEES

1. Safety Review Board (SRB)

The Safety Review Board (SRB) is a high level committee which considers strategic safety functions. The board shall be chaired by the Accountable Executive and shall normally include the Senior Management of the organization. If required, directors of the organization shall be included in the SRB. As well as the Safety Manager serves as a secretariat handling the SRB inputs, preparing the presentation, drafting the recommendations and granting the Accountable Executive approval for implementation and monitoring.

The SRB is a formal process, which means documentation in the form of meeting schedules, agendas and minutes are produced and retained. Additionally, the output of the SRB would normally include action plans for changes to be implemented within the system when deemed appropriate. The SRB ensures that appropriate resources are allocated to achieve the established safety performance and gives strategic direction to the Safety Action Group (SAG).

To be effective, a formal review takes place on a regular basis, at least once per year and preferably biannually, or whenever it deemed necessary. Assessing opportunities for improvement and the need for changes to the system, including, but not limited to:

- Organizational structure;
- Defined safety objectives;
- Reporting lines, authorities, responsibilities;

- Policies, processes and procedures;
- Allocation of resources;
- Identification of training needs.

The SRB monitors the following, but not limited to:

(a) Safety performance against the safety policy and objectives;
(b) Effectiveness of the SMS implementation;
(c) Effectiveness of the safety oversight of sub-contracted organizations;
(d) That necessary corrective or mitigating actions are being taken in a timely manner; and
(e) Effectiveness of the auditing of the SMS.
(f) Effectiveness of the organization’s safety management processes which support:
1) the declared organizational priority of safety management; and
2) promotion of safety across the organization.

2. Safety Action Group (SAG)

The SAG reports to and takes strategic direction from the SRB. It comprises managers, supervisors and staff from operational areas and chaired by a designated manager. SAG(s) are more operationally focused. The Safety Manager may also be included in the SAG.
To be effective, a formal SAG(s) meetings to take place on a regular basis, at least quarterly or whenever deemed necessary.

SAG(s) are responsible for, but not limited to:

(a) Oversees operational safety;
(b) Resolves identified risks;
(c) Assesses the impact on safety of operational changes;
(d) Implements corrective action plans; and
(e) Ensures that corrective action is achieved within agreed timescales.

The SAG reviews:

(a) The effectiveness of previous safety recommendations; and
(b) Safety promotion.

3.11 SMS IMPLEMENTATION PLAN

1. The SMS implementation plan shall detail all aspects of the development and implementation of the SMS. It is expected that the SMS program will mature over time through a process of continuous improvement.
2. The implementation plan shall address all the areas covered in the SMS Manual with particular attention being given to safety strategy, safety objectives, safety management processes and activities, resource implications, training, safety promotion and time lines.
3. A planning group may be established to implement the plan, the planning group may be able to build upon existing strengths by reviewing the organization’s current capabilities for safety management (including experience, knowledge, processes, procedures, resources, etc.). Shortcomings in safety management experience shall be recognized and resources to assist in development and implementation of the SMS identified. Many operational units may already have internal procedures in place for the investigation of incidents, hazard identification, safety

monitoring, etc.
These shall be reviewed and perhaps modified for integration within the SMS. It is important that the organization re-use as many existing procedures as practicable, as there is no need to replace known and effective procedures and processes. By building on such an experience base, the development of an SMS will be less disruptive.
During this review process, the planning group shall also examine best industry practices for safety management by consulting with other organizations of similar size and mission.
4. An organization shall consider a phased approach to SMS implementation. A suggested approach is outlined in Table 1 below.

3.12 GAP ANALYSIS AND PROJECT PLAN

1. Organizations would need to conduct a gap analysis of their system(s) to determine which components and elements of a safety management system are currently in place, and which components or elements shall be added or modified to meet SMS as well as regulatory requirements. The review involves comparing the SMS components and elements against the existing systems in the organization.
2. A checklist may be used to account for each component and their respective sub-elements. The checklist can provide for a 'Yes' and 'No' response, in terms of the compliance of the existing system, to the SMS requirements. Remarks for partial compliance or deviations shall be made as well as actions required in order to meet the criteria. There shall be a column for annotating existing organization documentation where the requirement is addressed.
3. Once the gap analysis is complete and fully documented, the items identified as missing or deficient will form the basis of the SMS implementation plan.
Organizations may format their implementation plan to suit their individual needs.

ELEMENTS	PHASE 1	PHASE 2	PHASE 3
Safety Policy, Objectives and Planning			
Management commitment and responsibility	x		
Safety accountabilities of managers	x		
Appointment of key safety personnel	x		
SMS implementation plan	x - (including gap analysis)		
Third party interface		x	
Coordination of the Emergency Response Plan		x	
Documentation	x		
Safety Risk Management			
Hazard identification process		Proactive/predictive hazard identification	
Risk assessment and mitigation process	Reactive	Proactive and predictive	
Safety Assurance			
Safety performance monitoring and measurement	Reactive – incident and accident investigation		
Internal safety investigation	x		
The management of change			x
Continuous improvement of the safety system			x
Safety Promotion			
Training and education	Key personnel	All safety critical personnel	All safety critical personnel
Safety communication		x	x

Table 1: Phased approach to SMS implementation

3.13 THIRD PARTY INTERFACES – CONTRACTED ACTIVITIES

1. The provision of services supporting organization operations often involves third party interfaces (service providers, contractors, suppliers).
2. Whether a large corporate contractor or small business, the contracting authority
(e.g. an airline, an airport.... etc.) holds overall responsibility for the safety of services provided by the contractor. The contract with the third party should specify the safety standards to be met. The contracting authority then has the responsibility for ensuring that the contractor complies with the safety standards prescribed in the contract.
3. AN SMS shall ensure that the level of safety of an organization is not eroded by the inputs, services and supplies provided by external organizations.
4. As a general guideline, a third party contract shall include the following as a minimum standard:
• Any agreement for the provision of services shall be supported by a written contract prior to services commencing;

• All third party providers shall hold the appropriate qualifications/credentials or approvals for the work being outsourced;

• All third parties shall understand the operator's SMS, and their own responsibilities within the SMS program. The Operator must have a demonstrable process to assure themselves that the third party is aware of, and meeting these requirements;
• All third party organizations shall be able to demonstrate their ability to provide trained and competent staff.
• All written service level agreements shall contain a schedule of oversight to monitor the third party's performance on a regular basis;
• All agreements shall contain details on how any noted safety hazards and deficiencies will be addressed and the time frame for these actions (risk management process as outlined in this Publication); and

3.14 EMERGENCY RESPONSE PLAN

Successful response to an emergency begins with effective planning. An ERP provides the basis for a systematic approach to managing the organization's affairs in the aftermath of a significant unplanned event — in the worst case, a major accident.

The purpose of an emergency response plan is to ensure:
a) delegation of emergency authority;
b) assignment of emergency responsibilities;
c) documentation of emergency procedures and processes;
d) coordination of emergency efforts internally and with external parties;
e) safe continuation of essential operations while the crisis is being managed;
f) Proactive identification of all possible emergency events/scenarios and their corresponding mitigation actions, etc.

To be effective, an ERP should:
a) be appropriate to the size, nature and complexity of the organization;
b) be readily accessible to all relevant personnel and other organizations where applicable;
c) include checklists and procedures relevant to specific emergency situations;
d) have quick-reference contact details of relevant personnel;
e) be regularly tested through exercises;
f) be periodically reviewed and updated when details change, etc.

ERP contents

An ERP would normally be documented in the format of a manual that should set out the responsibilities, roles and actions of the various agencies and personnel involved in dealing with specific emergencies. An ERP should take account of such considerations as:
a) Governing policies. The ERP should provide direction for responding to emergencies, such as governing laws and regulations for investigations, agreements with local authorities, company policies and priorities.
b) Organization. The ERP should outline management's intentions with respect to the responding organizations by:
1) designating who will lead and who will be assigned to the response teams;
2) defining the roles and responsibilities of personnel assigned to the response teams;
3) clarifying the reporting lines of authority;
4) setting up an emergency management centre (EMC);
5) establishing procedures for receiving a large number of requests for information, especially during the first few days after a major accident;
6) designating the corporate spokesperson for dealing with the media;

7) defining what resources will be available, including financial authorities for immediate activities;
8) designating the company representative to any formal investigations undertaken by State officials;
9) Defining a call-out plan for key personnel.

An organizational chart could be used to show organizational functions and communication relationships.

c) Notifications. The plan should specify who in the organization should be notified of an emergency, who will make external notifications and by what means. The notification needs of the following should be considered:

1) management;
2) State authorities (search and rescue, the regulatory authority, the accident investigation board, etc.);
3) Local emergency response services (aerodrome authorities, fire fighters, police, ambulance, medical agencies, etc.);
4) relatives of victims (a sensitive issue that, in many States, is handled by the police);
5) company personnel;
6) media; and
7) Legal, accounting, insurers, etc.

d) Initial response. Depending on the circumstances, an initial response team may be dispatched to the accident or crisis site to augment local resources and oversee the organization's interests. Factors to be considered for such a team include:

Who should lead the initial response team?
Who should be included on the initial response team?
Who should speak for the organization at the accident site?
What would be required by way of special equipment, clothing, documentation, transportation, accommodation, etc.?

e) Additional assistance. Employees with appropriate training and experience can provide useful support during the preparation, exercising and updating of an organization's ERP. Their expertise may be useful in planning and executing such tasks as:

acting as passengers or customers in exercises;
handling survivors or external parties;
Dealing with next of kin, authorities, etc.

f) Emergency management centre (EMC). An EMC (normally on standby mode) may be established at the organization's headquarters once the activation criteria have been met. In addition, a command post (CP) may be established at or near the crisis site. The ERP should address how the following requirements are to be met:

1) Staffing (perhaps for 24 hours a day, 7 days per week, during the initial response period);
2) Communications equipment (telephones, facsimile, Internet, etc.);
3) Documentation requirements, maintenance of emergency activity logs;
4) Impounding related company records;
5) Office furnishings and supplies; and
6) Reference documents (such as emergency response checklists and procedures, company manuals, aerodrome emergency plans and telephone lists).
7) The services of a crisis centre may be contracted from an airline or other specialist organization to look after the service provider's interests in a crisis away from home base. Company personnel would normally supplement such a contracted centre as soon as possible.

g) Records. In addition to the organization's need to maintain logs of events and activities, the organization will also be required to provide information to any State investigation team. The ERP should address the following types of information required by investigators:

1)all relevant records about the product or service concerned;
2)lists of points of contact and any personnel associated with the occurrence;
3)notes of any interviews (and statements) with anyone associated with the event;
4)Any photographic or other evidence.

h) Accident site.
For a major accident, representatives from many jurisdictions have legitimate reasons for accessing the site: for example, police; fire fighters; medics; aerodrome authorities; coroners (medical examining officers) to deal with fatalities; State accident investigators; relief agencies such as the Red Cross and even the media. Although coordination of the activities of these stakeholders is the responsibility of the State's police and/or investigating authority, the service provider should clarify the following aspects of activities at the accident site:

1) nominating a senior company representative at the accident site if:
   —At home base;
   — Away from home base;
   — Offshore or in a foreign State;
2) management of surviving victims;
3) the needs of the relatives of victims;
4) security of the wreckage;
5) handling of human remains and personal property of the deceased;
6) preservation of evidence;
7) provision of assistance (as required) to the investigation authorities;
8) Removal and disposal of the wreckage; etc.

i)News media. How the company responds to the media may affect how well the company recovers from the event. Clear direction is required regarding, for example:

1)What information is protected by statute (FDR data, CVR and ATC recordings, witness statements, etc.);
2)who may speak on behalf of the parent organization at head office and at the accident site (public relations manager, chief executive officer or other senior executive, manager, owner);
3) prepared statements for immediate response to media queries;
4) what information may be released (what should be avoided);
5) the timing and content of the company's initial statement;
6) Provisions for regular updates to the media.

j) Formal investigations. Guidance for company personnel dealing with State accident investigators and police should be provided.

k) Family assistance. The ERP should also include guidance on the organization's approach to assisting crisis victims or customer organizations. This guidance may include such things as:
   1) State requirements for the provision of assistance services;
   2) travel and accommodation arrangements to visit the crisis site;
   3) programme coordinator and point(s) of contact for victims/customers;
   4) provision of up-to-date information;
   5) Temporary assistance to victims or customers.

   Note. — ICAO Circular 285, Guidance on Assistance to Aircraft Accident Victims and their Families, provides further guidance on this subject.

l) Post-occurrence review. Direction should be provided to ensure that, following the emergency, key personnel carry out a full debrief and record all significant lessons learned which may result in amendments to the ERP and associated procedures.

Checklists

7. Everyone involved in the initial response to a major aviation event will be suffering from some degree of disorientation. Therefore, the emergency response process lends itself to the use of checklists. These checklists can form an integral part of the company's operations manual or emergency response manual. To be effective, checklists must be regularly:

a) reviewed and updated (for example, currency of call-out lists and contact details); and
b) Tested through realistic exercises.

Training and exercises

8. An ERP is a paper indication of intent. Hopefully, much of an ERP will never be tested under actual conditions. Training is required to ensure that these intentions are backed by operational capabilities. Since training has a short "shelf life", regular drills and exercises are advisable. Some portions of the ERP, such as the call-out and communications plan, can be tested by "desktop" exercises. Other aspects, such as "on-site" activities involving other agencies, need to be exercised at regular intervals. Such exercises have the advantage of demonstrating deficiencies in the plan, which can be rectified before an actual emergency. For certain service providers such as airports, the periodic testing of the adequacy of the plan and the conduct of a full-scale emergency exercise may be mandatory.

3.15 DOCUMENTATION – SMS MANUAL

1. The component elements of the SMS manual shall incorporate the requirements covered throughout this Publication. It is an important management function to provide direction and guidance to managers and staff in an organization on how the organization intends to conduct its business based on safety management principles.

2. The primary function of the safety management documentation is to provide management with the ability to effectively communicate the organization's approach to safety to the whole organization. The following components and elements need to be documented:

• Safety policy, objectives and planning:
- Management commitment and responsibility;
- Safety accountabilities of managers;
- Appointment of key safety personnel;
- SMS implementation plan;
- Third-party interfaces – contracted activities;
- Coordination of the emergency response plan; and
- Documentation.

• Safety risk management:
- Hazard identification processes; and
- Risk assessment and mitigation processes.

• Safety assurance:
- Safety performance monitoring and measurement;
- Internal safety investigations;
- The management of change; and
- Continuous improvement of the safety system.

• Safety training and promotion: -
Training and education; and
- Safety promotion.

3. The documentation shall be written so that it reflects the intent and processes of the SMS. Thus, a change to the SMS will require an update of the SMS Manual.

4. To facilitate easy comprehension and application, the content of the SMS Manual shall be concisely written.

5. Any information that changes regularly shall be put into annexes/appendices. This includes, for example, names of personnel assigned specific safety responsibilities.

6. The amendment and distribution of SMS documentation needs to be controlled.

Chapter 4

Safety Risk Manaegment

- The Risk Management is defined as ‘The culture, processes and structures that are directed toward realizing potential opportunities whilst managing adverse effects’
- The process of risk management involves establishing an appropriate infrastructure and culture and applying a logical and systematic method of establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risks associated with any activity, function or process in a way that will enable organizations to minimize losses and maximize gains**.**
- Risk management can be applied at many levels in an organization. It can be applied at the strategic level and operational levels.
- In very broad terms, the objective of risk management is to eliminate risk where practical or reduce the risk (probability/consequence) to acceptable levels, and to manage the remaining risk so as to avoid or mitigate any possible undesirable outcome of the particular activity. It is therefore integral to the development and application of an effective SMS.
- Organizations pursuing a pro-active strategy for safety risk management believe that the risk of accidents or incidents can be minimized by identifying vulnerabilities and by taking the necessary actions to reduce the risk of adverse consequences arising from them.
- The specific design, integration and implementation of the safety risk management system will be influenced by, and dependent on, the requirements of the individual operator, its processes, policies, practices and SMS.

4.1 HAZARD IDENTIFICATION

4.1.1 Hazards are an inevitable part of aviation activities; however, their manifestation and potential adverse consequences can be effectively managed through mitigation strategies, these strategies are designed to minimize the likelihood of hazards leading to unsafe conditions.

4.1.2 Aviation can coexist with hazards as long as they are adequately controlled. Hazard identification is the first step in the SRM process. It precedes a safety risk assessment and requires a clear understanding of hazards and their related consequences.

4.1.3 Understanding the system and its operating environment is essential for the achievement of high safety performance. Having a detailed system description that defines the system and its interfaces will help. Hazards may be identified throughout the operational life cycle from internal and external sources.

4.1.4 People can be confused by the difference between a hazard and a risk. A risk is the potential outcome of the hazard and is usually defined in terms of the severity of the consequences and the likelihood of the harm occurring. For example, a runway excursion (overrun) is a potential consequence related to the hazard of a contaminated runway. By clearly defining the hazard first, one can more readily identify possible consequences. In general terms, you can consider that a hazard exists in the present, whereas the risk associated with it is the potential future outcome.

4.1.5 Hazard identification is the first step in the SRM process. There must be a process to identify hazards that could impact aviation safety in all areas of operation and activities. This includes equipment, facilities and systems. Any aviation safety-related hazard identified and controlled is beneficial for the safety of the operation. It is important to also consider hazards that may exist as a result of the SMS interfaces with external organizations.

4.2 Sources for hazard identification:

There are variety of sources for hazard identification, internal or external to the organization.

4.2.1 Internal sources for hazard identification may include, but not limited to the following:

a. Normal operations monitoring: this uses observational techniques to monitor the day-to-day operations and activities such as line operations safety audit (LOSA) or any other similar program.
b. Automated monitoring systems: this uses automated recording systems to monitor parameters that can be analyzed such as flight data monitoring (FDM).
c. Voluntary and mandatory safety reporting systems; this provides everyone, including staff from external organizations, with opportunities to report hazards and other safety issues to the organization.
d. Audits: these can be used to identify hazards in the task or process being audited. These should also be coordinated with organizational changes to identify hazards related to the implementation of the change.
e. Feedback from training; training that is interactive (two-way) can facilitate identification of new hazards from participants.
f. Organization's safety investigations: hazards identified in internal safety investigation and follow-up reports on accidents/incidents.

4.2.2 External sources for hazard identification may include, but not limited to the following:

a. Aviation accident reports; reviewing accident reports; this may be related to accidents in the State or to a similar aircraft type, regional or operational environment.
b. State's mandatory and voluntary safety reporting systems as summaries of the safety reports received from organizations.
c. State's oversight audits and third-party audits; external audits can sometimes identify hazards. These may be documented as unidentified hazards or captured less obviously within audit findings.
d. Trade associations and information exchange systems (example: IATA), many trade associations and industry groups are able to share safety data that may include identified hazards.

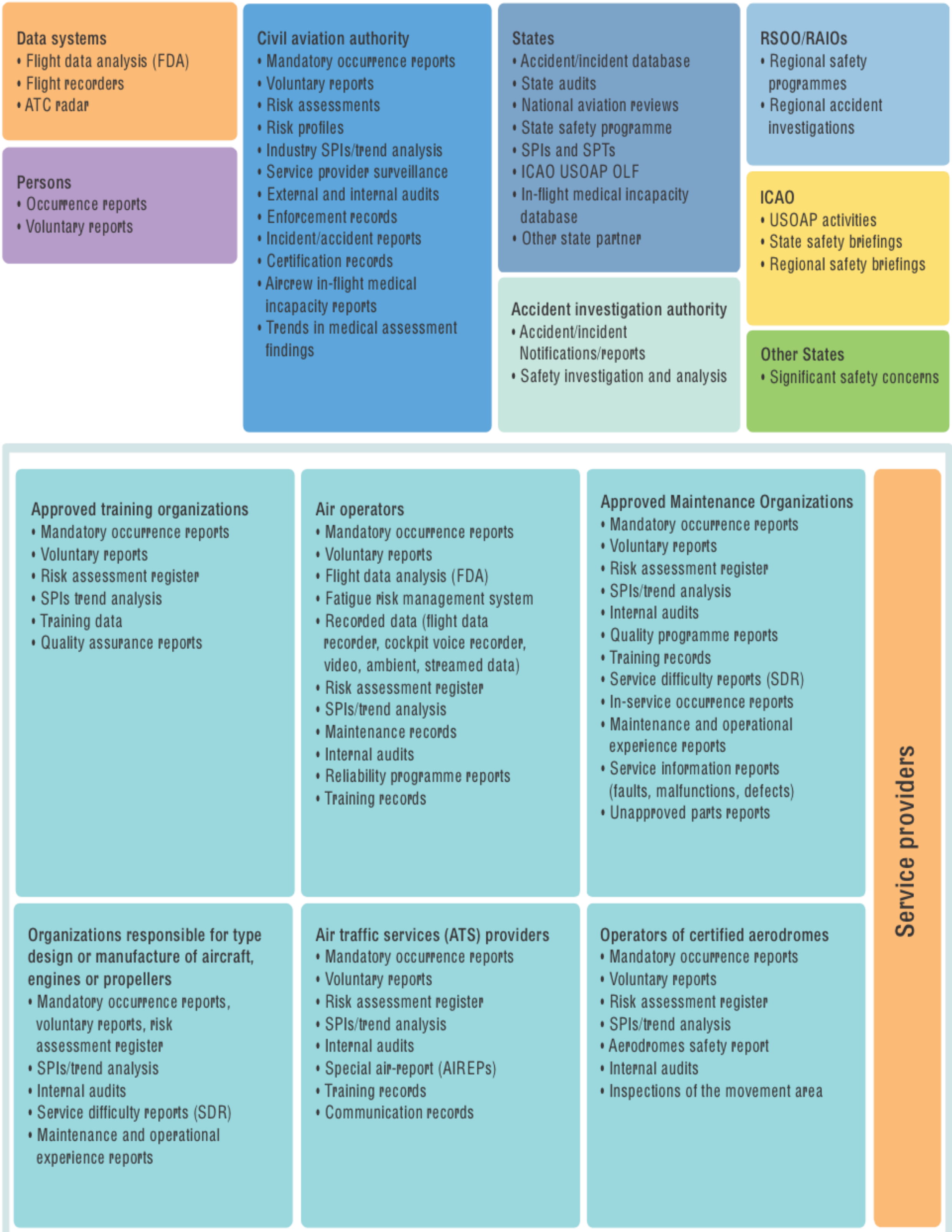

Figure 2: Examples of sources for hazard identification

4.2.3 The following should be considered when identifying hazards:

a. System description;
b. Design factors, including equipment and task design;
c. Human performance limitations (e.g. physiological, psychological, physical and cognitive);
d. Procedures and operating practices, including documentation and checklists, and their validation under actual operating conditions;
e. Communication factors, including media, terminology and language;
f. Organizational factors, such as those related to the recruitment, training and retention of personnel, compatibility of production and safety goals, allocation of resources, operating pressures and corporate safety culture;
g. Factors related to the operational environment (e.g. weather, ambient noise, vibration, temperature and lighting);
h. Regulatory oversight factors, including the applicability and enforceability of regulations, and the certification of equipment, personnel and procedures;
i. Performance monitoring systems that can detect practical drift, operational deviations or deterioration of product reliability;
j. Human-machine interface factors; and
k. Factors related to the SSP/SMS interfaces with other organizations.

4.3 Hazard identification methodologies

4.3.1 The two main methodologies for identifying hazards are:

a. Reactive. This methodology involves the analysis of past outcomes or events. Hazards are identified through investigation of safety occurrences. Incidents and accidents are an indication of system deficiencies and therefore can be used to determine which hazard(s) contributed to the event.

b. Proactive. This methodology involves collecting safety data of lower consequence events or process performance and analyzing the safety information or frequency of occurrence to determine if a hazard could lead to an accident or incident. The safety information for proactive hazard identification primarily comes from flight data analysis (FDA) programs, safety reporting systems and the safety assurance function.

4.3.2 Predictive analysis approach

Hazards can also be identified through predictive analysis of safety data, which identifies adverse trends and makes predictions about emerging hazards The predictive analysis involves data gathering and extracting information from historical and current data and using it to predict hazards and behavior patterns, in order to identify possible negative future outcomes, events and/or emerging risks and opportunities, analyzing system processes and the environment to identify potential future hazards and initiating mitigating actions.

The core of predictive analysis relies on capturing relationships between variables from past occurrences and exploiting them to predict the unknown outcome.

Major events are most often preceded by many smaller events, which by themselves may casually appear inconsequential.

Common challenges in addressing the predictive approach method:

- Collect enough data to make predictions;
- Getting individuals to report incidents and "potential" hazards; and
- Categorize collected data to prepare for predictive analysis activities.

It shows from the common challenges as stated above, the importance of getting individuals actively engaged in reporting hazards and smaller events they face in operations, based on a healthy, trusted “Just Culture” climate, where the “non-punitive” principles are applied. It is also beneficial to the organizations and ECAA to gather data from global aviation communities sharing the safety concerns and emerging risks, in a manner that enables the organizations and ECAA to work together to find those failure points and eliminate them before they escalate into an accident or serious incident in the future.

4.4 Hazards related to SMS interfaces with external organizations

Organizations should also identify hazards related to their safety management interfaces. This should, where possible, be carried out as a joint exercise with the interfacing organizations. The hazard identification should consider the operational environment and the various organizational capabilities (people, processes, technologies) which could contribute to the safe delivery of the service or product’s availability, functionality or performance.

As an example, an aircraft turnaround involves many organizations and operational personnel all working in and around the aircraft. There are likely to be hazards related to the interfaces between operational personnel, their equipment and the coordination of the turnaround activity.

4.5 Practical drift

Scott A. Snook's theory of practical drift is used to understand how the performance of any system "drifts away" from its original design. Tasks, procedures, and equipment are often initially designed and planned in a theoretical environment, under ideal conditions, with an implicit assumption that nearly everything can be predicted and controlled and that everything functions as expected. This is usually based on three fundamental assumptions:

a. The technology needed to achieve the system production goals is available;
b. Personnel are trained, competent and motivated to properly operate the technology as intended; and
c. Policy and procedures will dictate system and human behavior.

These assumptions underlie the baseline (or ideal) system performance, which can be graphically presented as a straight line from the start of operational deployment as shown in the following Figure.

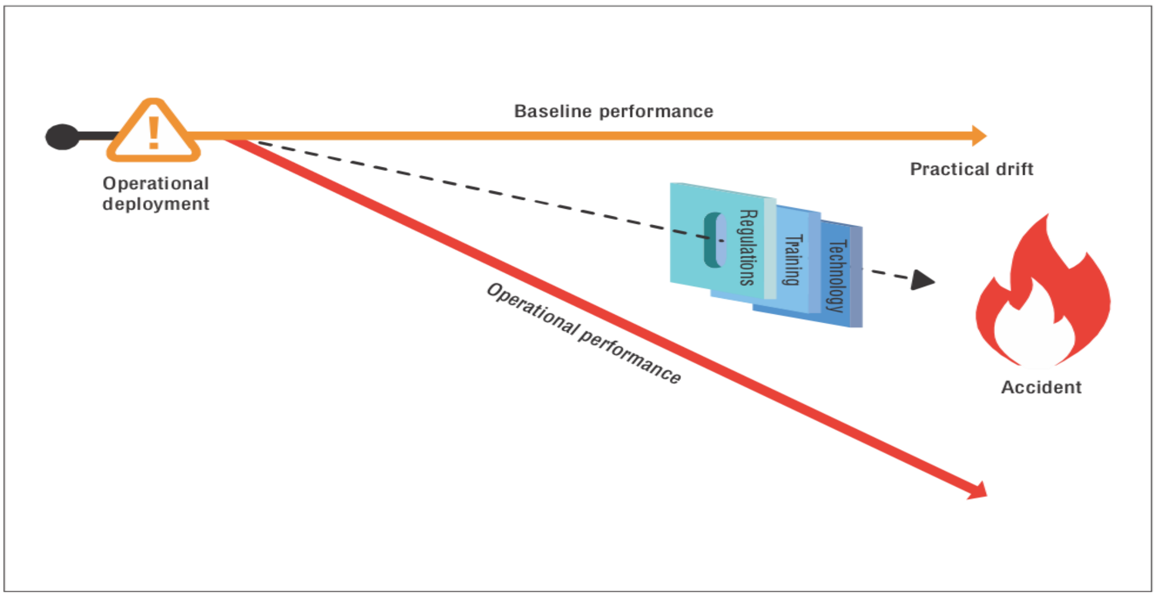

Figure 3: Concept of practical drift

Once operationally deployed, the system should ideally perform as designed, following (the baseline performance line) most of the time. In reality, the operational performance often differs from the assumed baseline performance as a consequence of real-life operations in a complex, ever-changing and usually demanding environment (operational performance line). Since the drift is a consequence of daily practice, it is referred to as a "practical drift". The term "drift" is used in this context as the gradual departure from an intended course due to external influences.

Snook contests that practical drift is inevitable in any system, no matter how careful and well-thought-out its design. Some of the reasons for the practical drift include:

a. Technology that does not operate as predicted;
b. Procedures that cannot be executed as planned under certain operational conditions;
c. Changes to the system, including the additional components;
d. Interactions with other systems;
e. Safety culture;
f. Adequacy (or inadequacy) of resources (e.g. support equipment); and
g. Learning from successes and failures to improve operations, and so forth.

In reality, people will generally make the system work on a daily basis despite the system's shortcomings, applying local adaptations (or workarounds) and personal strategies. These workarounds may bypass the protection of existing safety risk controls and defenses.

Safety assurance activities such as audits, observations and monitoring of SPIs can help to expose activities that are "practically drifting". Analyzing the safety information to find out why the drift is happening helps to mitigate the safety risks. The closer to the beginning of the operational deployment that practical drift is identified, the easier it is for the organization to intervene.

4.6 MANAGEMENT DILEMMA

In any organization engaged in the delivery of services, (production/profitability and safety risks are linked). An organization must maintain profitability to stay in business by balancing output with acceptable safety risks (and the costs involved in implementing safety risk controls). Typical safety risk controls include technology, training, processes and procedures. For the State, the safety risk controls are similar, i.e. training of personnel, the appropriate use of technology, effective oversight and the internal processes and procedures supporting oversight. Implementing safety risk controls comes at a price – money, time, resources – and the aim of safety risk controls is usually to improve safety performance, not production performance. However, some investments in "protection" can also improve "production" by reducing accidents and incidents and thereby their associated costs.

The need to balance profitability and safety or (production and protection) has become a readily understood and accepted requirement from an organization perspective. This balance is equally applicable to the State's management of safety, and balance resources required for State protective functions that include certification and surveillance.

4.7 HAZARD AND OCCURRENCE REPORTING

1. Every event is an opportunity to learn valuable safety lessons. The lessons will only be understood, however, if the event is analyzed so that all employees, including management, understand not only what happened, but also why it happened.
This involves looking beyond the event and investigating the contributing factors, the organization and HF within the organization that played a role in the event.
2. To enable analysis and organizational learning, the organization shall maintain procedures for the internal and external reporting and recording of incidents, hazards and other safety-related issues. The collection of timely, appropriate and accurate data will allow the organization to react to information received and apply the necessary corrective action to prevent a recurrence of the event.

4.7.1 STATUTORY REPORTING REQUIREMENTS

1. Organizations are required to meet statutory reporting requirements under the relevant Egyptian Civil Aviation Regulations **(ECAR 39)** requirements. Reportable matters are categorized as Immediately Reportable Matters (IRM) and Routine Reportable Matters (RRM).
2. IRM and RRM are required to be reported to ECAA. IRM and RRM are events relating to an organization's operations, and therefore need to be included in the organization's internal reporting system.
3. Reportable Matters can be entered into the organization's Internal Reporting System (IRS) database along with any other matters reported through the company's IRS (for example, hazards).

4.7.2 KEY ELEMENTS – INTERNAL REPORTING SYSTEM

1. An Internal Reporting System (IRS) is a method of gathering valuable safety Information from the people who are probably aware of a range of hazards in organization – the staff. The IRS shall be accessible by all operational safety critical personnel and be user-friendly.
2. An organization's IRS shall encompass the following fundamental elements:
   - Procedures for reporting occurrences (including IRM and RRM), hazards, or safety concerns;
   - Methods for the collection, storage and distribution of data (hazard register or log);
   - Procedures for analyzing data, safety reports and any other safety related information;
   - Documentation of corrective action and risk reduction strategies;
   - Determination of the effectiveness of corrective action; and
   - Ongoing monitoring and review.

4.7.3 Safety Surveys

1. Safety surveys provide managers and staff the opportunity to respond to questions about various safety related matters. The results of such surveys can be analyzed to provide cost effective identification of hazards and safety concerns. Surveys may be conducted using electronic or paper-based checklists, questionnaires or interviews.
2. A Safety survey can be used to establish an organizational benchmark and then be re-used as a way of measuring improvement over a period of time.
3. When conducting safety surveys, the following points shall be considered:
   - Affected managers and staff shall be told before the survey starts;
   - Affected managers and staff shall receive an assurance of confidentiality regarding the information volunteered through the survey;
   - Any perception of bias shall be avoided;
   - Surveys shall not be used too often or they may start to be ignored;
   - When conducting a survey interview, avoid criticism of the person being interviewed; and
   - Hearsay and rumor need to be substantiated before being accepted.

4.8 Hazard Categorization

Hazards may be categorized into 4 main categories or families (ORG – HUM – ENV – TECH), each main category is divided into hazard sub-categories, and finally, each sub-category includes different specific hazards/threats, the specific hazard is the one that must be assessed for severity of the consequences and the likelihood of the harm occurring, using the risk assessment process.

Example:

Occurrence investigation revealed that an (Informal process) is being used within the organization without reference to a documented procedure – the informal process is the (specific hazard) this is the one to be risk assessed (against the existing controls within the organization) and what actions should the organization consider as (extra controls, measures or defenses) to control that risk and prevent its recurrence.

As said, the informal process in this example is the (specific hazard), it is driven from the management system (hazard sub-category) which is related to (ORG) main hazard category or family.

The following table should be used for hazard categorization. It includes some of the specific hazards/threats that can be used as a minimum.

Hazard Categorization

rganization ☐ **Human** ☐ **Environment** ☐ **Technical** ☐

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
ORG		**Regulator**		Lack of, poor or ineffective legislation and/or regulations	
				Lack of or ineffective accident investigation capability	
				Poor organizational safety culture	
		Management System		Lack of or incomplete description of roles, accountabilities and responsibilities	
				Limited or lack of resources availability or planning, including staffing	
				Lack of or ineffective policies	
				Lack of or poor management and labor relationships	
				Lack of or ineffective organizational structure	
				Poor organizational safety culture	
				Lack of or ineffective safety management processes, including risk management, safety assurance, auditing, training and resource allocation	
Organizational management, documentation, processes and procedures, supervision				Lack of or ineffective audit procedures	
				Lack of or limited resource allocation	
				Incorrect, incomplete or lack of training and knowledge transfer	
				Unofficial organizational structures	
				Changes, upgrades or new tools, equipment, processes or facilities	
				Incorrect or ineffective shift/crew member changeover procedures	
				Changes or turnover in management or employees	
				Informal processes	
				Lack of or poor staffing recruitment/assignment	

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
		Documentation, Processes and Procedures		Incorrect, poor or lack of internal and external communication including language barriers	
				Lack of, incorrect or incomplete manuals, or operating procedures	
				Lack of, incorrect or incomplete employee duty descriptions	
				Lack of, incorrect or incomplete reports and records	
				Lack of, incorrect or incomplete control of necessary documents for personnel (licenses, ratings and certificates)	
		Supervision and operational task demands		Flight planning – high-risk tasks with low crew exposures	
				Team fitness –physical and mental conditions, amount of rest and accommodation during rest period	
				Operational complexity – consider amount of exposure to known hazards, the predictability of hazards	
				Pressure to achieve – company/commercial pressures	
				Management's personnel policies – crew pairing, operational control, operational support, scheduling, duty time	
				Workload task demands – work overload/task saturation, additional workload (unexpected, administrative, unfamiliar)	
				Time pressure – FTL, night curfew	
				Operational task demands – caused by pax, ground operations, technical problem/failure, ground services, and technical support.	
HUM		**Cognitive – Experience, knowledge and recency**		Inadequate or inaccurate knowledge (adequacy of knowledge)	
				Personal experience and qualification (experience & qualification)	
				Recency factors (route or operational activity)	
				Illness / incapacitation	

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
limitation of the human which in the system has the potential for causing harm		**Physiology – factors related to physiological conditions of persons**		Impairment – fitness (alcohol, drugs, medication, pain, stress, depression)	
				Fatigue/alertness (sleep deficit, disorder, disruption, jet lag)	
				Vestibular or visual illusion	
				Personal physical sensory limitations	
				Personal workload management (adapting to short notice, inappropriate allocation of tasks, shedding of tasks etc)	
		Psychological limitations – factors which involves thinking such as learning, memory, personality or attitudes		Human judgement factors (spatial, separation, timing/speed)	
				Information processing (incorrect assumption, comprehension, mindset/expectancy, confirmation bias, misrecognition, misunderstanding)	
				Mental/emotional state (alertness, apprehension, panic factor, boredom)	
				Psychological – Attention (boredom/monotony, distraction, attention, vigilance)	
				Personality and attitude (complacency and risk-taking)	
				Skills/technique/ability (airmanship)	
ENV **Aerodrome affecting landing, taxiing and parking operation**		**Runway/taxiway characteristics, conditions or lighting/markings**		Vehicles and people movement	
				Distracting lights	
				Laser beams	
				Deficient approach lighting	
				NOTAM deficiency	
		Aerodrome condition		Poor condition or improper runway surface	
				Misleading or unclear markings and lighting	
				Inadequate runway length, sloping runway	
				FOD	
				Taxiway and runway system complexity	
				Bay gradient/lack of space / visual interference	
		Wildlife condition		Wildlife on airfield	
				Flying wildlife	

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
		Geography		Mountains or bodies of water	
				Altitude at the aerodrome	
		Weather / natural disasters		Extreme weather	
				Ash – volcanic or burnt	
				Excessive or cross-wind	
				Thunderstorms and lightning	
				Heavy rain	
				Fog (reduced visibility)	
				Wind shear	
				OTHERS: (…………………)	
		Climate condition		Extreme temperature, icing,	
TECH **Air Navigation services affecting landing, take-off, climb, cruise, descent, approach**		**Traffic pattern**		Excessive aircraft in a pattern or given airspace	
				Runway incursions by aircraft or vehicles	
				Unauthorized procedures by aircraft	
				Similar sounding or confusing call signs	
				Traffic complexity (mixture of aircraft type)	
				Ineffective design and flow of traffic pattern	
				Unauthorized flights entering into traffic pattern	
		ATC actions		Loss of separation between aircrafts	
				Loss of separation between aircraft and terrain or obstacles	
				Incomplete clearances	
				Incorrect, confusing or incomplete communication	
				Improper reading of clearance instructions	
		ATC technical		Communication system failures or anomalies	
				Navigation aid failures or anomalies	
		Communications		Incorrect, confusing, or incomplete communications between ATC and aerodrome personnel	
				Incorrect, confusing, or incomplete communications between ATC and aircraft	
				Incorrect, confusing, or incomplete coordination between or within ATC facilities	

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
				Radio/Frequency failures or anomalies	
				Navigational aid (radars, satellites, VOR, ADS-B, etc) failures or anomalies	
				Differences in ICAO and national Air Traffic Control phraseology	
				Not using the standard international aviation language	
				Language barriers (Multiple languages)	
				Lack of, or wrong aeronautical information	
		Facilities		Faulty electrical power supply systems on airport or navigational aids (radars, satellites, VOR, ADS-B, etc)	
				Faulty, incorrect or incomplete airfield markings or lighting	
				Faulty, incorrect, or incomplete approach lighting	
				Insufficient equipment, radios, infrastructure, or personnel	
				Taxiway and runway system complexity	
				Inadequate airfield or terrain drainage	
TECH **Air Operation**		**Facilities**		Faulty electrical power supply systems on airport or navigational aids (radars, satellites, VOR, ADS-B, etc)	
				Faulty, incorrect or incomplete airfield markings and lighting	
				Faulty, incorrect, or incomplete approach lighting	
				Taxiway and runway system complexity	
				Insufficient equipment, radios, infrastructure, or personnel	
				Poor HVAC (heating, ventilation, and air conditioning)	
				Noisy environment	
				Lack of or poor Lighting	
				Poor facilities (inadequate space)	

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
				Lack of, limited or incorrect type of aircraft parking	
		Pre-flight preparation		Poor airworthiness verification	
				Lack of or poor verification of equipment and instruments necessary to a particular flight or operation	
				Lack of, incorrect or incomplete aircraft performance limitations verification	
				Lack of, incorrect or incomplete flight planning	
				Lack of or poor aircraft dispatch or release	
				Lack of or poor maintenance release	
				Poor fuelling processes	
				Obsolete documents, manuals and charts	
		Aircraft loading		Incorrect cargo loading and distribution	
				Unauthorized hazardous materials carriage	
				Improper stowage of carry-on baggage	
				Improper weight & balance calculation	
		Flight operations		Lack of or poor CRM (crew resource management)	
				Improper execution of procedures in all phases	
				Use of obsolete documents	
				Absence of or incorrect flight and cabin crew manuals or charts on board	
				Improper response to flight route changes	
				Inadequate or complicated procedures	
				Equipment & instruments for particular flight not available or malfunctioning	
				Lack of or poor flight following	
				Language barriers (Multiple languages)	

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
				Lack of, or poor communication (ATC, ramp, maintenance, flight Ops, cabin, dispatch, etc)	
				Deficient communication (with all operation support)	
		Ground Handling		Deficient communication	
				Reckless vehicular movement in vicinity of aircraft	
				Unattended loose objects near vicinity of aircraft	
				Poorly maintained handling equipment	
		Technical Handling		Incomplete maintenance at aircraft handover	
				Incomplete maintenance release such as MEL	
				Deficient communication	
		Aircraft systems		Technical deficiencies in aircraft, components systems, subsystems and related equipment	
				Aircraft design deficiencies affect the human / machine interface.	
TECH **Maintenance**		**Facilities**		Poor HVAC (heating, ventilation, and air conditioning)	
				Noisy work environment	
				Lack of, or poor Lighting	
				Poor facilities (inadequate space, equipment or infrastructure)	
		Maintenance Activity		Lack of, or poor maintenance release	
				Lack of, or poor maintenance programs (Including imprecise maintenance data or transcription errors when creating job-cards)	
				SUPS (Suspected Unapproved Parts)	
				Maintenance movement of aircraft/run-ups	
				Lack of, or poor communication (ATC, ramp, flight Ops, cabin, dispatch, etc)	
				Language barriers in maintenance teams (Multiple languages)	
				Poor control of outsourced maintenance (any maintenance completed outside the maintenance facility or organization including third party maintenance)	

Category	Tick √	Sub-category	Tick √	Specific hazard/threat	Tick √
				Lack of or, inappropriate specialized processes (including NDT, plating, welding, composite repairs etc…)	
				Lack of or, improper Airworthiness Directive Control	
				Ineffective or lack of procedures to ensure materials, parts, or assemblies are worked or fabricated through a series of precisely controlled steps, and that undergo physical, chemical, or metallurgical transformation (some examples are heat-treating, brazing, welding, and processing of composite materials).	
				Lack of or, inadequate reliability program	
		Tooling		Lack of, or poor tool accountability (Including traceability or registration)	
				Lack of or unsafe or unreliable equipment, tools, and safety equipment;	
				Inappropriate layout of controls or displays	
				Mis-calibrated tools	
				Inappropriate or incorrect use of tools for the task	
				Lack of, or inadequate instructions for equipment, tools, and safety equipment	
		Maintain ability		Complex design (Difficult fault isolation, multiple similar connections, etc)	
				Inaccessible component/area	
				Aircraft configuration variability (Similar parts on different models)	

Table 2: Hazard categorization

4.9 RISK MANAGEMENT AND MITIGATION PROCESS

4.9.1 Introduction

The SRM process systematically identifies hazards that exist within the context of the delivery of organization’s products or services. Hazards may be the result of systems that are deficient in their design, technical function, human interface or interactions with other processes and systems. They may also result from a failure of existing processes or systems to adapt to changes in the organization’s operating environment. Careful analysis of these factors can often identify potential hazards at any point in the operation or activity life cycle.

Safety risk assessments and safety risk mitigations will need to be continuously reviewed to ensure they remain effective. Figure 4 provides an overview of the hazard identification and safety risk management process for any organization.

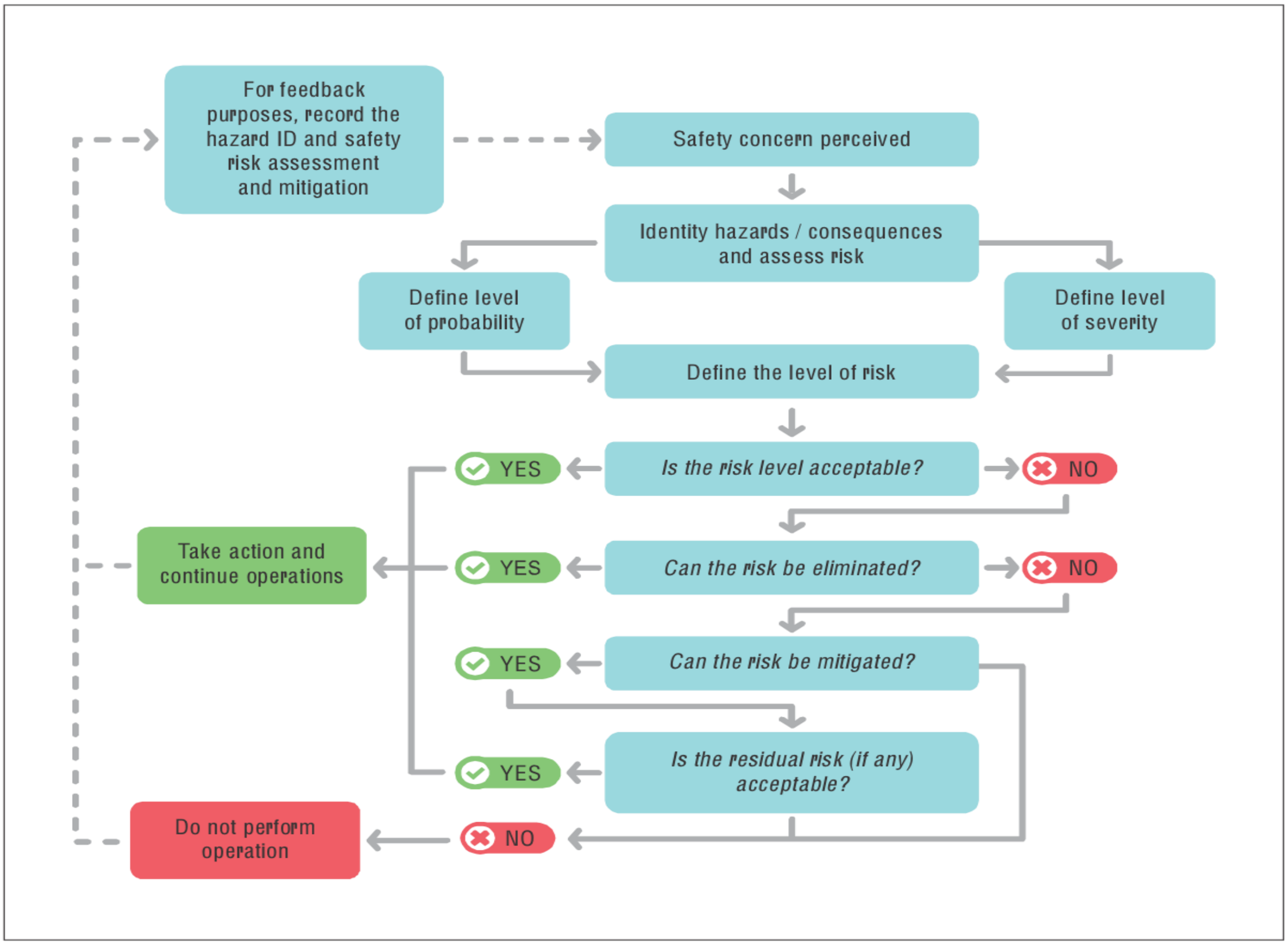

Figure 4: Safety risk management process

4.9.2 Safety Risk Management Structured Process

Safety risk assessment and mitigation processes are a teamwork activity rather than a one-man show. When a hazard or a safety concern is perceived a risk assessment team "RAT" is assigned, headed by (the safety manager or a dedicated risk assessment manager) according to the organization's structure, part of the team is the concerned process owner department(s) and other departments having (direct/indirect) influence on the risk being assessed. The task of the RAT is brainstorming to provide a structured method of identifying hazards, potential risks and mitigation actions (refer to Form 1 risk assessment form)

The identification of safety hazards across the organization is crucial in order to address potential risks, that may impact or pose harm to (Property, Operations, People, Regulatory Compliance "National/International" and Public Confidence). The following illustrates Safety Risk Management structured process example:

1. Hazard(s) and consequence(s) are identified according to the hazard identification process, refer to (Table 2 hazard categorization);
2. Existing defenses, such as processes and procedures within the organization, must be recalled and evaluated against regulations/procedures, training and technology to assess their effect in controlling the outcomes of the hazard;
3. Rank the probability of occurrence, according to the probability classification table as shown in (Table 3);
4. Rank the severity of their impact using the severity classification table as shown in (Table 4), considering all the potential consequences related to the hazard, taking into account the worst foreseeable situation or the most credible outcome;
5. Upon defining the probability of occurrences and the severity of their impact, the current risk index can be identified using the risk matrix as shown in (Table 5);
6. The current risk index can be examined against risk tolerability as shown in (Table6);
7. Action will be taken according to the risk index range in the tolerability table and based on whether or not existing defenses are capable of eliminating, reducing or controlling the risk. If not, identify additional defenses/mitigations and controls where required and repeat points (3 to 6), the result is the new risk index or residual risk after additional controls/defenses and mitigations;
8. Evaluate to confirm if the hazard has been eliminated or if the risk is appropriately controlled (according to the risk tolerability table) in both cases a monitoring method should be stated (audit, inspection, SPIs, etc.) is required to confirm that the mitigation actions are effective in controlling the hazard outcomes;
9. Record and Document the risk assessment using a safety risk assessment form, example provided (Form 5 risk assessment form), it should include a date, the hazard being addressed, specific component of the hazard, consequences (risks), existing defenses/controls, current risk index, risk mitigations (extra defenses/controls or measures, if any), risk index after assessment (residual risk), responsible departments according to each role (actions, owners and dates), monitoring method(s) and next review requirements;
10. Sign the risk register form according to the risk tolerability and level of authority, for example, it requires the signature of the Accountable Executive for acceptance if the risk

tolerability falls in the Intolerable Region (Red), either under the existing controls in place, or after proposed additional controls to mitigate the risk;

11. Keep and maintain a record of the risk register and continue to monitor;
12. During the monitoring process, if mitigation actions are proven to be ineffective or if any residual risk(s) appears, a re-assessment must be conducted, and the monitoring process continues until the mitigation actions are proven to be effective in accepting the risk(s) including residual risk(s); and
13. After monitoring and evaluating the mitigation actions, if found proven to eliminate or control the risk, these mitigation actions could be used in updating the procedures (SOPs), training, regulations, etc.

After completing these steps, you should have:

a. A list of safety hazards and risks
b. A list of current controls and defenses in place to manage these risks
c. A list of further controls and defenses required to improve safety across the organization
d. Staff involvement in identifying safety deficiencies and priority areas for improved risk management.

Safety risk assessment and control should be prioritized appropriately to assess and control the highest safety risk(s), allocate resources to the highest safety risk(s), effectively maintain or improve safety, and achieve the safety objectives and safety performance targets.

The following risk (probability, severity, matrix and tolerability) are mainly based on the ICAO doc. 9859 and modified by ECAA as best practices in the industry.

4.9.3 Risk Probability

Safety risk probability is the likelihood that a safety consequence or outcome will occur. It is important to envisage a variety of scenarios so that all potential consequences can be considered. The following questions can assist in the determination of probability:

a. Is there a history of occurrences similar to the one under consideration, or is this an isolated occurrence?
b. What other equipment or components of the same type might have similar issues?
c. What is the number of personnel following, or subject to, the procedures in question?
d. What is the exposure of the hazard under consideration? For example, during what percentage of the operation is the equipment or activity in use?

The following table shows the risk probability classification, to be used as a minimum:

Likelihood	Meaning	Value
Frequent	Likely to occur many times (has occurred frequently), or it occurs: • At least weakly, including inspection activities (internally/externally), or • For audit activities (internally/externally), the issue occurs 5 times or more per year.	5
Occasional	Likely to occur sometimes (has occurred several times), or it occurs: • At least monthly, including inspection activities (internally/externally), or • For audit activities (internally/externally), the issue occurs 4 times per year.	4
Remote	Unlikely to occur, but possible (has occurred rarely), or it occurs: • At least quarterly, including inspection activities (internally/externally) or • For audit activities (internally/externally), the issue occurs 3 times per year.	3
Improbable	Very unlikely to occur (not known to have occurred), or it occurs: • No more than once every 6 months, including inspection activities (internally/externally) or • For audit activities (internally/externally), the issue occurs 2 times per year.	2
Extremely improbable	Almost inconceivable that the event will occur, or it occurs: • once a year, including inspection and/or audit activities (internally/externally).	1

Table 3: Risk probability

4.9.4 Risk Severity

Once the probability assessment has been completed, the next step is to assess the severity, taking into account the potential consequences related to the hazard. Safety risk severity is defined as the extent of harm that might reasonably be expected to occur as a consequence or outcome of the identified hazard.

The following table shows the risk severity classification, to be used as a minimum:

Severity	Sub-section	Meaning	Value
Catastrophic	Property	• Equipment destroyed. • Aircraft crash. • Complete destruction of facility.	**A**
	Operation	• Full Loss of safety margin; an "accident" as defined by ICAO. • Total inability to provide safe services in compliance with applicable Safety Regulatory Requirements.	
	People	• 3 or more fatalities, other than natural causes.	
	Regulatory compliance (National/ International)	• Severe (sanction) restrictions on conducting activity in certain markets or geographies, or certain activities.	
	Public confidence	• External reputation irrevocably destroyed or damaged. E.g. resulting in legal action	
Severity	**Sub-section**	**Meaning**	**Value**
Hazardous	Property	• Major equipment damage that takes 7 or more days to repair.	**B**
	Operations	• A Large reduction in safety margins, Physical distress or a workload such that the organization cannot be relied upon to perform the tasks accurately or completely. • Serious inability to provide safe services. It involves circumstances indicating that the ability to provide services is severely compromised and has the potential to impact safe operations over a significant period of time.	
	People	• 1 or 2 fatalities, other than natural causes. • Multiple serious injury that requires more than 48 hours of hospitalization, (refer to full description by ICAO).	
	Regulatory compliance (National/ International)	• Enforcement including issuing of fines and/or limiting an approved scope of work.	
	Public confidence	• Medium term damage to organization's reputation e.g. several negative stories in the press.	

Severity	Sub-section	Meaning	Value
Major	Property	• Significant equipment damage that can be repaired in (2 to 6) days.	**C**
	Operations	• Serious incident, as defined by ICAO. • A significant reduction in safety margins, a reduction in the ability of operational personnel to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency. • Partial inability to provide services in compliance with applicable Safety Regulatory Requirements.	
	People	• An injury that requires less than 48 hours of hospitalization.	
	Regulatory compliance (National/ International)	• A corrective action related to regulatory non-compliance.	
	Public confidence	• Short-term damage to organization's reputation e.g. single negative story in the press.	
Severity	**Sub-section**	**Meaning**	**Value**
Minor	Property	• Limited equipment damage that can be repaired the same day or requires spare parts.	**D**
	Operations	• Operating limitations. • Ability to provide safe but degraded services. • Use of emergency procedures. • Minor incident, resulting in damage that neither destroys the equipment nor causes substantial damage.	
	People	• Injury where first aid is required.	
	Regulatory compliance (National/ International)	• Observation or recommendation	
	Public confidence	• External reputation is minimally affected; little effort is required to recover. • Customer dissatisfaction	
Severity	**Sub-section**	**Meaning**	**Value**
Negligible	Property	• Maintenance inspection required only.	**E**
	Operations	• Little consequences with no safety significance.	
	People	• Injury where first aid is not required.	
	Regulatory compliance (National/ International)	• A notice with no effect on activities	
	Public confidence	• No effect on reputation	

Table 4: Risk severity

4.9.5 Safety Risk Tolerability The safety risk index rating is created by combining the results of the probability and severity scores. it is an alphanumeric designator.

The respective severity/probability combinations are presented in the safety risk assessment matrix (Table) below using a (5 by 5 matrix), the index obtained from the safety risk assessment matrix should then be exported to a safety risk tolerability (Table 5) that describes — in a narrative form — the tolerability criteria for the particular organization, showing what kind of actions are required according to the level of tolerability authorization, which should be used by the organization. As an example, the criterion for safety risk assessed as 4B falls in the "intolerable" category. In this case, the safety risk index of the consequence is unacceptable. The organization should therefore take risk control action to reduce:

a. the organization's exposure to the particular risk, i.e., reduce the probability component of the risk to an acceptable level;
b. the severity of consequences related to the hazard, i.e., reduce the severity component of the risk to an acceptable level; or
c. both the severity and probability so that the risk is managed to an acceptable level.

Safety Risk	Severity				
Probability	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

Table 5: Risk matrix

Safety Risk Index Range	Safety Risk Description	Recommended Action
5A, 5B, 5C, 4A, 4B, 3A	INTOLERABLE	Take immediate action to mitigate the risk or stop the activity. “Requires the Accountable Executive acceptance”.
5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	TOLERABLE	Can be tolerated based on safety risk mitigation. Safety Manager acceptance is required.
3E, 2D, 2E, 1B, 1C, 1D, 1E	ACCEPTABLE	Acceptable as is. No further safety risk mitigation is required. Just Monitoring and Data Collection. Safety Manager acceptance is required.

Table 6: Risk tolerability

4.9.6 Risk Tolerability Level of Authority

The Safety Manager is authorized to make decisions and acceptance, regarding risk in (an acceptable and tolerable range) - according to the organization’s matrix with respect to the safety of all operations. Whenever, the safety risk index is intolerable – falling in the red region (either under the existing controls in place, or after proposed additional controls to mitigate the risk), it requires the Accountable Executive acceptance.

4.10 RISK CRITERIA AND THE CONCEPT OF 'ALARP'

4.10.1 Where risk is concerned, there is no such thing as absolute safety. Risk management systems are often premised on the concept of As Low As Reasonably Possible (ALARP). In doing so, there is an acceptance that not all risk can or shall be eliminated. There are practicable limits to which the aviation industry is able to go and the extent to which the industry and the community will pay to reduce adverse risks.

4.10.2 The principle of managing risk to a level that is ALARP is as follows:

- There is an upper level of risk that is deemed to be intolerable. If a risk is found to be intolerable, risk reduction measures are essential, regardless of cost;
- There is a lower level of risk that is deemed to be broadly acceptable. At this risk level (and below), maintain current systems and monitor and review the risk. Further risk reduction may be

made, but only if the cost is insignificant; and

- The ALARP region lies between the upper and lower levels of risk. If risk falls into this region, it shall be reduced as much as is reasonably practicable.

4.10.3 In the ALARP region, risk reduction measures shall be identified and evaluated in terms of cost and possible risk benefit. Any risk falling within the ALARP range shall be assessed and reduced unless the cost of reducing the risk is grossly disproportionate to the benefit gained. This comparison may be a quantitative one, or based on qualitative arguments. Figure 5 and 6 illustrates "The ALARP principle ".

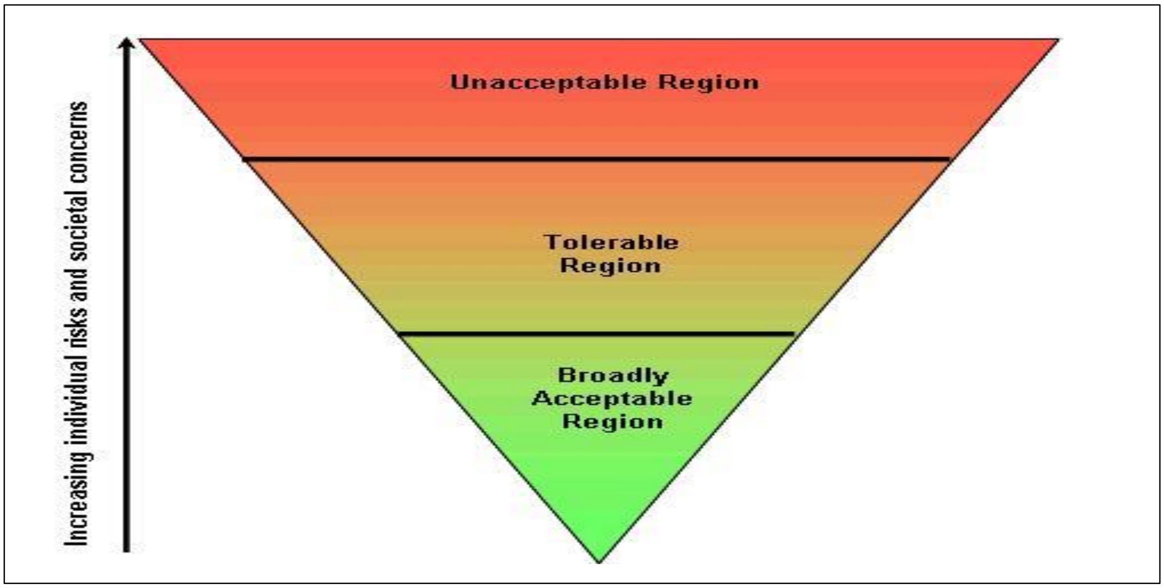

Figure 5: ALARP principle

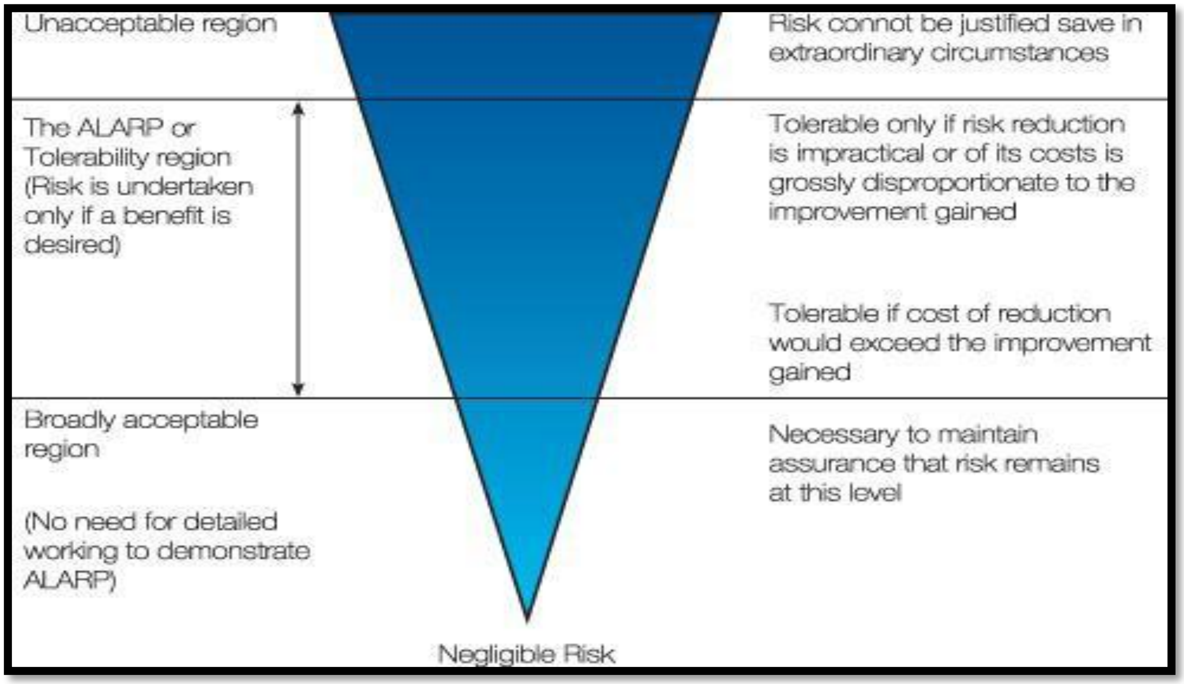

Figure 6: Details of ALARP principle

4.10.4 The risk can only be said to be ALARP when it can be demonstrated that all justifiable risk reduction measures have been considered and the remaining mitigation strategies cannot be justified.

4.10.5 The ALARP principle operates in an environment of continuous improvement. Both the risks and the methods of control change and evolve over time and consequently require a continual reassessment as to which risk, and their respective treatments, are reasonable to sustain and which are not.

4.11 Safety Risk Mitigation Strategies

4.11.1 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 reducing exposure to that safety risk. It is easier and more common to reduce the likelihood than it is to reduce the severity.

4.11.2 Safety risk mitigations are actions that often result in changes to operating procedures, equipment or infrastructure. Safety risk mitigation strategies fall into three categories:

a. 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.
b. Segregation: Action is taken to isolate the effects of the consequences of the safety risk or build in redundancy to protect against them.
c. 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.

The safety risk mitigation strategies can be summarized by the use of the hierarchy of controls as explained below.

4.11.3 Hierarchy of Controls

Selecting the most appropriate risk treatment option or control involves balancing potential benefits derived in relation to the achievement of safety outcomes against efforts and disadvantages of implementation. This directly links to ALARP – As Low As Reasonably Practicable for risk management. Risk treatment options are not necessarily mutually exclusive or appropriate in all circumstances. When determining appropriate controls, the hierarchy of controls decision-making pyramid can assist in decision-making.

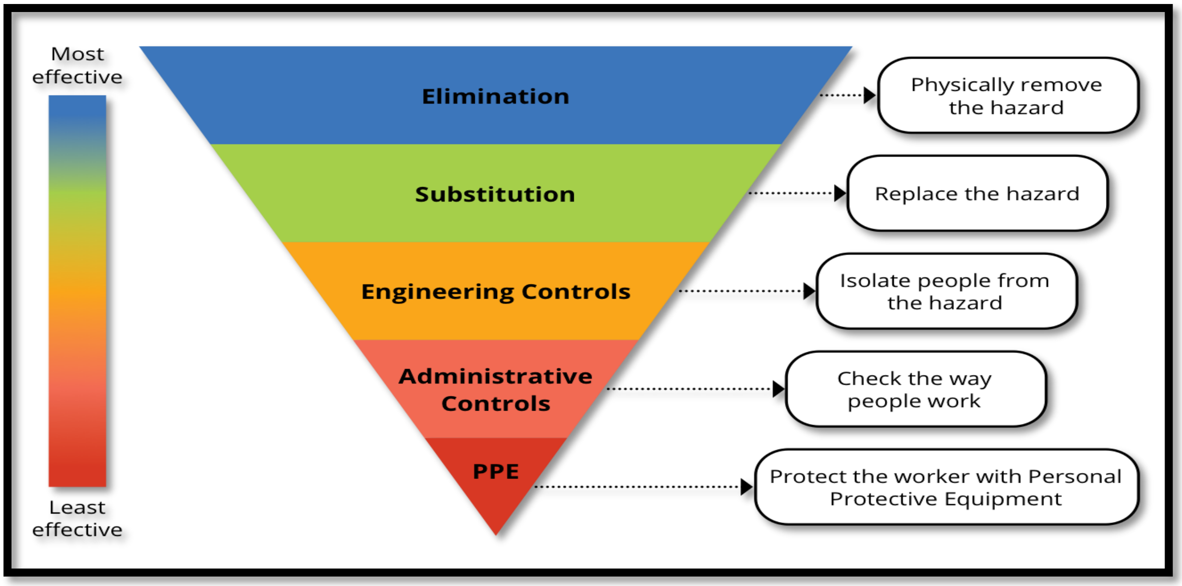

Figure 7: Hierarchy of controls decision-making pyramid

Selecting the most appropriate risk treatment option or control involves balancing potential benefits derived in relation to the achievement of safety outcomes against efforts and disadvantages of implementation. This directly links to ALARP – As Low As Reasonably Practicable for risk management. Risk treatment options are not necessarily mutually exclusive or appropriate in all circumstances. When determining appropriate controls, the hierarchy of controls decision-making pyramid can assist in decision-making.

Safety risk mitigation strategies	Control	Details
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.	Elimination	Eliminating the hazard and the risk it creates is the most effective control measure. The best way to eliminate a hazard is to not introduce the hazard in the first place. For example, you can eliminate the risk of a fall from height by doing the work at ground level. It may not be possible to eliminate a hazard if doing so means you are unable to deliver your service. If it is not possible to eliminate the hazard, then you can still attempt to eliminate as many of the risks associated with the hazard as possible.
Segregation: Action is taken to isolate the effects of the consequences of the safety risk or build in redundancy to protect against them.	Substitution or isolation	• Substitution is the process of removing a risk by replacing it with another risk that is either less likely to occur or less severe in its potential damages. • Isolation is performed by placing some form of barrier between the person and the risk factor to provide protection. It's important to conduct a new risk assessment after substitution or isolation has been completed to identify any new risks created by the substitute/isolate process.
	Engineering Controls	Reduce the risks through engineering changes or changes to systems of work. Engineering controls is the process of designing and installing additional safety features in the workplace or on equipment. System redundancy features within aircraft design is an example of engineering risk controls enacted at the aircraft manufacturing stage.
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.	Administrative Controls	Use administrative actions to minimise exposure to hazards and reduce potential level of harm. Administrative controls are work methods or procedures designed to minimise exposure to a hazard. In most cases, administrative controls use systems of work to control the risk. Measures could include developing standard operating procedures, providing dedicated training targeted at the risk or using signs to warn people, such as minimum equipment list or unserviceable tags.
	Personal protective equipment (PPE)	Use PPE to protect people from harm. This level is designed around assuming an incident will occur and protecting an employee from harm when it does. PPE includes items such as hard-hats, hi-vis clothing, noise-reducing ear protection or cut-resistant gloves.

Table 7: Safety risk mitigation strategies

Use administrative controls and PPE only:

a. as last resorts when there are no other practical control measures available
b. as an interim measure until introducing a more effective way of controlling the risk
c. to increase the effectiveness of higher-level control measures.

4.11.4 When considering each control or combination of controls, you must consider the likelihood of a particular control being effective. (Example: standard operation procedures may not be understood and followed, and PPE may not always be worn. Further controls, such as signs or supervision, may be needed to make a control more likely to be effective or to raise awareness of the control in the first place).

However, be aware that using the hierarchy of control response and ALARP can result in hazard controls sinking to the bottom and resulting in ineffective risk mitigation. that undermines safety culture and risk management are shown in the following table.

Selected control (The hierarchy of response)	Top management response (How hazards sink to the bottom)
Eliminate the Hazard	“That’s far too expensive. Tell Ops they’ll have to manage this” “You know this one is one of the most profitable lines...”
Substitute the Hazard	“No, changing the process will be really difficult”. “Have our competitors done this?”
Isolate the Hazard	“Not really practical. Put a sign on it and tell them to be careful” “We may replace this process in the refurb in 3-years. Let’s wait”
Use engineering controls	“No, we can’t change the tooling as it’s approved. Not viable for us” “Have you got a budget for this?”
Use Administration Control	“We’re really busy right now. Can we do the training next year?” “Do we really need a procedure for this. It’s common sense...”
Use Personal Protective Equipment	“What do you mean the equipment is un-committable” “Sorry, that’s the job. You’re going to have to deal with it!”

Table 8: Examples of hazard controls sinking to bottom

4.11.5 The consideration of human factors is an integral part of identifying effective mitigations because humans are required to apply, or contribute to, the mitigation or corrective actions. For example, mitigations may include the use of processes or procedures. Without input from those who will be using these in “real world” situations and/or individuals with human factors expertise, the processes or procedures developed may not be fit for their purpose and result in unintended consequences. Further, human performance limitations should be considered as part of any safety risk mitigation, building in

error capturing strategies to address human performance variability. Ultimately, these important human factors perspective results in more comprehensive and effective mitigations.

4.11.6 To be completely effective, a risk assessment and mitigation program would typically be implemented in a manner that:

a. Is active in all areas of the organization where there is a potential for hazards that could affect aircraft operations;
b. Has some form of central coordination to ensure all existing or potential hazards that have been identified are subjected to risk assessment and, if applicable, mitigation.

4.11.7 Effectiveness of the Risk Management Program

The following Assessment Tool is to be used, for assessing the risk management program:

Desired Outcome

a. The organization maintains an overview of its operational risks and through implementation of mitigation actions, as applicable, ensures risks are at an acceptable level.
b. Suitability Criteria (Suitable to the size, complexity and nature of operations)
c. Number and type of analyzed hazards and corresponding risks.
d. Means used for recording risks and mitigation (control) actions.
e. Safety data used for the identification of hazards.

Effectiveness Criteria

a. Risk register(s) across the organization capture risk assessment information, risk mitigation (control) and monitoring actions.
b. Safety risks are expressed in at least the following components:
    - Likelihood/Probability of an occurrence.
    - Severity of the consequence of an occurrence.
    - Likelihood/Probability and severity have clear criteria assigned.
c. A matrix defines safety risk tolerability to ensure standardization and consistency in the risk assessment process, which is based on clear criteria.
d. All relevant hazards are analyzed for corresponding safety risks.
e. Risk mitigation (control) actions include timelines, allocation of responsibilities and risk control strategies (e.g. hazard elimination, risk avoidance, risk acceptance, risk mitigation).
f. Mitigation (control) actions are implemented to reduce the risk to a level of “As Low As Reasonably Practical - ALARP”.

g. Identified risks and mitigation actions are periodically reviewed for accuracy and relevance.
h. Effectiveness of risk mitigation (control) actions are monitored at least yearly.
i. Personnel performing risk assessments are appropriately trained.

j. The program takes into consideration any area of the organization where there is a potential for hazards that could affect safe operations.
k. The program has some form of central coordination to ensure all existing or potential hazards that have been identified as relevant are subjected to risk assessment and, if applicable, mitigation.

4.11.8 Safety Risk Management Documentation

Safety risk management activities should be documented, including any assumptions underlying the probability and severity assessment, decisions made, and any safety risk mitigation actions. This may be done using a spread sheet or table. Where safety information can be stored and analyzed. Maintaining a register of identified hazards minimizes the likelihood of losing sight of known hazards. When hazards are identified, they can be compared with the known hazards in the register to see if the hazard has already been registered, and what action(s) were taken to mitigate it.

4.11.9 Hazard register/log/list

The hazard register/log/list is usually in a table format and typically include, but not limited to:

a. the hazard;
b. potential consequences;
c. assessment of associated risks;
d. identification date;
e. hazard category;
f. short description;
g. when or where it applies;
h. who identified it and
i. what measure have been put in place to mitigate the risks.

4.11.10 Risk assessment form

This form is to be utilized by the RAT (Risk Assessment Team) to assess the risk consequences of the identified hazard. The following form is an example that can be utilized by organizations.
The Identified risks and mitigation actions must be periodically reviewed (at least yearly, and preferably twice a year) for accuracy, relevance and the effectiveness of risk mitigation actions. This review should be conducted by any means of mechanism established by the organization

(could be through Safety Action Group(s) - SAGs and introduced in Safety Review Board- SRB). If required, the mitigation actions could be integrated into a standard/practice or procedures. It is important to maintain a record of the risk assessment form and using the included information to fill-in the hazard register/log/list. If monitoring shows that mitigation actions are being ineffective, then the risk assessment must be revisited

The following is an example of a risk assessment form that can be utilized.

<table>
<tr><td colspan="4">Type of operation or activity:</td><td>Risk Ref. No.</td><td>Date
/ /</td><td>Next Review
MM/YYYY</td><td colspan="2">1st review
MM/YYYY
Sign</td><td>2nd review
MM/YYYY
Sign</td></tr>
<tr><td colspan="6" rowspan="2">Description:</td><td colspan="4">After 2nd review choose from below</td></tr>
<tr><td colspan="2">Re-issue & continue review
Yes/No</td><td colspan="2">Integrate mitigations into standard/practice or procedures
Yes – N/A</td></tr>
<tr><td>Hazard CAT</td><td>Hazard Sub-CAT (if any)</td><td>Specific hazard</td><td>Conseq. (Unwanted high-risk event)</td><td>Existing controls in place</td><td>R.I* R.T**</td><td>Additional controls to mitigate the risk</td><td>R.I* R.T**</td><td>Responsible, due date</td><td>Monitoring method(s)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="10">RAT members (Position/name/signature/date)</td></tr>
<tr><td colspan="5">Safety Manager acceptance (if the risk is acceptable/tolerable - falls in green/yellow regions) Name/signature/date.</td><td colspan="5">AE acceptance (if the risk is intolerable before and/or after mitigations - falls in red region) Name/signature/date.
State: Not Required, if conditions are not met.</td></tr>
</table>

R.I * (Risk Index) / R.T** (RISK Tolerability) = A- Acceptable, T- Tolerable, Intol - Intolerable

Form 1: Risk assessment form

Chapter 5

SAFETY Assurance

5.1 GENERAL

Safety assurance within the organization shall be monitored and reviewed by a range of formal safety review processes, initiated through senior management and the Safety Department/Safety Manager. This oversight can be used to confirm the effective functioning of the SMS as documented.

5.2 SYSTEMS TO ACHIEVE SAFETY OVERSIGHT

The following elements are desirable:

- A system for analyzing flight recorder data for the purpose of monitoring organization operations and for detecting unreported safety events;
- An organization-wide system for the capture of written safety event/issue reports;
- A planned and comprehensive safety audit review system which has the flexibility to focus on specific safety concerns as they arise;
- A published system for the conduct of internal safety investigations, the implementation of remedial actions, and the communication of such information;
- Systems for effective use of safety data for performance analysis and for monitoring organizational change as part of the risk management process;
- Arrangements for ongoing safety promotion based on the measured internal safety performance and assimilation of experience of other operations;
- Periodic review of the continued effectiveness of the safety management system by an internal, independent body; and
- Line managers monitoring work in progress in all safety critical activities to confirm compliance with all regulatory requirements, organizational standards and local procedures.

5.3 SAFETY PERFORMANCE MONITORING AND MEASUREMENT

1. Safety management requires feedback on safety performance to complete the safety management cycle. Through feedback, system performance can be evaluated and any necessary changes effected. In addition, all stakeholders require an indication of the level of safety within an organization for various reasons, for example:
   - Staff may need confidence in their organization's ability to provide a safe working environment;
   - Line management requires feedback on safety performance to assist in the allocation of resources between the often-conflicting goals of production and safety;
   - Passengers are concerned with their own personal safety;
   - Senior management seeks to protect the corporate image (and market share); and
   - Shareholders wish to protect their investment.

2. The size and complexity of the organization will determine the best methods for establishing and maintaining an effective safety performance monitoring program.
   - Organizations providing adequate safety oversight employ some or all of the following methods:
   - By establishing an effective hazard and occurrence reporting system
   - Their front-line supervisors maintain vigilance (from a safety perspective) by monitoring day-to-day activities;

- They regularly conduct inspections (formal or informal) of day-to-day activities in all safety-critical areas;
- They sample employees' views on safety (from both a general and a specific point of view) through safety surveys;
- They systematically review and follow up on all reports of identified safety issues;
- They systematically capture data which reflect actual day to- day performance;
- They conduct macro-analyses of safety performance (safety studies);
- They follow a regular operational audit program (including both internally and externally conducted safety audits); and
- They communicate safety results to all affected personnel.

5.4 Safety investigation

5.4.1 Objective

The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability. (ICAO Annex 13).

The benefits of conducting a safety investigation include:

a. Gaining a better understanding of the events leading up to the occurrence;
b. Identifying contributing human, technical and organizational factors;
c. Identifying hazards and conducting risk assessments;
d. Making recommendations to reduce or eliminate unacceptable risks; and
e. Identifying lessons learned that should be shared with the appropriate members of the aviation community.

Functionally, the State safety investigator often is separated from the safety regulator-the investigator investigates the causes of safety accidents and incidents and makes recommendations to the regulator for corrective actions, while the regulator promulgates and enforces regulations on the approved organizations (AOC holders – service providers).

Both investigators and regulators have safety as their ultimate goal, but their organizational and functional lines are kept firm so as to enhance the objectivity of the investigating agency, and therefore the credibility of its findings.

Aviation organizations internal safety investigation - for every accident or serious incident, there will likely be hundreds of minor events or near-misses, many of which have the potential to become an accident. It is important that all reported events/hazards be reviewed internally within the aviation organization and a decision taken on which ones shall be investigated, and how thoroughly. The Organizational Safety Policy/SMS Protocols would need to state that the purpose of internal investigations is to find systemic causes and implement corrective actions, NOT to apportion blame to individuals. Where a 'Just Culture' policy is in place, the Policy and Protocols for internal investigations shall clearly reference such policy.

To maintain this credibility, and to maintain the line between the Egyptian Civil Aviation Authority (ECAA) and the Egyptian Aircraft Accident Investigation Directorate (EAAID) while respecting the mandate of each other, and collaboratively working with aviation organizations in a reselient and efficient aviation community- ECAA established this guidance material, requiring aviation organizations mandatory reports to be submitted to ECAA, the organization must provide the Hazard category (refer to Table 2 in chapter 4), Initial Event Risk Classification (ERC) (refer to Table 10 in chapter 5), and identify any failed barriers (refer to Table 12 in chapter 5). ECAA will evaluate the event accordingly to determine the level of investigation, EAAID will have direct access to the mandatory reporting system developed by (ECAA – Safety Management Directorate).

5.4.2 Scope of safety investigation

Data that initially may seem to be unrelated could later prove to be relevant once the relationship between the different elements of an occurrence are better understood. Investigation and analysis of safety occurrences is an essential ingredient of the overall risk management process in aviation. Effective safety management systems largely depend on the quality of the investigation of reported accidents and analysis of incidents and safety issues.

Without a structured investigation methodology, it is difficult to collect, integrate and analyze all pertinent information, assess risks and produce impartial output that would help improve safety.
There may be a need to filter reports on entry when there are a large number of safety reports. This may involve an initial event risk classification to determine whether further investigation is necessary and what level of investigation is required.

Safety reports are often filtered through the use of taxonomy, or a classification system. Filtering information using a taxonomy can make it easier to identify common issues and trends. ECAA is utilizing the CAST/ICAO Taxonomy, all aviation organizations under ECAA's oversight are required to use the same taxonomy in reporting to ECAA.
Identified hazards and their potential consequences should be documented. This will be used for safety risk assessment processes. Hazard identification should be continuous and part of the organization 's ongoing activities. Some conditions may merit more detailed investigation. These may include:

a. Instances where the organization experiences an unexplained increase in aviation safety-related events or regulatory non-compliance; or
b. Significant changes to the organization or its activities

5.4.3 Decision to Investigate

Not all occurrences or hazards can or should be investigated; the decision to conduct an investigation and its depth should depend on the actual or potential consequences of the occurrence or hazard.
Occurrences and hazards considered to have a high-risk potential are more likely to be investigated and should be investigated in greater depth than those with lower risk potential. A structured decision-making approach with defined trigger points should be used.
These will guide the safety investigation decisions: what to investigate and the scope of the investigation.

This could include:

a. The severity or potential severity of the outcome;
b. Regulatory or organizational requirements to carry out an investigation;
c. Safety value to be gained;
d. Opportunity for safety action to be taken;
e. Risks associated with not investigating;
f. Contribution to targeted safety programs;
g. Identified trends;
h. Training benefit; and
i. Resources availability.

Effective investigations do not follow a simple step-by-step process that starts at the beginning and proceeds directly through each phase to completion. Rather, they follow an iterative process that may require going back and repeating steps as new data are acquired and/or as conclusions are reached.

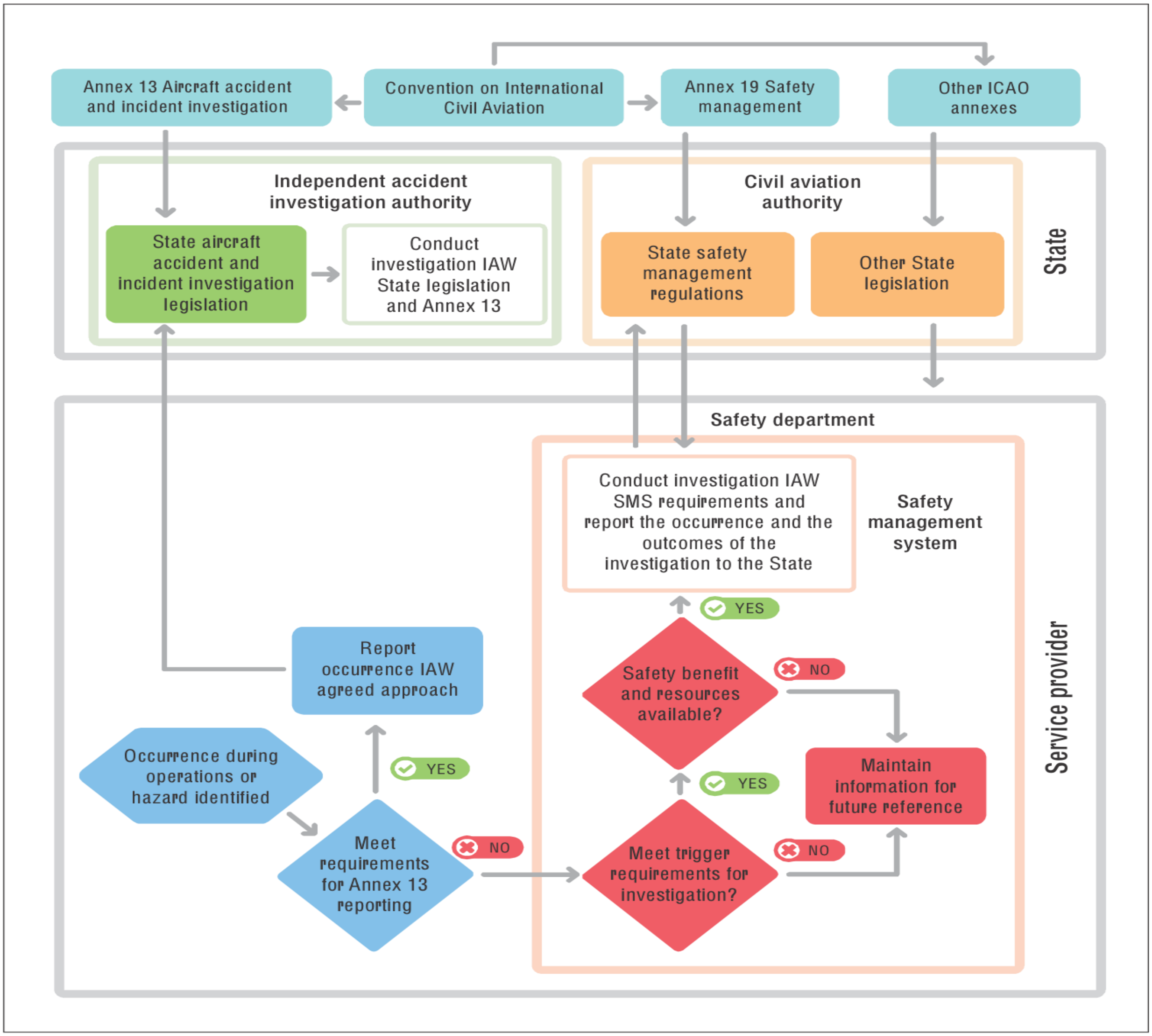

Figure 8: Safety investigation decision process

5.4.4 INVESTIGATION MANAGEMENT

5.4.4.1 Official State Investigation

a) The Egyptian Aircraft Accident Investigation Directorate – EAAID is fully independent from ECAA and aviation organizations. EAAID is entitled to investigate in Aviation accidents, serious incidents and (it may elect to investigate in any other occurrence that deems necessary to do so)
b) ECAA is entitled to investigate in other occurrences, refer to (table 10 in chapter 3 occurrence category and level of investigation) for more explanation. Where ECAA conducts an investigation into an organization event, the organization's Safety Manager, or delegate, would act as the organization's point of contact/coordinator for the investigation. This way the Safety Manger will be kept informed as the investigation progresses.

Resources are normally limited, thus the effort expended shall be proportional to the perceived benefit in terms of potential for identifying systemic hazards and risks to the organization.

5.4.4.2 Investigations carried out by approved aviation organizations (AOC holders – service providers)

There is a number of safety occurrences that do not warrant official investigations to be carried out by ECAA. Nevertheless, those occurrences may be indicative of high-risk hazards and could lead to the identification of systemic problems that will not be revealed unless thoroughly investigated. Sound safety management principles and practices require that approved aviation organizations analyze and/or investigate occurrences which put or might put at risk the safety of their services.
The accountability for the management of internal safety investigations shall be documented in the organization's SMS specifically to determine:

- The scope of the investigation;
- The composition of the investigation team including specialist assistance if required;
- That the investigation outcomes are recorded for follow-up trend analysis; and
- That there is a timeframe for completion.

The accountable person in charge of the investigation shall have the authority to:

- Interview any manager or staff member; and
- Access any company information source.

NOTE: It is very important to emphasize that, in case EAAID is carrying out an official investigation related to any occurrence, while either ECAA and/or the approved organization (AOC holder – service provider) are investigating the same occurrence internally. <u>The official report to any official local, regional or international bodies shall be the sole responsibility of EAAID and this mandated right shall always be observed and respected.</u>

5.5 Level of investigation using Initial – Event Risk Classification- ERC based on (ARMS Methodology)

Using this methodology as an initial evaluation of the event/occurrence, to indicate the course of action to be taken by ECAA in determining the level of investigation.
The category of the event/occurrence as being an accident with fatalities/injuries/whole loss of the aircraft or sustained major damage that prevents the aircraft from flying again, must be taken into consideration. The definitions of accident, serious incident and incident according to (ICAO Annex 13 and ECAR 801) are to be observed. According to the actual/projected result of the event/occurrence, the investigation level (investigator) should be determined, as shown in the following table:

Category	Investigator
Accident	Egyptian Aircraft Accident Investigation Directorate (EAAID)
Serious Incident (MTOW > 2250 KG)	Egyptian Aircraft Accident Investigation Directorate (EAAID)
Serious Incident (MTOW < 2250 KG)	ECAA
Incidents (ERC Score = 2500)	ECAA
Incidents (ERC Score 500 < 2500)	Approved Organization (AOC holders – service providers), the investigation and recommendations shall be provided to ECAA in a manner that provides protection of the individual's identity.
Incidents (ERC Score < 500)	Approved Organization (AOC holders – service providers), the investigation and recommendations shall be provided to ECAA upon request.

Table 9: Occurrence category and level of investigation

Notes:

a) In the event that ECAA is investigating the same occurrence as the EAAID:
- ECAA shall inform EAAID and will ensure that each other's mandate is respected.
- Should ECAA send a representative to the site of an occurrence in order to evaluate ECAA responsibilities or to determine if any immediate correction or remedial measures are required, that representative will endeavor to make contact with EAAID lead investigator on site.
- In any activity undertaken by ECAA, the interests of the EAAID with regard to evidence preservation will be respected. However, this will not be an impediment to ECAA taking whatever action deemed necessary for fulfillment of their obligations related to immediate correction action, remedial and preventive measures.

b) Taking into consideration, the approved organization (AOC holder – service provider) safety performance and/or safety risk profile, the following shall be considered:

1. In the cases where ECAA requires the investigation to be carried out by that approved organization, the following shall be applied:
    - Provide ECAA with an immediate correction action;
    - Provide ECAA with the initial internal investigation report and recommendations in Max.7 working days from the day of occurrence.
    - Provide ECAA with a follow-up report, including remedial and/or preventative measures and a risk assessment if any, in Max.30 days from the day of occurrence, and
    - Provide ECAA with a final closure report, in Max. 90 days from the day of occurrence, including all the actions taken and results of monitoring the preventive measures, including if any, change in (procedures – training – etc.) in a manner to prevent recurrence of the event/occurrence.
2. According to the situation and the recommendations provided by the approved organization, ECAA may require more actions to be taken by the approved organization investigating the (event/occurrence) internally to prevent recurrence, or ECAA may continue the investigation.
3. The investigation may be carried out by ECAA even if the ERC < 2500. In this case, ECAA shall inform the organization of the intention.

5.5.1 Initial – Event Risk Classification (ERC) methodology questions:

The Initial-ERC will produce a numerical Risk Index value for each event (refer to Table 10).
The Index is an estimated risk value that can be used to quantify risk, which is useful for summing up risks of similar events and making statistics and helps in identifying Safety Issues, and the required actions to be taken (refer to Table 11).
The following 2 questions must be answered to the extent possible knowledge of the event.

5.5.1.1 Question 1:

If this event had escalated into an accident, what would have been the most probable outcome?

Take all the contextual factors as they were (the location, airport, crew, aircraft, time of day, weather, etc.)
In your mind, try to escalate the event into an accident outcome (Including "minor injuries or damage" which would fall outside the ICAO Accident definition while still having some concrete safety consequence).

- If it was virtually impossible that the event could have escalated into an accident outcome, then you are at the bottom row, at ERC value 1.
- If you can imagine credible accident scenarios (even if improbable ones), then consider the most probable scenario and judge its typical consequence (pick the resulting row in the matrix)

5.5.1.2 Question 2:

What was the effectiveness of the remaining barriers between this event and the most probable accident scenario?

Now think how much "safety margin" existed between the real-life event and the imagined accident scenario. Consider both the number of the remaining barriers and how strong they are. Barriers that
already failed are ignored. Only the barrier which worked and any subsequent barriers still in place are taken into account. You should pick…

- **Not effective:** if the only thing separating the event from an accident was pure luck or exceptional skill, which is not trained nor required.
- **Minimal:** if some barrier(s) were still in place but their total effectiveness was "minimal" e.g. this could be a GPWS warning just before an imminent CFIT.
- **Limited:** if this is an abnormal situation, more demanding to manage, but with still a considerable remaining safety margin – e.g. a moderate error in load-sheet or loading vs. slight rotation problems at take-off.
- **Effective:** typically consisting of several good barriers – e.g. pax smoking in the lavatory vs. in-flight fire accident.

Question 2 What was the effectiveness of the remaining barriers between this event and the most credible accident scenario?				Question 1 If this event had escalated into an accident outcome, what would have been the most credible outcome?		Typical accident scenarios
Effective	Limited	Minimal	Not Effective			
50	102	502	2500	Catastrophic Accident	Loss of aircraft or multiple fatalities (3 or more)	Loss of control, mid-air collision, uncontrollable fire on board, explosions, total structural failure of the aircraft, collision with terrain
10	21	101	500	Major Accident	1 or 2 fatalities, multiple serious injuries, major damage to the aircraft	High-speed taxiway collision, major turbulence injuries
2	4	20	100	Minor Injuries or damage	Minor injuries, minor damage to aircraft	Pushback accident, minor weather damage
1				No accident outcome	No potential damage or injury could occur.	Any event which could not escalate into an accident, even if it may have operational consequences (e.g. diversion, delay, individual sickness)

Table 10: Initial Event Risk Classification (I-ERC)

5.5.1.3 Required Actions

The required actions are taken according to the following color coding:

Red	Investigate immediately and take action.
Yellow	Investigate and/or carry out further analysis and Risk Assessment
Green	Use for continuous improvement (flows into the Database)

Table 11: Color coding for required actions

5.6 Failed Barriers

Apart from the initial ERC scenarios and scoring, the failed barriers (refer to Table below) must be identified and assessed by the approved organization (AOC holder – service provider), this will aid in identifying the hazard category which falls under 4 families (ORG – HUM – ENV – TECH), each main category is divided into hazard sub-categories, finally, each sub-category includes different specific hazards/threats, (refer to table 1 hazard categorization)– identification of the specific hazard is an important process, that allows the organization to set extra mitigations to strengthening the barriers and monitoring their effectiveness in preventing recurrence, serving the goal of continuous improvement of the SMS and maintaining safe operations.

Question: what were the failed barriers? Select one or more from the table below.

Barrier name	Description/ Meaning
Aircraft, Equipment and Infrastructure	The aircraft, ATC unit, an aerodrome or other type of infrastructure that is involved in the occurrence.
Tactical Planning	Includes organizational and individual planning before the flight or other operational activity that supports the reduction of the cause.
Regulations, Processes, Procedures and Compliance	Includes effective, understandable and available regulations, procedures and processes that are complied with (excluding the use of procedures for recovery barriers).
Situational awareness and action	Includes situational awareness and human vigilance for operational threats which ensures identification of operational hazards and effective action to prevent an accident.
Warning systems operation and action	Addresses the availability of warning systems and actions within the unit in question and if they are functioning, operational and are complied with.
Recovery action	Addresses the human reaction to the situation and the handling of the recovery action (late recovery from a potential accident situation).

Table 12: Failed barriers

5.7 Investigation Phases

The investigation process is triggered by a notification (report) submitted in accordance with the established safety occurrence reporting arrangements. Several basic phases of an investigation can be distinguished:

Phase	Description
Set up of the investigation team.	A team with the required skills and expertise. The investigating team may require the assistance of other specialists. Often, a single person is assigned to carry out the investigation (according to the concerned organisation structure).
Individual(s) involved in the occurrence.	If the Initial Event Risk Classification score is 500 or more (refer to Table 10). Individual(s) must be initially removed from duty, until released by the investigation team. This initial removal from duty following an occurrence does not have any disciplinary connotation and is solely to facilitate the investigation. If the occurrence resulted in fatalities, serious injuries or damage to aircraft/equipment – the individual(s) must undergo alcohol/drug test. Individual(s) involved in the occurrence must be interviewed, managerial/supervisory personnel may be called for interview too. Usage of just culture decision tree or similar tool by the investigation team is required (refer to Figure 11).
Gathering of factual information.	That is pertinent to the understanding of the circumstances and the events leading to the occurrence. A variety of information sources will be used to collect the necessary data for the reconstruction of the event. To ensure the continued availability of such data for the purpose of aviation safety improvement, information sources and personnel information need to be protected.
Event reconstruction.	In order to establish the exact sequence of events leading to the safety occurrence with its causal and contributory factors. The output of the reconstruction phase should be a set of events that agrees with recorded information, and which unifies the views of the various persons who were involved in these events immediately before and after the occurrence.
Analysis of the information. "Must include a root cause analysis".	To assess the risk and provide explanation of the technical and operational factors, and underlying (including organisational) factors and issues. The analysis shall provide argumentation about why the occurrence happened and enable the drawing of conclusions and identification of safety actions to eliminate or mitigate the risk.
Drawing conclusions.	On the basis of collected and analysed information, generally presented by the following categories: • Main (direct) cause(s) and contributing factors leading to the occurrence; • Findings that identify additional hazards which have risk potential but have not played direct role in the occurrence; • Other findings that have potential to improve the safety of operations or to resolve ambiguity or controversy issues contributed to the circumstances surrounding the occurrence.

	Identifying the lessons to be learned from a safety occurrence requires an understanding of not just what happened, but why it happened. Therefore, the investigation should look beyond the obvious causes and aim to identify all the contributory factors, some of which may be related to weaknesses in the system's defences or other organisational issues.
Identification of safety recommendations and actions to be taken.	In order to eliminate or mitigate the safety deficiencies identified by the investigation. The safety recommendations are the main product of any occurrence investigation and are made in the final report.
Communication of safety messages.	To those who have the authority to implement the safety recommendations and to the aviation community in general by means of safety information exchange and lessons dissemination.

Table 13: Investigation phases

5.8 Investigation Methodology

Effective safety management requires an integrated and structured approach to safety investigations. An integrated and structured approach to safety investigations considers all aspects that may have contributed to unsafe behavior or created unsafe conditions. The logic flow for an integrated process for safety investigations is depicted in the following Figure 9 – Integrated Safety Investigation Methodology (ISIM). Using this type of model can guide the safety investigator from the initial hazard or incident notification through to the communication of safety lessons learned. The investigation should identify what happened and why it happened, and this require root cause analysis to be applied as part of the investigation. Ideally, the people involved in the event should be interviewed as soon as possible after the event. The investigation should include:

a) Establishing timelines of key events, including the actions of the people involved;
b) Review of any policies and procedures related to the activities;
c) Review of any decisions made related to the event; and
d) Identifying any risk controls that were in place that should have prevented the event occurring.

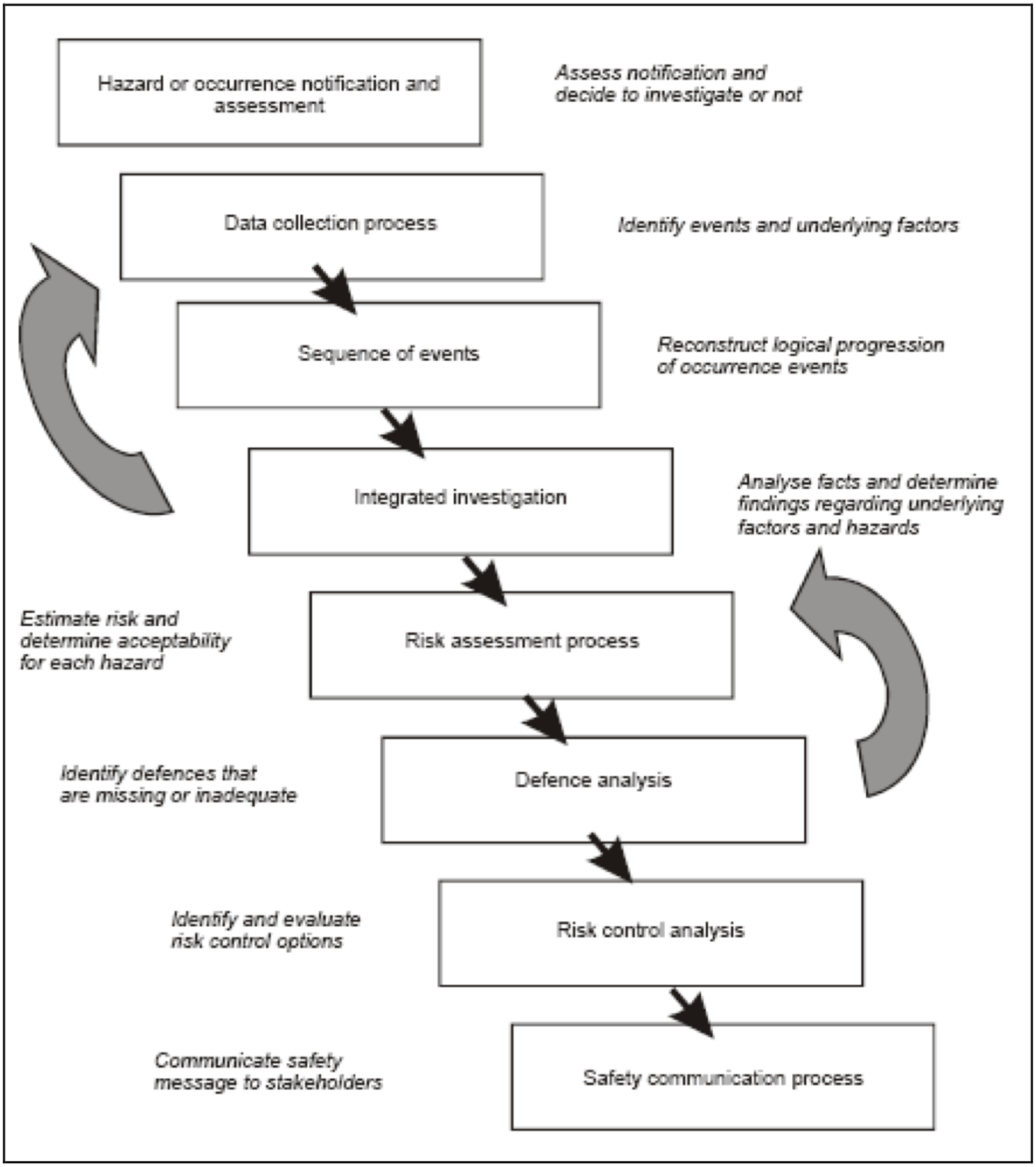

Figure 9: Integrated Safety Investigation Methodology (ISIM)

5.9 Practices of Investigation

Examples of poor occurrence investigation practice	**Examples of high-quality occurrenc investigation and effective organizational learning**
• Reporting forms and requirements are not clear. • No standard investigation methodology used. • Tendency to focus on individual error – “didn’t follow the procedure”. • ‘Blame’ approach rather than a Just Culture philosophy. • Little emphasis on understanding human factors. • Systemic causes not properly investigated or identified – all recommendations concern re-training of individuals concerned. • Recommendations not followed up. • Lessons learnt from occurrences not shared or communicated. • Investigators are not trained in formal investigation principles.	• A common and effective methodology for the investigation and reporting of all safety occurrences. • An underlying Just Culture’ approach to investigation. • Trained, competent investigators. • An understanding of the human factors that contribute to such events. • A process for reliably identifying systemic causes of occurrences, resulting in recommendations focusing on aspects additional to training, e.g. interface design, SOPs, airspace design, etc. • A common “language” for communicating lessons learnt from occurrences to all relevant parties. • Investigator’s sharing de-identified lessons learned.

Table 14: Examples of poor vs. high-quality occurrence investigation

5.10 Investigation Form

The investigation form is utilized for gathering all required information to prepare the occurrence final investigation report. It may contain, but is not limited to the following:

- Brief description of the occurrence being investigated;
- Aircraft type, registration, route, flight number, date, time and flight phase, or (equipment/facility if the occurrence is not related to an aircraft);
- If applicable, occurrence category according to ICAO taxonomy categorization;
- Date of investigation;
- Information about the individual being interviewed for investigation, involved in the occurrence (name, position, license No., etc.). And Information about the investigation team (names and positions);
- Gathered technical information from the individual involved in the occurrence (in the form of questions and answers) to assist in identifying the problem and reaching the root cause;

- Initial recommendations by the investigation team. And the Signature of the individual involved in the occurrence, after answering all questions included in the investigation form; and the Signatures of the members of the investigation team.

5.11 Investigation Report

Based on the data gathered, the hazard should be identified (refer to Table 1 hazard categorization in chapter 1);

Risk assessment can be generated if required (refer to Figure 5 risk assessment form) based on risk probability/severity (refer to Tables 2 and 3 respectively), the resultant risk index (refer to table 4 – risk matrix), risk tolerability (refer to table 5) refer to chapter 2;

A just culture decision tree or a Culpability model to be used (refer to Figure 9 in chapter 4);

Most importantly the root cause (refer to chapter 5) must be determined to act upon to prevent recurrence and maintain safety; and

The Investigation report shall be prepared as per ICAO Annex 13 and shall contain recommendations based on information derived from the investigation. It will be distributed to the relevant entities for implementation of recommendations. The required corrective actions and preventive measures must be responded to by the concerned entity according to the stipulated time frame set forth in the investigation report.

A justification for not applying any of the recommendations must be presented to the investigation team first, to evaluate the justification and then to decide the required course of action.

Applied corrective actions and preventive measures shall be evaluated through audits/inspections reviewing safety performance, etc.

De-identified safety Information derived from investigations shall be disseminated to ensure safety awareness amongst the aviation community.

6.Human in the System

6.1 People’s responsibilities towards safety

6.1.1 How people think about their responsibilities towards safety and how they interact with others to perform their tasks at work significantly affects their organization’s safety performance. Managing safety needs to address how people contribute, both positively and negatively, to organizational safety. “Human factors” is about understanding the ways in which people interact with the world, their capabilities and limitations, and influencing human activity to improve the way people do their work. As a result, the consideration of human factors is an integral part of safety management, necessary to understand, identify and mitigate risks as well as to optimize the human contributions to organizational safety.

6.1.2 The following are key ways in which safety management processes consider human factors:

a. senior management commitment to creating a working environment that optimizes human performance and encourages personnel to actively engage in and contribute to the organization's safety management processes;
b. responsibilities of personnel with respect to safety management are clarified to ensure common understanding and expectations;
c. personnel are provided with information by the organization that:
    - describes the expected behaviors with respect to the organizational processes and procedures;
    - describes what actions will be taken by the organization in response to individual behaviors;
d. human resourcing levels are monitored and adjusted to ensure there are enough individuals to meet operational demands;
e. policies, processes and procedures are established to encourage safety reporting;
f. safety data and safety information are analyzed to allow consideration of those risks related to variable human performance and human limitations, with particular attention to any associated organizational and operational factors;
g. policies, processes and procedures are developed that are clear, concise and workable, with the aim of:
    - Optimizing human performance;
    - Preventing inadvertent errors;
    - Reducing the unwanted consequences of variable human performance; the effectiveness of these are continually monitored during normal operations
h. ongoing monitoring of normal operations includes assessment of whether processes and procedures are followed and when they are not followed, investigations are carried out to determine the cause;
i. safety investigations include the assessment of contributing human factors, examining not only behaviors but reasons for such behaviors (context), with the understanding that in most cases people are doing their best to get the job done;
j. management of the change process includes consideration of the evolving tasks and roles of the human in the system;
k. Personnel are trained to ensure they are competent to perform their duties, the effectiveness of training is reviewed, and training programs are adapted to meet changing needs.

6.1.3 The effectiveness of safety management depends largely on the degree of senior support and management commitment to create a working environment that optimizes human performance and encourages personnel to actively engage in and contribute to the organization's safety management processes.

6.1.4 To address the way that the organization influences human performance there must be senior-level support to implement effective safety management. This includes management commitment to create the right working environment and the right safety culture to address human factors. This will also influence the attitudes and behaviors of everyone in the organization.

6.2 SHELL Model

6.2.1 Several models have been created to support the assessment of human factors on safety performance. The SHELL Model is well known and useful to illustrate the impact and interaction of the different system components on the human and emphasizes the need to consider human factors as an integrated part of SRM.

Figure 8 illustrates the relationship between the human (at the centre of the model) and workplace components. The SHELL Model contains four components:

a. Software (S): procedures, training, support, etc.;
b. Hardware (H): machines and equipment;
c. Environment (E): the working environment in which the rest of the L-H-S system must function; and
d. Liveware (L): other humans in the workplace.

Figure 10: SHELL Model

6.2.2 Liveware. The critical focus of the model is the humans at the front line of operations, and depicted in the centre of the model. However, of all the dimensions in the model, this is the one which is least predictable and most susceptible to the effects of internal (hunger, fatigue, motivation, etc.) and external (temperature, light, noise, etc.) influences. Although humans are remarkably adaptable, they are subject to considerable variations in performance. Humans are not standardized to the same degree as hardware, so the edges of this block are not simple and straight. The effects of irregularities at the interfaces between the various SHELL blocks and the central Liveware block should be understood to avoid tensions that may compromise human performance. The jagged edges of the modules represent the imperfect coupling of each module. This is useful in visualizing the following interfaces between the various components of the aviation system:

a. Liveware-Hardware (L-H). The L-H interface refers to the relationship between the human and the physical attributes of equipment, machines and facilities. This considers the ergonomics of operating the equipment by personnel, how safety information is displayed and how switches and operating levers are labelled and operated so they are logical and intuitive to operate.

b. Liveware-Software (L-S). The L-S interface is the relationship between the human and the supporting systems found in the workplace, e.g. regulations, manuals, checklists, publications, processes and procedures, and computer software. It includes such issues as the recency of experience, accuracy, format and presentation, vocabulary, clarity and the use of symbols. L-S considers the processes and procedures – how easy they are to follow and understand.

c. Liveware-Liveware (L-L). The L-L interface is the relationship and interaction between people in their work environment. Some of these interactions are within the organization (colleagues, supervisors, managers), and many are between individuals from different organizations with different roles (air traffic controllers with pilots, pilots with engineers etc.). It considers the importance of communication and interpersonal skills, as well as group dynamics, in determining human performance. The advent of crew resource management and its extension to air traffic services (ATS) and maintenance operations has enabled organizations to consider team performance in the management of errors. Also within the scope of this interface are staff/management relationships and organizational culture.

d. Liveware-Environment (L-E). This interface involves the relationship between the human and the physical environment. This includes things such as temperature, ambient light, noise, vibration and air quality. It also considers the external environmental factors, such as weather, infrastructure and terrain.

6.3 Human performance and behaviors

Error and performance are both merely the outcomes of behaviors and actions. Error must therefore be able to account for performance and vice versa.
The following may be considered as contributing factors, but not limited to:

a. Fatigue
b. Situation awareness
c. Workload
d. Training and experience/expertise

e. Familiarity
f. Memory and capability

6.4 Just culture decision tree

As always said, the purpose of a safety investigation is to establish the facts and contributory factors for the prevention of accidents and incidents, not to apportion blame or liability.

Effective safety investigation seeks to identify the cause of human errors and risky behaviors and take appropriate action to prevent them from recurring.

Disciplinary actions should not be taken against anyone who discloses an occurrence involving safety in which he/she is personally involved unless such disclosure indicates beyond any doubt an unacceptable behavior such as wilful violations, gross negligence and destructive acts.

The just culture decision tree is based on the human performance culpability evaluation decision tool. To be applied for the purpose of deriving a decision regarding the culpability of individuals involved in an occurrence. (This tool is basically based on the idea of culpability decision tree given by Dr. James Reason).

There are many culpability decision tree and models, the following just culture decision tree (Figure 9) has been recognized by ECAA as it is beneficial to address both (the individual involved in the occurrence and the supervisory level involvement too), using this model in (Figure 9) or any other structured means/methods serving the same purpose, will assist the investigation team in the concerned occurrence to set the remedial or administrative actions if required, either for the concerned individual involved in the occurrence and/or the supervisory level within the organization to prevent recurrence.

Using the provided just culture decision tree (Figure 11):

a. The first row indicates the behavior type, starting from the top left with the good behaviors (exceptional and expected), and moving right till the end where (reckless behavior) is reached.
b. The second row is questioning the individual behavior, review the question and follow the arrows (Yes, will direct you down to the third row where the actions to be taken against the individual), while (No, will direct you to the right to the next question, until you reach the decision for the actions to be taken).
c. Forth row is questioning the head of department/supervisor’s behavior, review the question and follow the arrows (Yes, will direct you down to the fifth row where the actions to be taken against the head of department/supervisor), while (No, will direct you to the right to the next question, until you reach the decision for the actions to be taken).
d. This diagram sketches out the basic essentials of a decision tree for discriminating the culpability of an unsafe act (behavior) of an individual. The main assumptions of use of this tool are:

- The actions under scrutiny have contributed either to an accident, a serious incident or an equivalent degree of impact on safety consequences.
- In an organizational accident, there are likely to be a number of different unsafe acts,and the decision tree is intended to be applied separately to each of them.

e. Conclusions like (at-risk behavior) may indicate a system-induced violation and error – are more organization-related and should be dealt with accordingly (reviewing in depth the processes, procedures, etc.)

6.5 Definitions to understand human performance and behaviors

a. Culpability – the amount of blameworthiness that an individual's behavior merits based on the nature of the deviation from expected behavior, the outcomes of the deviation, and the responsibility and authority of that individual, in the context of the situation in which the behavior occurred.

b. Behavior – a human act or sequence of human actions. Behavior consists of a plan or intention (a goal plus the means to achieve it), a sequence of actions initiated by the plan, and the extent of success in achieving the goalas each action is performed.

c. Errors and Mistakes: are the result of actions that fail to generate the intended outcomes. They are categorized according to the cognitive processes involved towards the goal of the action and according to whether they are related to planning (mistake) or execution of the activity (error). They can be broadly distinguished into two categories:

- Category 1 – A person intends to carry out an action, the action is appropriate, but he carries it out incorrectly, and the desired goal is not achieved. – An execution failure has occurred. Execution failure is an error. Errors are called Slips and Lapses. They result from failures in the execution and/or storage stage of an action sequence.

  Slips – inadvertent action that is not adequate, related to attention failures, (example-an aircraft's flight crew that becomes so fixated on trouble-shooting a burned-out warning light, that they do not notice their fatal descent into the terrain).

  Lapses – a temporary failure related to memory failures, often appear as omitted items in a checklist, place losing, or forgotten intentions.

- Category 2 – A person intends to carry out an action, and does so correctly, but the action is inappropriate, and the desired goal is not achieved – A planning failure has occurred. Planning failures are Mistakes. "Mistakes may be defined as deficiencies or failures in the judgmental and/or inferential processes involved in the selection of an objective or in the specification of the means to achieve it." (Reason, 1990).

Simply mistakes are intended actions giving a result different from expectation.

d. Human performance levels and associated errors can be classified as follows:

- Skill-based error – an error associated with human performance behavior based on highly-practised actions in a familiar situation. The plan was adequate, but the action(s) failed to go as planned, as a result of (slips or lapses), where the person's intentions were correct, but the execution of the action was flawed – done incorrectly, or not done at all.

Once a situation is recognized as unfamiliar, <u>human performance shifts from a skill-based to a rule-based level</u>.

- Rule-based error – an error associated with human performance behavior based on the selection of stored rules. First of all, human tries to solve the problem by relying on a set of memorized rules and can commit rule-based errors. These kinds of errors depend on the application of a good rule (a rule that has been successfully used in the past) selected to a wrong situation, or on the application of a wrong rule.

When humans recognize that the current situation does not fit with any rule stored, <u>they shift to knowledge-based behavior.</u>

- Knowledge-based error – an error associated with human performance behavior in response to a totally unfamiliar situation (no skill, rule or pattern recognizable to the individual). It is based on gathering information on all the aspects of a situation, analyzing all the data and deriving the right decision. Actions conformed to the plan, but the plan was inadequate to achieve its intended outcome due to an inaccurate mental picture based on limited information and time resources (and cognitive resources) and it can result in a failure.

e. Violation – the intentional deviation from expected behavior as specified in operational procedures, rules, or standards, but in which the consequences were not intended.

f. Routine: Rules are broken because they are felt irrelevant or because people do not appreciate the dangers anymore (Cutting corners at every opportunity).

g. Optimizing: It is sometimes possible to get the job done faster, more conveniently or experience a thrill by not adhering to the rules (Actions to further personal rather than strictly tasks-related goals). It could be a personal optimizing violation or (an organizational optimizing violation, if the individual thinks the organization will get benefit from his/her behavior).

h. Sabotage – behavior in which both the act and the damaging outcome were intentional.

i. Substitutional Test – This test will momentarily take the specific individual out of the picture and replace him/her with another person, in order to give us further insight into the influence of the organization on the behavior of an individual in the situation being evaluated. (Not included in the provided example of just culture decision tree below – it is beneficial to ask up to 3 other individuals in the same organization, with the same level of training and qualifications, if they are in the same situation how they are going to act?).

Just Culture – Decision Tree

Figure 11

			Human Error			At Risk Behavior		Reckless Behavior	
BEHAVIOUR TYPE ➡	Exceptional Behavior	Expected Behavior	Unintentional Error (Slip, Lapse, or Mistakes)	Unintentional Error (Slip, Lapse, or Mistakes)	Routine Violation	Situational Violation	Organizational Optimizing Violation	Personal Optimizing Violation	Reckless Violation
Team Member Behavior Start ➡	Did the team member go above & beyond call of duty?	Were all procedures and instructions followed?	Were procedures unclear or not workable and/or Defective Training & Experience?	Did the team member think they were doing things the right way?	Do other team members normally not follow procedures in the same way?	Did the team member think the procedure was a barrier to getting the job done?	Did the team member think there was some benefit for the organization by doing the job a different way?	Did the team vary from the procedure to make it easier for themselves?	Did the team member intentionally not follow the procedure without thinking or caring about the consequences?
	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ⬇
Team Member Consequence	-Recognition or reward -Record on employee file -Convey cause of recognition to department members ☐Copy to Direct Supervisor	-No Action	-System produced error needing correction of root causes -Console person on correct procedures	-Does this happen often? (If yes, routine error & record for trend analysis) -Console person on taking more care.	-Console team members on importance of following correct procedures and not taking short cuts. -Reorientation for all members on procedures	-Coach the team member on speaking up when procedures cannot be followed and delaying the job until it can be completed safely. -Training is required	-Coach the team member on balancing work and time pressure with organization values, training is required -Formal disciplinary action. Record on employee file	-Formal disciplinary action. -Record on employee file	-Formal disciplinary action. -Record on employee file
Head of Department/ Supervisor Behavior Start ➡	Did the Head/ Supervisor also exhibit exceptional behavior?	Do the Head/ Supervisor lead by example by complying with procedures and instructions?	Did the Head/ supervisor know the procedure was unclear or not workable and/or Defective Training & Experience?	Did the Head/ Supervisor think the task was being completed in the required manner?	Do the Head/ supervisor not always ensure work is completed in the appropriate and correct manner?	Did the Head/ Supervisor know the procedure was a barrier to getting the job done however managed the matter appropriately?	Did the Head/ Supervisor authorize shortcuts or other non-approved methods thinking this was a benefit for the organization?	Did the Head/ Supervisor not manage the variance/ behavior on this or previous occasions?	Did the Head/ Supervisor condone or ignore the actions of the team member?
	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ☐ No ⬇ ➡	☐ Yes ⬇
Head of Department/ Supervisor Consequence	-Recognition or reward. -Record on employee file -Convey cause of recognition to department members ☐Copy to direct supervisor	-No Action required	-Console on how to monitor, evaluate & enforce procedures. -Leadership skills training	-Does this happen often? (if yes, routine error & record for trend analysis) -Console employee on taking more care.	-Console on how to monitor, evaluate & enforce procedures. -Leadership skills training	-Review procedure for possible defects -Coaching on how to monitor, evaluate & enforce procedures. -Leadership skills training	-Consider leadership training. -Formal disciplinary action. -Record on employee file	-Formal disciplinary action. -Record on employee file	-Formal disciplinary action. -Record on employee file

7. ROOT CAUSE ANALYSIS – RCA

7.1. Introduction

a. Principles of RCA are closely related to those of risk assessment, particularly in terms of the thoroughness of the analysis. Both processes consider not simply the person involved in an issue, but all aspects of the organisation and each individual in that organisation where that person works. This approach has the premise that human error is a consequence rather than a deliberate action and, as such, proactive measures and continuous reform of different aspects of the processes and organisation can address latent conditions in the system and increase the system's resistance to operational hazards. The term "latent conditions" refers to flawed procedures or organizational characteristics capable of creating hazards if the right conditions or actions occur.

b. Therefore, RCA treats errors as defects in the system rather than in an individual. RCA looks beyond the symptom to find the organizational defect that permitted an error to occur. The more thorough the analysis, the greater the likelihood you will uncover why the system deficiency could occur, and how your organisation can respond definitively. An effective RCA can be as simple as asking and answering a question (five times) about why something happened, or more sophisticated techniques such as fish bone, bow tie, fault tree analysis, etc. (Examples of Root Cause Analysis techniques are readily available on the internet), regardless of which technique is being utilized by the organization, you must state and document it in carrying out the Root Cause Analysis.

c. A superficial analysis might have led to disciplinary action against one individual, which is indicative of a blame culture, and would, most likely, lead to a recurrence of the same error by a different individual. RCA is analyzing the process, thus "human error" must not be accepted as the root cause.

d. Root causes are those over which management has control – general cause classifications such as human error, equipment failure or external factor. Such causes are not specific enough to allow management to make effective changes. Management needs to know exactly why a failure occurred before action can be taken to prevent recurrence.

e. Root causes are those for which effective recommendations can be generated, that directly address the root causes identified during the investigation. If vague recommendations such as, "Improve adherence to written policies and procedures," then probably have not found a basic and specific enough cause and need to expend more effort in the analysis process.

f. Root causes are underlying causes. The goal should be to identify specific underlying causes. The more specific the team can be about why an event occurred, the easier it will be to arrive at recommendations that will prevent recurrence.

g. Root Cause Analysis – RCA, must be utilized in addressing the following:

- Deep analysis and/or investigation of an event or occurrence, taking into consideration the level of investigation, (refer to chapter 3 safety investigation – item 5 Level of investigation using Initial – Event Risk Classification).
- Addressing audit/inspection findings, either if the audit/inspection is carried out internally within an organization or carried out by ECAA during oversight activities or carried out by third parties.

Note: The more significant the event/finding, the shorter the response time.

7.2 Considerations for the RCA process

The RCA should consider two major areas:

a. Systems analysis plays an increasingly important role because of the increasing aviation complexity and variety of organisation activities, equipment and multicultural environment issues. The systems analysis emphasizes a harmonized approach to an enterprise, this harmonized approach recognizes the wide range of interrelated issues that are potentially associated with a problem in the system. System analysis including:

- specific written procedures and planning for all activities;
- clearly established authority and responsibilities;
- communications processes; and
- Methods of measuring results, detecting system errors, and preventing recurrence.

b. Human factors analysis begins with the organisation itself where the occurrence happens (flight operations, ground operations, training, maintenance, ATS, etc.). Each of those organisations:

- Defines the environment where staff conducts their tasks.
- Defines the policies and procedures that staff must follow and respect.
- Allocates the resources that staff needs to achieve the safety and production goals

7.3 Human Factors

Within any organization, human factors analysis looks at how their staffs communicate and perform in the work environment and then seeks to incorporate that knowledge into the design of equipment, processes, etc. This enhances safety and maximizes the human contribution, partly by designing systems to anticipate the inevitability of human error. The human factors discipline addresses a wider

range of issues affecting how people interface with technology and the operational system; how people learn about new or changed equipment, technology, and documentation; and how people adapt to the general workplace environment.

Any organisation should be aware that knowledge gained from human factors can help to avoid operational staff errors, ensure that individuals' initial skill sets match task requirements, ensure that individuals maintain and improve their skills, and enhance the work environment. Throughout the aviation system, people are both the source of some of the risks and an integral part of identifying and managing all risks (refer to chapter 4 – Human in the System).

7.4 Achieving effective corrective action

The key steps in achieving effective corrective action are based on the **Plan, Do, Check and Act (PDCA Module)**

Plan	**Define the problem**
	
	"Problem Statement"
	
	The more you define a problem, the easier it becomes to identify the cause(s) and the solution(s).
		To define the problem:
		• Clearly understand it and the process (es) involved.
		• Gather facts about what did or did not happen.
		• Collect evidence (no assumptions or opinions)
		• Do not jump to conclusions.
		
		The more you define a problem, the easier it becomes to identify the cause(s) and the solution(s).
		
		Define the problem "Problem Statement" by answering:
		
		❖ What?
		  • What changed (from when your system/process was compliant before)?
		  • What happened that shouldn't have?
		  • What didn't happen that should have?
		❖ When?
		  • When did the problem begin (date/time)?
		  • How often did the problem occur?
		❖ Where?
		  • Where did the problem physically occur? (Location)?
		  • Where did the problem occur in your process/system (what work was being done)?
		❖ Who?
		  • Who discovered it? (Internal/external audit or inspection – investigation- etc.
		❖ How does the problem impact your organization?
		  • How big is the problem?
		  • How much bigger can it get?
		  • How does the problem affect your safety performance?

	Identify the Cause(s)	Focus on how people work within your organization's system, not on individual involvement in the event. ❖ The way to solve a problem effectively is through the connection of the cause-and-effect. As follows: a. Processes are how your organization gets work done; b. People carry out the steps of each process; c. Processes should give people the information and tools they need to do the job effectively; d. Problems result when a process fails. ❖ Work processes often fail when: a. The process is not clearly documented; b. The process and its intended outcome are not clearly understood; c. The defined process is incorrect; or d. The defined process is not followed. ❖ The root cause is reached when: a. You cannot identify any other cause; or b. The cause would be completely outside your Organization's control. ❖ Root causes are those for which your organization: a. Has control to fix; and b. Can adopt effective solutions to prevent recurrence.
	Develop Corrective Action	Corrective actions should: a. Be specific in stating the actions to eliminate or control causes (i.e. 'adopt', 'begin', 'install', 'conduct', 'amend'; 'disable'; etc., rather than 'review', 'analyze', 'investigate', 'consider', 'assess', etc.); b. Be specific in timeline for implementation; c. Prevent recurrence of the problem statement with reasonable certainty; and d. Not cause unintended consequences or introduce new problems.
Do	**Take Corrective Action**	The Corrective Action Plan – CAP to be implemented when it is accepted by the auditor/inspector/investigator. Taking corrective action includes:

		a. Get resources (e.g. personnel, capital, equipment, tools, supplies) to carry out the CAP; b. Organize and perform CAP activities; and c. Determine evaluation activities.
Check	**Evaluate the Corrective Action**	Monitoring corrective actions is important so organizations know if the changes were adopted and if they worked as intended. Follow-up includes two steps: a. Verify CAP activities – To ensure the CAP was completed, verify that your organization: • Amended all relevant documents, system requirements, and record-keeping requirements to reflect process and system changes; • Use effective communications and training methods to make sure that employees know about the changes and understand the reasons; • Is consistently applying the changes; • Has done everything set out in the CAP; and • Adopted all corrective actions within the approved timeline. b. Validate effectiveness – To determine if corrective actions are effective, validate that: • The solutions work as planned and deliver the expected results; • Corrective actions are truly eliminating or controlling causes, not simply reducing the likelihood of their recurrence; • The changes did not cause unintended consequences or introduce new problems; and • The problem has not recurred. Note: Depending on the complexity of the CAP, it may take a reasonable period of time before the organization sees the effectiveness of its corrective actions.
Act	**Revise the Corrective Action (if required)**	Analyze any discrepancy to identify the reasons for it. Return to the appropriate step of the corrective action process and take further action as necessary.

Table 15: Effective corrective action

7.5 Example of effective vs ineffective Corrective Action process

Situation: A team member was tasked to close Valve A; instead, he closed Valve B.

Corrective Action Process		
	Ineffective	**Effective**
Problem Statement	Emphasis on Who: • Team member Z closed the wrong valve	Emphasis on What, When, Where, Impact: • Valve B was closed on Pipe #3 in main plant during shift change at 6:31pm on Christmas Day, shutting off glycol for de-icing.
Analysis	• Did the team member make a mistake?	• Was the documented procedure followed? • Is the procedure correct? • Did the team member receive enough training? • Is the operator qualified to do the work? • Did shift handover take place? • Did shift supervisors give conflicting directions? • Was the equipment faulty? • Were the valves clearly labeled? • Are there measures in place to detect valve errors?
Causes	• Operator error	• Unclear procedures • Incomplete training • Inconsistent supervision during shift change
Corrective Actions	• Retrain the operator on the procedure. • Remind all operators to be alert when closing valves.	• Revise the procedure to meet user needs. • Check that valve labels on equipment match the revised procedure. • Give update training on the revised procedure to staff. • Set up a supervisory shift handover process. • Evaluate effectiveness in 3 months.
Outcome	Unlikely to prevent recurrence	Likely to prevent recurrence

Table 16: Effective vs ineffective corrective action process

7.6 Template example of the 5 whys Root Cause Analysis technique

A simple and effective RCA technique is the 5 whys analysis technique, by asking why something happened 5 times (other Root Cause Analysis techniques are readily available on the internet)

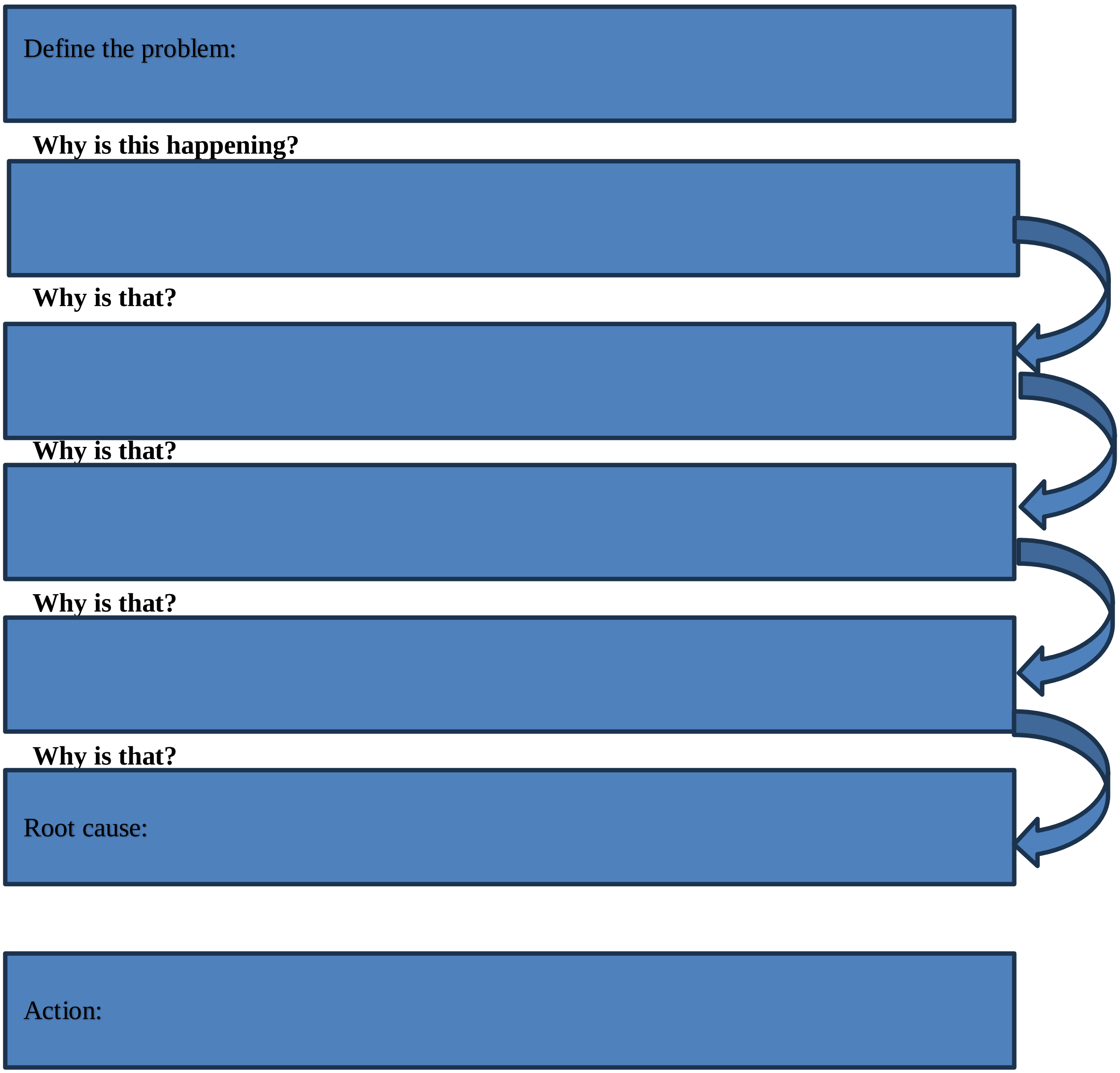

Figure 12: Template of RCA 5 whys technique

Tips:

a. Don’t list 5 different reasons, you want to go deep in 1 reason.
b. If your last answer is something you can’t control, go back up to the previous answer.
c. You may need more than 5 questions to arrive at the reason why an event took place, or you may need less if the root reason is more obvious.
d. There may be more than one root cause.
e. we are analyzing the system or the process, don’t accept “human error” as the root cause.
f. Examples of contributing factors and areas to be examined:

1) **Organizational (policies, procedures, methods, measurement, responsibilities, documentation, staffing levels, material and communication)**
    - What was the missing or weak step in the process?
    - What caused the missing or weak step in the process?
    - What is currently done to prevent failure at this step?
    - Was the documentation available?
    - Was the documentation appropriate according to the established standard?
    - Did staff reference the available documentation?
    - Does staff training address appropriate documentation and its utilization?
    - Is the documentation lacking in necessary information?
    - Is the documentation too cumbersome for staff to follow?
    - Was the staffing level appropriate? If no, did staffing issues contribute to the event?
    - Did actual staffing deviate from planned staff levels at the time of the event or during times leading up to the event?
    - Were there any unexpected issues or incidents that occurred at the time of the event or during key times that led up to the event? If yes, did the unexpected issue impact staffing or workload for staff? If yes, did staff believe this change in staffing or workload contribute to the event?
    - Was all necessary information available: when needed, accurate, and complete?
    - Is communication among participants adequate?
    - Are there barriers to communication?
    - Is prevention of adverse outcomes considered as a high priority?
2) **Human Factors (manpower)**
    - What was the human factor?
    - Was staff performance in the process addressed?
    - What is being done to prevent future occurrences?
    - Can orientation and training be improved?
3) **Environmental (Mother Nature)**
    - What environmental factors directly affected the outcome?
    - Was the physical environment appropriate for the process to be carried out?
    - Are systems in place to identify environmental risks?
    - Are responses to environmental risks planned and tested?
4) **Technical (equipment, machine)**
    - How did the equipment fail?
    - What broke?
    - What is currently being done to prevent an equipment failure?
    - What is currently being done to protect against a bad outcome if an equipment failure does occur?

8. Management of Change

8.1 Introduction

The Management of change is a formal process, to manage a change by proactively implementing a process in response to this change in a planned and systematic way, this process will identify hazards, assess and control safety risks, help in understanding the reasons for the change, analyzing the impact of the change and its effect on the organization and other organizations in the aviation community and develop plans to address the change and monitoring its implementation.

Change may affect the effectiveness of existing safety risk controls. In addition, new hazards and related safety risks may be inadvertently introduced into an operation when change occurs. Hazards should be identified and related safety risks assessed and controlled as defined in the organization's existing hazard identification or SRM procedures.

Small incremental changes often go unnoticed, but the cumulative effect can be considerable changes, large and small, might affect the organization's system description, and may lead to the need for its revision. Therefore, the system description should be regularly reviewed to determine its continued validity.

Note: concerning ECAR parts 171 & 172 for more details, refer to EACs 19-10 & 19-11 respectively "Guidelines for preparing safety cases".

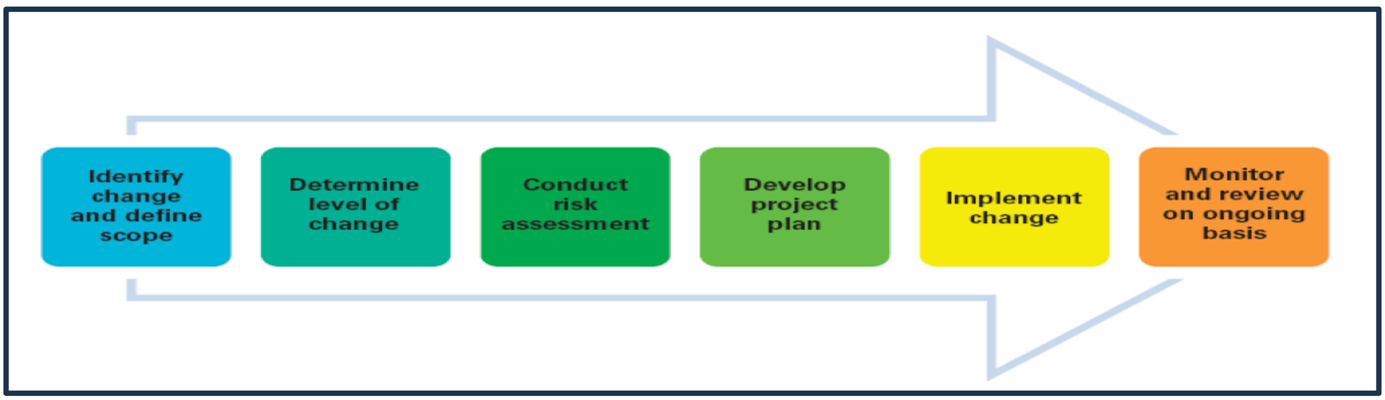

Figure 13: Management of Change process

Note: A Management of Change study must be presented first to ECAA to grant approval before the change takes place – this is to include as a minimum any organization's activity that requires ECAA's prior approval as well as any change in SMS structure or methodology.

8.2 Formal change management triggers

Organizations experience change due to a number of factors. The organization should define the trigger for the formal change management. Changes that are likely to trigger formal change management include, but not limited to:

a. organizational expansion or contraction (ie. Introduction of new technology or equipment; new fleet etc.)
b. changes in key personnel;
c. significant changes in staffing levels;
d. significant restructuring of the organization;
e. business improvements that impact safety; these may result in changes to internal systems, processes or procedures that support the safe delivery of the products and services;
f. changes to the organization's operating environment;
g. changes to the SMS interfaces with external organizations; and
h. changes in external regulatory requirements, economic changes and emerging risks;
i. physical changes (new facility or base, aerodrome layout changes etc.).

8.3 The organization's management of change process should take into account the following considerations:

a. Criticality. How critical is the change? The organization should consider the impact on their organization's activities, and the impact on other organizations and the aviation system.
b. Availability of subject matter experts. It is important that key members of the aviation community are involved in the change management activities; this may include individuals from external organizations.
c. Availability of safety performance data and information. What data and information are available that can be used to give information on the situation and enable analysis of the change.
d. The impact of the change on personnel. This could affect the way the change is accepted by those affected. Early communication and engagement will normally improve the way the change is perceived and implemented.

8.4 The management of change process should include the following activities:

a. understand and define the change; this should include a description of the change and why it is being implemented;

b. Understand and define who and what it will affect; this may be individuals within the organization, other departments or external people or organizations. Equipment, systems and

c. Processes may also be impacted. A review of the system description and organizations' interfaces may be needed. This is an opportunity to determine who should be involved in the change. Changes might affect risk controls already in place to mitigate other risks, and therefore change could increase risks in areas that are not immediately obvious;

d. Identify hazards related to the change and carry out a safety risk assessment; this should identify any hazards directly related to the change. The impact on existing hazards and safety risk controls that may be affected by the change should also be reviewed. This step should use the existing organization's SRM processes;

e. Develop an action plan; this should define what is to be done, by whom and by when. There should be a clear plan describing how the change will be implemented and who will be responsible for which actions, and the sequencing and scheduling of each task;

f. Sign off on the change; this is to confirm that the change is safe to implement. The individual with overall responsibility and authority for implementing the change should sign the change plan; and

g. develop assurance plan; this is to determine what follow-up action is needed. Consider how the change will be communicated and whether additional activities (such as audits) are needed during or after the change. Any assumptions made need to be tested.

8.5 Management of change from ECAA's perspective

ICAO Annex 19 does not explicitly require a State to establish formal activities for the management of change under the SSP. However, changes are an ever-present fact in the contemporary aviation system. When changes are introduced into a system, the established safety risk picture of the system will change. Changes may introduce hazards that may impact the effectiveness of existing defences. This could result in new risk or changes to existing safety risks. ECAA has chosen to adapt the management of change framework to evaluate and manage the impact of change in our aviation systems. To proactively identify the safety impact of change in the aviation system before they are implemented, and plan and execute proposed changes in a structured way.

There are two types of change – organizational change (for example, reallocation of responsibilities or restructuring within State aviation authorities) and operational change (for example, a change in airspace usage). The management of change under SSP should focus on those changes that could have a significant impact on the State's ability to fulfil its legal obligations (process change) and on the State safety management capabilities. Examples of changes with potential for significant impact to the safety risks of the State include, but are not limited to:

a. reorganization of State aviation authorities (including downsizing);
~~b.~~ changes in the SSP processes, including changes in methodology
c. changes in the regulatory environment, such as changes in existing State safety policies, programs, and regulations;
d. changes in the operational environment, such as introduction of new technologies, changes in infrastructure, equipment and services;
e. Rapidly changing industry (expanding, contracting, morphing) and its potential impact on the State oversight and performance monitoring capabilities.

8.6 Management of Change Form

The Management of Change – MOC must be documented using a dedicated form. The following form is an example that can be utilized.

<table>
<tr><td rowspan="3">Set by the entity requesting the change.</td><td>What is the change?</td><td colspan="2">Short brief of the change including time scale.</td></tr>
<tr><td>Who?</td><td colspan="2">Who is responsible of implementing the change? And
who needs to be involved initially?</td></tr>
<tr><td>Definition of the change.</td><td colspan="2">Define the major components or activities of the change.</td></tr>
<tr><td rowspan="10">Set by the safety department and MOC team.</td><td>MOC Reference No.</td><td></td><td>Date:</td></tr>
<tr><td rowspan="5">Identified Key Stakeholders
Consider who it affects: individuals, departments, organizations, authorities – who need to be notified of the change.</td><td>Within the organization</td><td></td></tr>
<tr><td>Service Providers</td><td></td></tr>
<tr><td>Within ECAA</td><td></td></tr>
<tr><td>Other Ministries Affected</td><td></td></tr>
<tr><td>Other States/ Organizations</td><td></td></tr>
<tr><td>Impact of Change</td><td colspan="2">Consider the impact on the organization, it’s processes and procedures, safety culture, regulatory requirements.</td></tr>
<tr><td>Action Plan</td><td colspan="2">Identify actions, responsibility, timelines</td></tr>
<tr><td>Deliverables</td><td colspan="2">How the change will be communicated</td></tr>
<tr><td>Assurance</td><td colspan="2">Monitoring & auditing</td></tr>
<tr><td></td><td>Safety Risk Assessment</td><td colspan="2">Related Safety Risk Assessment number and involved entities (risk assessment form must be attached – refer to chapter 2)</td></tr>
<tr><td colspan="4">Names and signatures of MOC team:</td></tr>
<tr><td colspan="4">The identified risks are considered tolerable, and change is acceptable to implement.</td></tr>
<tr><td colspan="2">Safety Manager Acceptance
Name/signature/date.</td><td colspan="2">Final Acceptance
Name/signature/date.</td></tr>
</table>

Form 2: Management of change

9. Data-driven decision-making

a. Safety risk decision-making tools and processes can be used to improve the repeatability and justification of decisions taken by organizational safety decision makers.

b. The primary purpose of safety analysis and safety reporting is to present a picture of the safety situation to decision makers which will empower them to make decisions based on the data presented. This is known as data-driven decision-making (also referred to as DDDM or D3M), a process-driven approach to decision-making.

c. Many aviation occurrences have resulted, at least in part, from poor management decisions, which can result in wasted money, labour and resources. The goal of safety decision makers is, in the short term, to minimize poor outcomes and achieve effective results, and in the long term, to contribute to the achievement of the organization's safety objectives.

d. Good decision-making is not easy. Decisions are often made without being able to consider all the relevant factors. Decision makers are also subject to bias that, whether consciously or not, affects decisions made.

e. The intent of D3M is not necessarily to make the "perfect" or ideal decision, but rather to make a good decision that achieves the short-term objective (about which the actual decision is being made) and works towards satisfying the longer-term objective (improved organizational safety performance).

f. Good decisions meet the following criteria:

- Transparent: the aviation community should know all the factors that influence a decision, including the process used to arrive at the decision.
- Accountable: the decision maker "owns" the decision and the associated outcomes. Clarity and transparency also bring about accountability – it's not easy to hide behind a decision where roles and responsibilities are defined in detail and where expectations associated with the new decision are clearly outlined.
- Fair and objective: the decision maker is not influenced by considerations that are not relevant (e.g. monetary gain or personal relationships).
- Justifiable and defendable: the decision can be shown to be reasonable given the inputs to the decision and the process followed.
- Reproducible: given the same information that was available to the decision maker, and using the same process, another person would arrive at the same decision.
- Executable: the decision is clear enough and that clarity minimizes uncertainty.

- Pragmatic: humans are creatures of emotion, which means eliminating emotion from a decision isn't feasible. However, what can be eliminated are self-serving emotional biases. A healthy question to ask in the face of difficult decisions is: whom does the decision serve?

9.1 Advantages of data-driven decision-making

a. D3M enables decision makers to focus on desired safety outcomes which align with the safety policy and objectives, and address various aspects related to change management, safety risk assessments, etc. D3M can assist with decisions related to:
   - changes that can be expected in statutory and regulatory requirements, emerging technologies or resources which may affect the organization;
   - potential changes in the needs and expectations of the aviation community and interested parties;
   - various priorities that need to be established and managed (e.g. strategic, operational, resources);
   - new skills, competencies, tools and even change management processes that may be needed to implement new decision(s);
   - risks that must be assessed, managed or minimized;
   - existing services, products and processes that currently provide the most value for interested parties; and
   - Evolving demands for new services, products and processes.

b. A structured approach such as D3M drives decision makers to decisions that are aligned with what the safety data is indicating. This requires trust in the safety performance management framework; if there is confidence in the SDCPS, there will be trust in any decisions derived from them.

9.2 Common challenges with data-driven decision-making

a. Implementing processes for data collection and analysis takes time and money, as well as expertise and skills that may not be readily available to the organisation. The appropriate amount of time and resources vested into the decision-making process needs to be carefully considered.

b. Factors to consider include the amount of money involved in the decision, the extent of the influence of the decision and the decision’s safety permanence. If the organisation does not understand what is involved, then the D3M process may become a source of frustration for safety decision makers, causing them to undermine or abandon the process.

c. Like SMS, D3M and safety performance management require a commitment to build and sustain the structures and skills necessary to maximize the opportunities presented by D3M.

d. It is harder to build trust in data than it is to trust an expert's input and opinion. Adopting the D3M approach requires a shift in the culture and mindset of the organisation where decisions are based upon reliable SPIs and the results of other safety data analysis.

e. The D3M process can be a critical tool that increases the value and effectiveness of the SMS. Effective safety management depends on making defendable and informed decisions. In turn, effective D3M relies on clearly defined safety data and information requirements, standards, collection methods, data management, analysis and sharing, all of which are components of a D3M process.

f. In some cases, the decision-making process may become bogged down in an attempt to find the "best possible" solution, also known as "analysis paralysis". Strategies that can be used to avoid this include:

- setting a deadline;
- having a well-defined scope and objective; and
- not aiming for a "perfect" decision or solution the first time, but rather coming up with a "suitable" and "practical" decision and improving further decisions.

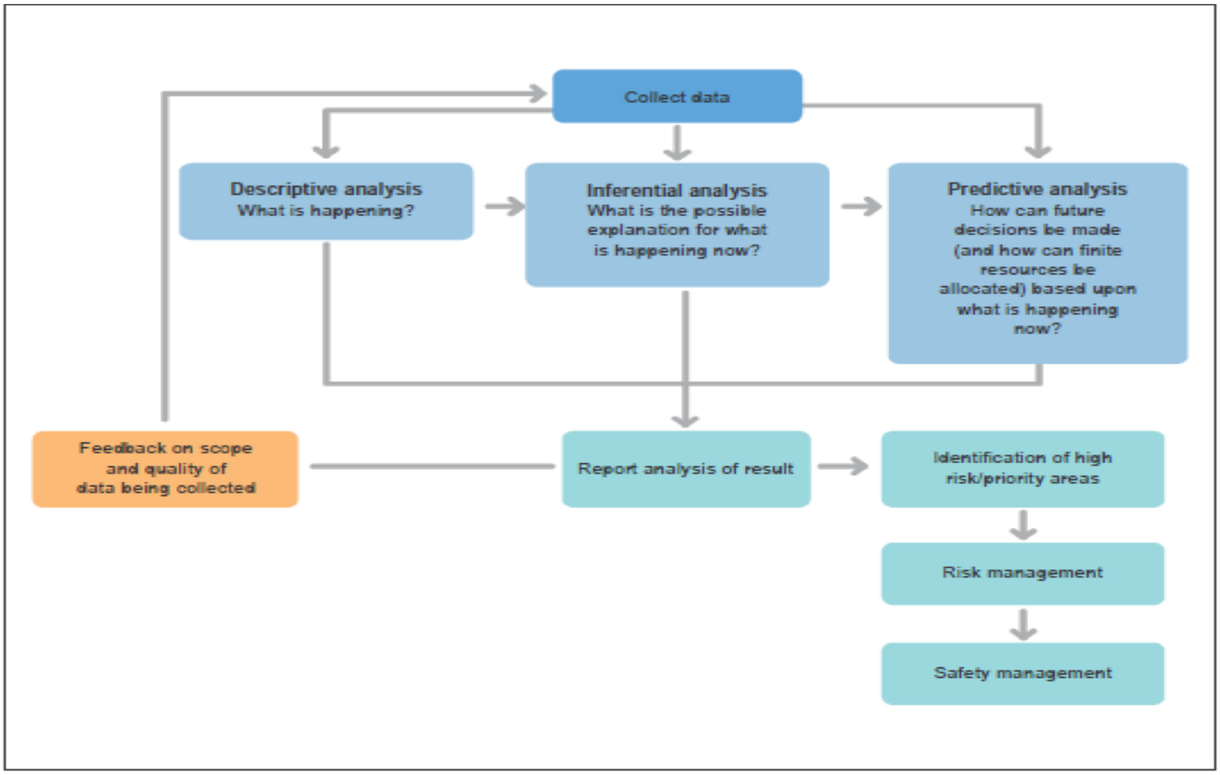

Figure 14: D3M integration with safety management

9.3 Data- Driven decision-making process

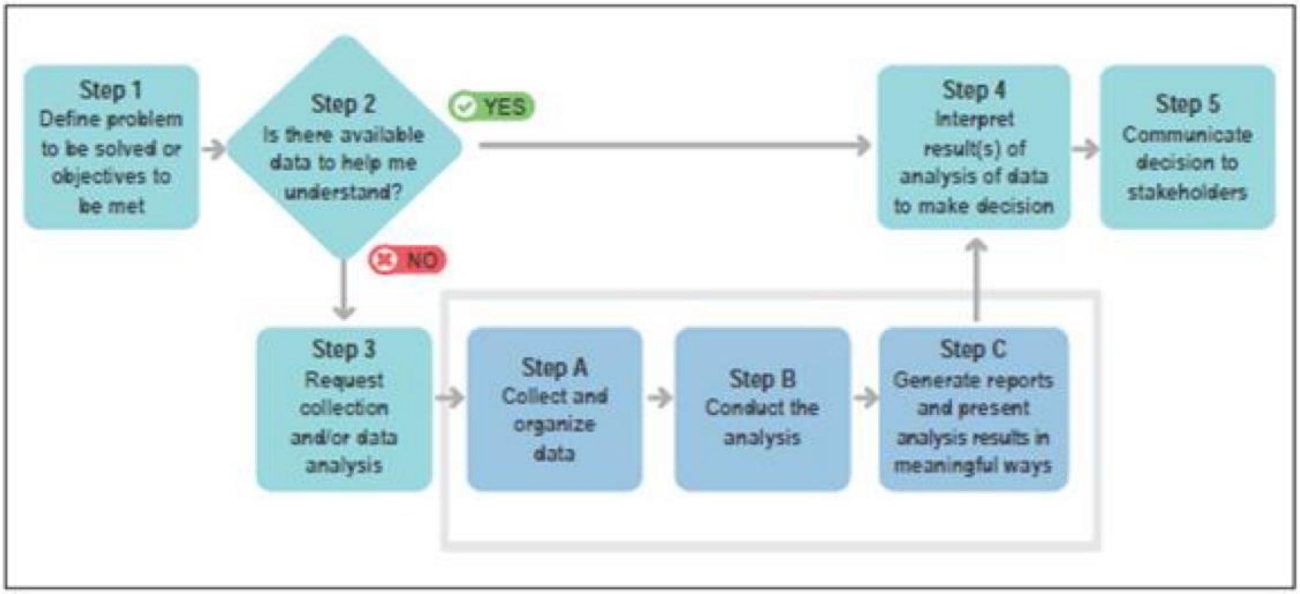

Figure 15: Data-driven decision-making phases

STEP 1 — defining the problem or objective

a. The first step in planning and establishing the D3M process is to define the problem that needs to be solved or the safety objective that must be achieved. What is the question that needs to be answered? What decision must the safety decision makers make? How will it align with the more strategic organizational objectives? In the process of defining the problem statement, decision makers should ask themselves the following questions:

- Does the collection and analysis of data support and relate to the organization's safety objectives or safety targets?
- Is the required data available? Or can it be obtained in a reasonable manner?
- Is it practical and feasible to collect and analyze the data?
- Are the required resources (people, equipment, software, funds) available?

b. In the safety management context, the main problem statements within the organisation are related to evaluating and selecting safety priorities – in alignment with the safety objectives – and establishing measures for safety risk mitigation.

STEP 2 — access to data to support the decision-making

a. The next step is to identify what data is needed to answer the problem (taking into account the provisions on information protection). No data is any more valuable than other data. Focus should be on whether the available data is appropriate to help answer and resolve the problem.

b. If the data required is available, proceed to step 4. If the right data is not available, the organisation will need to collect, store, analyze and present new safety data and safety information in meaningful ways.

STEP 3 — request data to support the decision-making

a. If the data isn't already available, the organisation needs to find ways of collecting it. This may mean establishing another SPI and perhaps aligned SPTs.

b. Establishing additional indicators can come at a cost. Once the cost is known, the organisation should estimate if the benefits outweigh those costs. The focus should primarily be on identifying, monitoring and measuring safety data that is needed to make effective data-driven safety decisions. If the costs outweigh the benefits, consider alternative data sources and/or indicators.

c. In the planning phase of the D3M process, the organisation must define what it wants to achieve by establishing the SPTs and SPIs and analyzing the data. Why does the organisation need to address the identified problem? What is a reasonable target? And how and where will safety decision makers use the results of data collection and analysis? Having a clear understanding of why the organisation needs to collect, analyze, share and exchange safety data and information is fundamental for any SDCPS.

d. The following elements combine to enable an organisation to identify trends, make informed decisions, evaluate the safety performance in relation to defined objectives, assess risks or fulfill its requirements:

- safety performance management - as the safety data and safety information governance framework;
- SDCPS - as the safety data collection and processing functionality; and
- D3M as a dependable decision-making process.

STEP 4 — interpret results of data analysis and make data-driven decision

a. The data gathered must be presented to the decision makers at the right time and in meaningful ways. The appropriateness and size of the data sets, the sophistication of the analytics and the skills of the data analysts will only be effective if the data is presented when needed and in formats that make it easy for decision makers to comprehend. The insights gained from the data should inform decision-making, and ultimately, improve safety performance.

b. There are many decision-making models available. Using an agreed and standardized approach will maximize consistency and effectiveness of the organization's data-driven decisions, most include the following steps:

- assemble a team/group with the necessary skills and experience (e.g. safety action group (SAG));
- clearly define the safety problem or objective and the context;
- review the organization's SPTs and safety objectives to ensure continued alignment;
- review and interpret the safety data to understand what it is indicating;
- consider and analyze the viable alternatives;

- consider the risk of feasible actions (or inactions);
- gain consensus among the decision-making group;
- commit to the data-driven decision and act on the decision (turning data into action); and
- Monitor and evaluate the outcomes.

STEP 5 — communicate the decision

For the safety decision to be effective, it needs to be communicated to stakeholders, these include:

a. staff required to enact the necessary actions;
b. person who reported the situation (if required);
c. all personnel, to ensure they are kept informed of safety improvements (safety promotion); and
d. Organizational knowledge managers to ensure the safety decision is incorporated into the learning of the organisation.

10. CONTINUOUS IMPROVEMENT OF THE SAFETY SYSTEM

1. Continuous improvement of the safety system requires management of two major components:
Maintenance – the objective of which is to maintain current technological, managerial, and operating standards, and
Improvement – This is aimed at improving current standards.
Under the maintenance function, the SM shall first establish a SMS that includes policies, rules, directives and standard operating procedures (SOPs) and then work towards ensuring that everybody follows SOPs. To achieve this, a combination of discipline and human resource development measures need to be employed.
Under the improvement function, management will be required to work continuously towards revising the current processes, in response to changing needs, operational environment or standards.

10.1 MANAGEMENT REVIEW

1. Formal management reviews of the SMS shall occur on a regular basis, at least once per year.
Preferably, there would be a biannual high level review process via the Safety
Committee to ensure:
• That the SMS continues to meet its core safety objectives;
• Safety performance is monitored against objectives; and
• Identified hazards are addressed in a timely and appropriate manner.
• The safety policy is being relevant and the need for update if required.

2. Following the formal management review, there shall be a periodic SAG review process at line management level, ideally quarterly meetings - to include, for example:

- Monitoring and reporting on safety management activities by SAG/Safety Committee;
- Measuring and reporting on safety management performance;
- Reporting on change management issues;
- Reporting on resource issues; and
- Reporting on safety training performance.

Note: For less complex organizations, this could be combined into a single process.

A safety review validates the SMS, confirming not only that people were doing what they were supposed to be doing, but also that their collective efforts have achieved the organization's safety objectives. Through regular review and evaluation, management can pursue continuous improvements in safety management and ensure that the SMS remains effective and relevant to the organization's operation.
Based on the SMS review, recommendations could include:

- Changed SMS objectives;
- Changed safety goals/targets;
- Improved SMS processes/procedures; and/or
- An implementation plan for improvement changes.

11. TRAINING AND EDUCATION

The key function of safety management training is to create awareness of the objectives of the SMS of the organization and the importance of developing a positive safety culture.
The SMS training shall focus on both the identification and reduction of hazards in the system, and the importance of the human component in achieving this.

11.1 TRAINING REQUIREMENTS

As part of the implementation of training in SMS, a Training Needs Analysis (TNA) shall be undertaken for all operational safety critical personnel in the organization.
Depending on the nature of the task, the complexity of safety management training required will vary from:
Safety management awareness training for all staff;
Training aimed at management's safety responsibilities;
Specific training for operational staff depending on organization's core business; and
Detailed training for safety specialists (such as the Safety Manager, Safety Representatives).

11.2 TRAINING DOCUMENTATION

1. Documentation shall be developed to support the SMS training plan, which includes:
A listing of the personnel (staff and third party personnel) who require SMS training;
A means of determining when each staff member is due to undergo a specific safety training course;
A method of determining the training provided to each member of staff;
Safety induction course/s for staff who have not previously been exposed to an SMS;
Recurrent safety course/s for all operational safety critical personnel; and
• A means of determining the effectiveness of the safety training provided. E.g. feedback questionnaire.
2. An SMS training register which incorporates individual training records shall be established and maintained. This may be incorporated in a centralized training record system.

11.3 INITIAL SAFETY TRAINING – ALL STAFF

1. All staff shall receive an appropriate induction course covering, for example:
HF elements supporting SMS;
Basic principles of safety management;
Corporate safety philosophy, safety policies and safety standards (including corporate approach to disciplinary action versus safety issues, integrated nature of safety management, risk management decision-making, safety culture, expected behaviors etc.);
Importance of complying with the safety policy and with the procedures that form part of the SMS;
Organization, roles and responsibilities of staff in relation to safety;
Corporate safety record, including areas of systemic weakness;
Corporate safety goals and objectives;

Corporate safety management programs (e.g. IRS, Internal Audit Program, LOSA, etc);
Requirement for ongoing internal assessment of organizational safety performance (e.g. employee surveys, safety audits and assessments);
Reporting reportable matters, hazardous events and potential hazards;
Lines of communication for safety matters;
Feedback and communication methods for the dissemination of safety information;
Safety awards programs (if applicable); and
Safety promotion and information dissemination.

11.4 SAFETY TRAINING FOR MANAGEMENT

It is essential that the management team understand the principles on which the SMS is based. Training shall ensure that managers and supervisors are familiar with:
The principles of the SMS;
Risk management process;
Their responsibilities and accountabilities for safety; and
Their legal liabilities.

11.5 SPECIALIST SAFETY TRAINING

1. A number of safety-related tasks require specially trained personnel. These tasks include:
Investigating safety events;
Monitoring safety performance;
Conducting risk assessments;
Managing safety databases; and
Performing safety audits.
2. It is important that staff performing these tasks receive adequate training in the special methods and techniques involved. Depending on the depth of training required and the level of existing expertise in safety management within the organization, it may be necessary to obtain assistance from external specialists in order to provide this training.

11.6 TRAINING FOR THE SAFETY MANAGER

The person selected as the SM needs to be familiar with most aspects of the organization, its activities, its management and staff.
Areas where the SM may require formal training include:
Familiarization with different types of operations in the organization.;
Understanding the role of human performance in accident causation and prevention;
Operation of the SMS;
Investigation of reportable matters and hazardous events;
Crisis management and emergency response planning;
Safety promotion;
Communication skills;
Computer skills such as word-processing, spreadsheets and database management; and
Specialized training or familiarization as required in specific fields based on organization core business and its operation.

11.7 SAFETY TRAINING FOR OPERATIONAL SAFETY CRITICAL PERSONNEL

In addition to the corporate induction training outlined above, staff engaged directly in operations require more specific safety training in relation to:
Procedures for reporting reportable matters;
Procedures for hazard reporting;
Specific safety initiatives;
Seasonal safety hazards and procedures (weather-related operations, etc.); and

Emergency procedures.

11.8 DELIVERY METHODS

The SM, in consultation with the training manager shall determine the best method of delivery that fits the training requirements considering the size and complexity of the organization.
Supporting education material could be delivered via:
An intranet system;
An internal document circulation system;
A safety library (centrally located);
Summaries (probably by the SM) notifying staff of the receipt of such information; and/or
A range of available safety posters strategically situated in workplace areas.

12. SAFETY PROMOTION AND COMMUNICATION

An ongoing program of safety promotion and communication shall ensure that the organization's staff benefit from safety lessons learned and continue to understand the organization's SMS. Safety promotion is linked closely with safety training and the dissemination of safety information. It refers to those activities which the organization carries out in order to ensure that their staff understands:

- Why SMS procedures are in place;
- What safety management means; and
- Why particular safety actions are taken, etc.

12.1 SAFETY PROMOTION AND SAFETY CULTURE

Safety promotion provides a mechanism through which lessons learned from safety event investigations and other safety related activities are made available to all affected staff. It also provides a means of encouraging the development of a positive safety culture and ensuring that, once established, the safety culture is maintained.
While it is important that personnel are kept well informed, they shall see evidence of the commitment of management to safety. The attitudes and actions of management will therefore be a significant factor in the promotion of safe work practices and the development of a positive safety culture.
Safety promotion activities are the primary means by which safety issues are communicated within the organization. These issues may be addressed through staff training programs or less formal mechanisms.
In order to propose solutions to actual or potential operational safety issues, staff shall be aware of the existing hazards identified and the corrective actions that have already been implemented. The safety promotion activities and training programs shall therefore:
Address the rationale behind the introduction of new procedures; and
Ensure the main focus is on 'what is going on within the organization'.
5. If a safety message is to be learned and retained, the recipient first has to be positively motivated. Unless this is achieved, much well-intended effort will be wasted. Propaganda which merely tells people to avoid making errors, to take more care, etc. is largely ineffective as it does not provide anything substantial to which
individuals can relate. This approach has sometimes been described as the 'bumper sticker' approach to safety.
6. Safety topics shall be selected for promotional campaigns based on their potential to control and reduce losses. Selection shall therefore be based on:
The experience of past events or near misses;
Hazards/potential hazards identified by hazard analysis; and
Observations from routine internal safety audits.
7. The SM/Department Managers/Safety Representatives shall be involved in encouraging staff to submit suggestions for promotional campaigns.

12.2 METHODS OF DISSEMINATION

1. The target audience, (employees) tend to be a 'critical audience', therefore the dissemination of information needs to be done well otherwise it will not be effective. All methods of dissemination – the spoken and written word, posters, videos, slide presentations, etc., require talent, skill and experience to be effective.

2. Once a decision has been made to disseminate safety information, a number of important factors shall be considered, including:

The audience: The message needs to be expressed in terms and vernacular that reflect the knowledge and culture of the audience.

The response: What is expected to be accomplished?

Media: Consider which media is the most effective. For example, print, web, multimedia, etc.

The style of presentation: This may involve the use of humor, graphics, photography and other attention-getting techniques.

3. The organizational safety promotion program shall be based on several different communication methods for reasons of flexibility and cost. Typical methods available are:

Spoken word: Perhaps the most effective method, especially if supplemented with a visual presentation. However, it is also the most expensive method, consuming time and effort to assemble the audience, aids and equipment.

Written word: The most popular method because of speed and economy, the printed safety promotion material also competes for attention with considerable amounts of other printed material.

Videos: Videos while offering advantages of dynamic imagery and sound to reinforce particular safety messages efficiently, also have two main limitations: expense of production and the need for special equipment for viewing..

Electronic media: Use of the Internet offers significant potential for improvement in the promotion of safety, as even small companies can establish and maintain a website to disseminate safety information. This may also include an electronic newsletter (eNewsletter) or podcasting to distribute key safety messages in a timely manner. This medium may be particularly effective in communicating with younger generations.

12.3 THE ESSENCE OF SAFETY MANAGEMENT

1. Safety should be actively managed from the very top of an organization. Safety management shall be seen as an integral strategic aspect of normal business management, recognizing the high priority attached by the organization to safety.

2. An organization's commitment to safety management is typically evidenced by the following:

- A demonstrable Board/CEO level of commitment to an effective formal Safety Management System shall exist;
- The safety contributions of staff shall be encouraged;
- Companies establishing an SMS need to take a pragmatic approach, building where possible on existing procedures and practices;
- A fully-fledged SMS is a formalized, organization-wide system. Established at the corporate level, the SMS then devolves out into the individual departments of the Organization. Flight Operations, Engineering and Maintenance, Ground Operations and all other departments whose activities contribute to the operator's safety performance will have their own processes and procedures under the umbrella of the corporate SMS;
- Where safety sensitive functions of the operator are outsourced (e.g. maintenance, ground handling), contractual agreements shall identify the need for an equivalent, auditable SMS in the supplier.

APPENDICES

APPENDIX 1

BENEFITS OF SAFETY MANAGEMENT SYSTEM

THE BENEFITS OF AN SMS

To improve on existing levels of aviation safety in the light of the continuing growth of the industry, additional measures are needed. One such measure is to encourage operators to develop and implement their own SMS that fits the size and complexity of their operation.

An SMS is as important to business survival of the organization as financial management. The implementation of an SMS shall lead to achievement of one of civil aviation's key goals; enhanced safety performance through the identification of hazards and reducing these hazards until they are ALARP. An effective SMS may produce the following benefits:

Reduction in incidents and accidents (occurrences);

Reduced direct and indirect costs;

Safety recognition by the travelling public;

Reduced insurance premiums; and

Proof of diligence in the event of legal or regulatory safety investigations.

SMS MAKE ECONOMIC SENSE

Few organizations can survive the economic consequences of a major accident.

Hence, there is a strong economic and safety case for developing and implementing an SMS. There are typically three types of costs associated with an accident or incident: direct, indirect and industry/social costs.

DIRECT COSTS

There are obvious on-the-spot costs that are easily measured. They mostly relate to physical damage, and include things like rectifying, replacing or compensating for injuries, aircraft equipment and property damage.

INDIRECT COSTS

Indirect costs are usually higher than direct costs, but are sometimes not as obvious and are often delayed. Even a minor incident will incur a range of indirect costs.

Indirect costs include:

Loss of business and damage to the reputation of the organization: Many large organizations will not charter an aircraft from an operator with a questionable safety record or one without a documented SMS in place.

Legal and damage claims: While organizations can take out insurance for public liability, it is hard to cover the costs of lost time handling legal actions and damage claims.

An organization shall take action to protect its interests, and to do so will cost both time and money.

Surplus spares, tools and training: If organizations have a spares inventory and people trained for a one-of-a -kind aircraft that is involved in an accident, the spares and training become surplus overnight. In many cases, the sale value of the spares is below the purchase cost.

Increased insurance premiums: An accident may push organizations into a higher risk category for insurance purposes, and therefore could result in increased premiums. The implementation of an SMS could help an operator negotiate a lower premium.

Loss of staff productivity: If people injured in an accident at work are unable to perform their normal duties, under Australian law they shall still be paid. They will also need to be replaced in the short term – again a substantial cost in terms of wages (and possibly training) as well as management time.

Aircraft recovery and clean-up: This is often an uninsured cost and is usually met by the operator.

Cost of internal investigations: This is a cost borne by the operator and is uninsurable.
Loss of use of equipment: Loss of an aircraft that is not replaced immediately means that the operator will lose business or jeopardize existing contracts.
Cost of short-term replacement equipment: Short-term hire is usually far above the cost of operating organization-owned equipment.
Consider the potential savings by reducing these typically uninsured costs. The simplest way is not to have an occurrence in the first place.

UNDERSTANDING A SAFETY MANAGEMENT SYSTEM

A SMS can be compared with a financial management system as a method of systematically managing a vital business function.
The features of a financial management system are well recognized:
Financial targets are set;
Budgets are prepared; and
Levels of authority are established, etc.
The formalities associated with a financial management system include:
'checks and balances'; and
The whole system includes a monitoring element so that corrections can be made if performance falls short of set targets.
Financial management is central to an organization's continued success and viability. The outputs from a financial management system are usually felt across the organization. Financial risks are still taken but financial control procedures shall ensure that there are no 'business surprises'. If there are, it can be disastrous for a small organization. For the larger organization, unwelcome media attention usually follows an unexpected loss.
An aircraft accident is also 'an unexpected loss' and not one that any organization in the aviation industry wishes to suffer. It shall be apparent that the management of safety shall attract at least the same focus as that of finance. The adoption of an effective SMS will provide this focus.

APPENDIX 2

THE MANAGEMENT SYSTEM