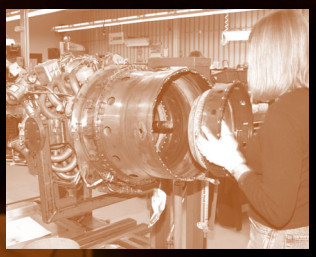
Transport Canada Transports Canada

# SAFETY MANAGEMENT SYSTEMS

## FOR FLIGHT OPERATIONS AND AIRCRAFT MAINTENANCE ORGANIZATIONS



**A guide to implementation**

Prepared by the

Commercial and Business Aviation Branch and the Aircraft Maintenance and Manufacturing Branch

TP 13881 E
03/2002

Canada

# Regulatory References

This guide applies to proposed regulatory changes applicable to:

CAR 573.09(11)
CAR 700.xx
CAR 720.xx
CAR 705.07(2)(c)
CAR 725.07(2)(a)(ii)
CAR 725.07(3)
CAR 725.124(5)(o)
CAR 725.135(oo)
CAR 706.07
CAR 726.07

# Acknowledgement

This guidance material was written by the staff
of the Commercial and Business Aviation Branch and
Maintenance and Manufacturing Branch
of Transport Canada Civil Aviation.

Transport Canada wishes to thank the following individuals,
companies and regulatory authorities for
their assistance in developing this material:

* Professor James Reason, University of Manchester

* Operating Standards Division, the United Kingdom Civil Aviation Authority

* Clifford Edwards, The Royal Dutch/Shell Group of Companies

* Air Canada

* Boeing Commercial Airplane Group

* Safety Services Branch, Transport Canada Civil Aviation

This document is a living document and will be revised at intervals
to take into account changes in regulations, feedback from industry and
recognized best practice. Updates will be noted via the Transport Canada
Civil Aviation website.

# Contents

# Contents

# Introduction

## [ Foreword ]

In Canada we enjoy an enviable aviation safety record and our Civil Aviation safety program has been cited by the International Civil Aviation Organization as one of the best in the world. However, with the predicted increase in air transportation and the probability that this will bring with it an attendant increase in the accident rate, we clearly cannot afford to maintain the status quo. To remain successful we must constantly challenge ourselves to improve the safety standard and work towards achieving a positive shift in the accident rate.

In response to this challenge, the Commercial and Business Aviation Branch and the Aircraft Maintenance and Manufacturing Branch have promulgated amendments to the *Canadian Aviation Regulations* (CAR) requiring the establishment of safety management systems (SMS) in certain types of operations.[i] This guidance material provides clarification regarding the intent and application of the proposed regulatory requirements. It is designed as a practical guide for the development and implementation of a safety management system within flight and maintenance operations.

The following information is not intended as a prescriptive formula for the development of a company's safety management system. The material contained herein is for explanatory purposes only. Where existing systems or components have been referenced, the example is used for the purpose of clarity and to demonstrate that there are existing systems available. It is not the intention of the authors to advocate that any one particular system be used. In keeping with performance based regulations, this guide is intended to provide details of the various SMS regulatory requirements and to offer examples of possible ways these elements can be enabled.

# Introduction

## What is a safety Management System?

A safety management system is a systematic, explicit and comprehensive process for the management of safety risks, that integrates operations and technical systems with financial and human resource management, for all activities related to an air operator or an approved maintenance organization's certificate.

A safety management system is a business-like approach to safety. In common with all management systems a safety management system provides for goal setting, planning, and measuring performance. It concerns itself with organizational safety rather than the conventional health and safety at work concerns. A company's SMS defines how it intends the management of air safety to be conducted as an integral part of the company's business management activities. A Safety Management System is woven into the fabric of an organization. It becomes part of the culture; the way people do their jobs.

The organizational structures and activities that make up a safety management system are found throughout an organization. Every employee in every department contributes to the safety health of the organization. In some departments safety management activity will be more visible than in others, but the system must be integrated into "the way things are done" throughout the establishment. This will be achieved by the implementation and continuing support of a safety program based on a coherent policy, that leads to well designed procedures.

# Introduction

## Key Generic Features of the SMS Approach

There is no definitive meaning attached to the term "safety management system", every organization, and industry, for that matter, has its own interpretation of what it is. From the Civil Aviation perspective there are five features that characterise a safety management system. These are:

- A comprehensive systematic approach to the management of aviation safety within the aircraft operating company, including the interfaces between the company and its suppliers, sub-contractors and business partners.
- A principal focus on the hazards of the business and their effects upon those activities critical to safety.
- The full integration of safety considerations into the business, via the application of management controls to all aspects of the business processes critical to safety.
- The use of active monitoring and audit processes to validate that the necessary controls identified through the hazard management process are in place and to ensure continuing active commitment to safety.
- The use of Quality Assurance principles, including improvement and feedback mechanisms.

In searching for ways to enable the aforementioned features, an organization may choose to utilize a commercial "off-the-shelf" system. Whilst this might be appropriate for some companies, the program should be tailored to meet the requirements of the individual organization rather than assuming that one size fits all. Attention should also be given to the linkages between the individual components; they should be linked in a systematic way, rather than appearing to be stand alone units.[ii]

## Key Features To The Regulatory Requirements

- A safety management plan;
- Clear authorities, responsibilities and accountabilities for safety at all levels within the organization.
- Occurrence and Hazard reporting,
- Data collection procedures
- Incident analysis
- Hazard identification and risk management
- Documentation
- Safety management training requirements
- Emergency response plan

# Introduction

## Why Bother?

It's often said that safety makes economic sense. Unless a company experiences a loss, or critically assesses both the direct and indirect costs of an occurrence, it is often difficult to relate to this statement. The direct costs are usually easy to quantify, they include damage to the aircraft, compensation for injuries and damage to property and are usually settled through an insurance claim.

The indirect costs are a little more difficult to assess, these are often not covered or fully reimbursed by the company's insurance and the impact is often delayed. This includes items such as:

- Loss of business and reputation;
- Legal fees and damage claims;
- Medical cost not covered by work man's compensation;
- Cost of lost use of equipment (loss of income);
- Time lost by injured person(s) and cost of replacement workers;
- Increased insurance premiums;
- Aircraft recovery and clean-up;
- Fines.

The economic argument is even more salient when one considers the following figures produced by the Boeing Aircraft Corporation. In 1996, Boeing estimated the average cost in U.S. dollars of the following:

- In-flight shutdown $500, 000
- Flight cancellation $ 50, 000
- Flight delay per hour $ 10, 000

The cost of implementing and maintaining a safety management system becomes less significant and well worth the investment when contrasted with the cost of doing nothing.

# SAFETY MANAGEMENT SYSTEM COMPONENTS

## safety management plan

In order to implement an effective safety management system it is necessary to define what the organization's safety objectives are, what form the system will take and who will assume responsibility for the system. Essentially, this involves defining the organization's philosophical approach to integrating safety as a primary business function.

# Safety Management System Components

## Safety Management Plan

An operator's safety managment plan should contain three principle things:

1. *A definition of the fundamental approach a company will adopt for managing safety within their organization. This includes a safety policy that clearly defines what the company's philosophical approach to safety and the performance goals it has established for itself.*

2. *Clearly defined roles and responsibilities for all personnel involved in safety.*

3. *A description of the safety management system components.*

### Safety Policy

An operator's safety policy should clearly state the company's intentions, management principles and aspirations for continuous improvements in the safety level. This can be achieved through documented policies describing what organizational processes and structures it will use to achieve the safety management system. This should also contain a statement outlining the company's objectives and the outcomes it hopes to achieve through its safety management system.

It is recommended that the safety policy include a description of each element of the system as required by the *Canadian Aviation Regulations*. This would resemble the description of other systems as detailed in a maintenance control manual (MCM), maintenance policy manual (MPM) or a company operations manual (COM).

# Safety Management System Components

***Safety Objectives***

***Mission Statement*** > The safety objectives of the organization should provide a starting point for the company's safety policy. It should be accompanied by top level statement regarding the company's commitment to achieving improvements in safety and should be widely publicized and distributed. For example, Transport Canada's mission is to *develop and administer policies, regulations and services for the best possible transportation system for Canada and Canadians - one that is safe, efficient, affordable, integrated and environmentally friendly.*

A similar type of pronouncement should be made by the organization. A typical statement outlining the objectives of a safety management program could read:

*The safety management program aims to continually improve the safety of ABC airline's flight operations by identifying, eliminating or mitigating any deficiencies in conditions, policies and procedures, and by ensuring that staff consider at all times the safety implications of their own actions, and those of their colleagues.*

It is important to ensure that the stated objectives are achievable and clearly define the limits within which the company will operate. They should be unambiguous, well documented, readily accessible and should be reviewed on a regular basis.

*Safety Goals*

Goal setting is vital to an organization's performance. All organizations have their own ways of setting and expressing goals. In some organizations the goals are not stated very explicitly. Other organizations set goals formally and document the process. Regardless of how management goals are set, few organizations are good at developing safety goals. The most common weakness in setting safety goals is focusing on outcomes. This usually means counting accidents, but we know that safe companies can have accidents while less safe operations can be lucky and avoid accidents. Although the ultimate goal is 'no accidents', there are more precise and useful ways of measuring safety, especially in a safe system, than counting accidents.

It is a never-ending struggle to identify and eliminate or control hazards. We will never run out of things to do to make the system safer. Sound management requires that we identify them, decide how to achieve them, and hold ourselves accountable for achieving them. Risk management procedures can help managers decide where the greatest risks are and help set priorities. Sound safety goal setting concentrates on identifying systemic weaknesses and accident precursors, and either eliminating or mitigating them.

***Safety Performance Measurement***

The safety performance of the operation needs to be monitored, proactively and reactively, to ensure that the key safety goals continue to be achieved. Monitoring by

audit forms a key element of this activity and should include both a quantitative and qualitative assessment. The results of all safety performance monitoring should be documented and used as feedback to improve the system.

It is widely acknowledged that accident rates are not an effective measurement of safety.[iii] They are purely reactive and are only effective when the accident rates are high enough. Furthermore, relying on accident rates as a safety performance measure can create a false impression; an assumption that nil accidents indicate the organization is safe. In reality, there will always be latent conditions within the system that might, if left unattended, lead to an accident. A more effective way to measure safety might be to address the individual areas of concern. For example, an assessment of the improvements made to work procedures might be far more effective than measuring accident rates.

Performance measurement should be integrally linked to the companies stated overall objectives. This requires two things: the development and implementation of a coherent set of safety performance measures; and, a clear linkage between the safety performance measures and the organization's business performance measures. This shows a clear relationship between the company's safety objectives and the achievement of its organizational and business goals.[iv] A simple example is given in the table below.

| Objective | | Safety Performance measures[v] |
|---|---|---|
| **Business Objective:** | Reduce Costs | Reduction in insurance rates |
| **Safety Objective:** | Decrease number and severity of hangar incidents | • Total number of event<br>• Number of damage-only events<br>• Number of near-miss accidents<br>• Lessons learned from event analyses<br>• Number of corrective action plans developed and implemented |

***Non-Punitive Disciplinary Policies***

The company should strive to develop a non-punitive, disciplinary policy as part of its safety management system. Employees are more likely to report events and cooperate in an investigation when some level of immunity from disciplinary action is offered. When considering the application of a non-punitive disciplinary policy, the company might want to consider whether the event involved willful intent on the part of the individual involved and the attendant circumstances. For example, has the individual been involved in an event like this before and did the individual participate fully in the investigation.

A typical disciplinary policy might include the following statements:

- *Safe flight operations are ABC airlines most important commitment. To ensure that commitment, it is imperative that we have uninhibited reporting of all incidents and occurrences that compromise the safety of our operations.*
- *We ask that each employee accept the responsibility to communicate any information that may affect the integrity of flight safety. Employees must be assured that this communication will never result in reprisal, thus allowing a timely, uninhibited flow of information to occur.*
- *All employees are advised that ABC Airlines will not initiate disciplinary actions against an employee who discloses an inci dent or occurrence involving flight safety. This policy cannot apply to criminal, international or regulatory infractions.*
- *ABC Airlines has developed Safety Reports to be used by all employees for reporting information concerning flight safety. They are designed to protect the identity of the employee who provides information. These forms are readily available in your work area.*
- *We urge all employees to use this program to help ABC Airlines continue its leader ship in providing our customers and employees with the highest level of flight safety.*[vi]

A non-punitive approach to discipline does not preclude the use of a general progressive approach to discipline in cases where an employee is involved in similar, recurrent events. This might involve the following steps:

- First offense-Verbal warning
- Second offense-Formal written warning
- Third offense-final written warning (may include suspension)
- Fourth offense-Termination.

Written warnings can remain active for one year, after which a letter of recognition for positive change will be written and attached to the formal written warning in the personnel file by the individual's direct supervisor.

## Roles And Responsibilities

An organization should document and define the roles and responsibilities of all personnel in the safety management system. Furthermore, a statement should be made attesting that everyone has a responsibility for safety. This includes a commitment on the part of top management to be accountable for safety within the company. The dedication and involvement of top management towards safety and safety practices should be clearly visible. It is important that senior management is seen to provide a strong and active leadership role in the safety management system. This includes a commitment to provide the resources necessary to attain the strategic safety objectives established by the organization. The following is a list of activities that demonstrate top management's active commitment to

SMS, these include:

- Putting safety matters on the agenda of meetings, from the Board level downwards
- Being actively involved in safety activities and reviews at both local and remote sites
- Allocating the necessary resources, such as time and money, to safety matters
- Setting personal examples in day-to-day work
- Receiving and acting on safety reports submitted by employees
- Promoting safety topics in company publications.[vii]

The ideal safety culture embodies a spirit of openess and should also demonstrate support for staff and the systems of work. Senior management should be accessible and dedicated to making the changes necessary to enhance safety. They should be available to discuss emerging trends and safety issues identified through the System. A positive safety culture reinforces the entire safety achievement of the company and is critical to its success.

***Documentation Of Roles And Responsibilities***

The following guidelines highlight some of the key areas that should be documented:

- The safety responsibilities for each position and task
- The competencies required for each position
- The line of responsibility for ensuring all staff are competent and trained for their duties and for ensuring that train ing takes place, and
- The responsibilities of the manager responsible for externally supplied services. All unapproved contracting companies should meet the company's own SMS standards or an equivalent to them.

Figure I demonstrates one possible organizational scenario that would meet the organizational requirements and reporting relationships, as detailed in the approved notice of proposed amendments to the Canadian Aviation Regulations. The solid lines represent reporting relationships, whilst the broken line represents lines of communication.

Figure I: **Sample SMS Organogram**


This diagram shows where existing organizational bodies, such as the safety office, fit into the safety management system. To put this in today's context, in many organizations the safety office is considered to be a stand-alone entity equal to any other operational body. The functions specific to the safety management system are concentrated within this silo and are not distributed throughout the organization. Safety management is a business function comparable to any other function in the operation. In the same way that financial considerations are integrated into the organization, so should safety management considerations. In SMS, safety is considered to be everyone's responsibility and is not unique to the safety office.

***Individual Roles and Responsibilities***

The effective management of safety requires a clear delineation of all lines of authority within the organization. There should be a clear understanding of the accountability, responsibility and authority of all individuals involved in the system. An effort should be made to document and distribute the organogram throughout the company,

thereby promoting a common understanding of everyone's role in the safety management system. Figure I offers an example of how the lines of responsibility might be established. In this diagram the safety management system functions are performed by the quality assurance manager and the flight safety officer. In other organsiations, these functions might be dispersed throughout the technical or operational area, thereby providing a safety management system that is fully integrated into all line activities.

Management's role, responsibilities and accountabilities for the SMS and organizational deficiencies identified through the system should be well defined and the lines of authority clearly understood. As stated in the proposed regulatory requirements, these requirements include:

- The accountable executive is responsible for establishing and maintaining the safety management system;
- The functional area, that is the area of direct responsibility, maintenance or flight operations for example, is responsible for the safety program;
- Everyone is responsible for safety in the organization. This includes operations and maintenance personnel as well as individuals in other non-technical areas such as marketing and customer service;
- SMS specific functions must be exercised by an individual employed within the operational area in which he/she works. The exception to this rule is in cases where the size of the operation, reasonably precludes the application of dedicated resources to this activity;
- The person responsible for the affected functional area, the Director of Operations or Maintenance for example, is accountable for determining and imple menting appropriate comprehensive corrective actions. The reason for this is threefold:

  > The functional director, that is the person with direct line responsibility for the affected area, is directly involved in the decision making process. In most cases, he/she has the knowledge and expertise to recommend effective corrective and preventative actions and has the authority to assign the appropriate resources where required.

  > The functional director must assume responsibility for safety within his/her own area of responsibility. In this way he/she is involved in the "safety" process and is accountable for issues that arise in his/her functional area.

  > A quality assurance function is provided because event investigations and corrective actions, are separate activities. This eliminates the potential for conflict of interest because the person who identifies the problem is not the person who determines what the corrective action is. This does not preclude discussion of safety findings within a safety committee environment; however, the final say on any remedial action resides with the responsible functional director.

# Safety Management System Components

The development of a positive safety culture is predicated on the involvement of all facets of the organization in the safety process. The objective of this requirement, therefore, is to involve all parties in the safety management system, thereby fostering a company wide commitment to safety management.

***Delegation Of Tasks To Effectively Operate the Safety Management System***

To ensure that the SMS operates effectively it is essential that the following tasks be delegated to company personnel as appropriate. The roles, responsibilities and accountabilities of each individual/position should be well defined and the lines of responsibility clearly understood. As stated in the proposed regulatory requirements, he/she is responsible for:

- Establishing and maintaining a report ing system to collect safety related data
- Conducting hazard identification and risk management analysis
- Conducting periodic reviews to deter mine the effectiveness of the program
- Developing and evaluating the results of safety initiatives
- Monitoring industry safety concerns that could affect the organization
- Determining the adequacy of training programs, and
- Advising reporters of the results of event analyses.

***Safety Office***

There is no regulatory requirement to have a safety office. It is recognized, however, that larger organizations may choose to employ a safety office as a consultative or administrative body. In these cases, the safety office may act as a repository for safety related reports and information, occupational health and safety issues, as well as provide risk assessment and data analysis expertise to the functional managers. The safety office may provide data directly to the accountable executive regarding major safety issues identified by the system. It should be noted that the responsibility for informing the accountable executive of major safety deficiencies identified within their responsible area remains with the appropriate functional director. Furthermore, whilst the safety office may be involved in discussions regarding possible corrective action, it is the responsibility of the functional director to determine what the corrective action will be and to ensure the outcome is monitored and evaluated. The safety office does not have the authority to overturn operational decisions related to safety issues identified by the system or the safety management system itself.

***Safety Committee***

The use of a safety committee in larger, more complex organizations can provide benefits to the organization. Safety committees provide a forum for discussing safety related issues from a cross-functional perspective and may lead to the inclusion of issues that look at safety from a broader viewpoint. Conventional health and safety

at work concerns are a good example of this. Frequently, safety issues are not limited to one specific area and require inputs and expertise from a variety of different fields. Safety committees provide a forum for this dialogue and can be utilized to assess the effectiveness of the system from a "big picture" perspective. They also provide a means by which safety achievements can be reviewed and safety information broadcast.

The safety office may coordinate and provide administrative assistance to the safety committee. It can also be a stand-alone entity; meaning, one can exist without the other. The accountable executive could be the chair of this committee and all parts of the organization must be represented. This does not preclude the existence of sub-committees with specific areas of responsibility.

***Employee Involvement In The Development And Implementation Of The System***

A successful safety management system requires a focused sense of ownership throughout the system. Whilst it is essential that top management commit to doing whatever it takes to improve safety, it is equally important that all employees feel they have a system that values their input and is responsive to their contributions and ideas. In order to achieve this, all employees should have the opportunity to contribute to the development and implementation of the safety management system. Employees are ideally placed to understand the most efficient and appropriate safety management mechanisms for their work environment. Their involvement in the decision-making process not only fosters ownership of the system, it also promotes a positive safety culture.

In effect, the organization is striving to create a shared vision. As such, it is not sufficient for the accountable executive to make a safety policy statement outlining what the organization is committing to, without first acquiring feedback from all employees. The problem with top down vision statements is that they reflect management's vision and do not always build on the individual's personal vision. The result can be an authoritarian statement that does not inspire the achievement of a common goal - in this case safety. When people truly share a common vision they are united in a common aspiration, they have a common identity and they have ownership in the system.[viii]

## Description of System Components

The safety management system plan must include a description of each component of the system and should clearly describe the interrelationships between each of these components. This is essential if company personnel, and the regulator, are to understand how the whole system is integrated. The documentary requirements for this element are discussed under the documentation section.

# documentation

## [documentation]

Up to date documentation is essential if the company is to operate in a safe and efficient manner in accordance with current aviation safety regulations, standards and exemptions. For this reason an operator's Safety Management System must address the four following documentary requirements.

- *The identification of applicable aviation safety regulations*
- *Consolidated documentation describing the systems for each component of the safety management system.*
- *The implementation of changes to company documentation required by changes to aviation safety regulations, standards and exemptions.*
- *The maintenance of current, applicable and effective documentation.*

The following paragraphs provide detail as to how this might be accomplished.

### Identification of Applicable Aviation Safety Regulations, Standards and Exemptions

The company must have a process for documenting the regulations, standards and exemptions by which it is regulated for the various activities it conducts. This documentation may reside in the company operations, maintenance policy manual, maintenance control manual or the company safety management program documentation as appropriate, but must be available to employees. The statement could be as simple as:

*This company is governed by the following aviation safety regulations, standards and exemptions…(list as appropriate).*

The company must provide employees with access to all pertinent technical and regulatory information. This can be accomplished by having appropriate documentation on site, or by having access to the information through other appropriate means that provides the same accessibility as on site documentation.

## Documentation Describing System Components

The requirement for a description of each component of the safety management system was discussed as an element of the safety management plan. Consolidated documentation describing each component of the system is essential if company personnel, and the regulator, are to understand how the whole system is integrated.

For air operators, this documentation must reside in the company operations manual. Current regulation requires that air operators have a description of their operational control systems. The requirement for safety management system components could be addressed in the same fashion.

## Implementing Changes To Company Documentation

When changes to company documentation are required the company must have a process in place to ensure these changes are implemented.

It is recommended that the process used identify the individual responsible for the activity and the procedure to be followed. The process should provide for early identification of amendments. This will allow the company to be proactive in addressing any required changes to company documents and procedures.

This process could be as simple as designating an individual with the appropriate knowledge as responsible for receiving any incoming correspondence of a regulatory nature i.e. CBAACs, AIP amendments, Airworthiness Notices, etc. These would be reviewed to identify any changes pertinent to the company operation. If changes were necessary the process would allow for a trigger to commence the amendment process to company documentation as necessary.

## Maintenance Of Current, Applicable And Effective Documentation

It is the company's responsibility to maintain current regulatory and company documentation. This includes regulations, standards and exemptions as well as the COM, the MPM and the MCM. Any changes in SMS documentation, if this is contained in a stand-alone manual, should also be included.

Activities that cause company documentation to become outdated are mainly due to changes within the company itself or changes to regulatory information. To address these occurrences the company must have processes in place to:

- Identify any changes within the organization that could affect company documentation.
- Periodically review regulatory information to ensure the most current information is available.
- Periodically review documentation such as the Maintenance Policy Manual, Company Operations Manual or Safety

Management Program documentation to ensure compliance with current regulations.

A process to address changes within the organization could consist of a trigger to review company documentation at any time a change to the company operations or structure occurs or is planned to occur.

Specific events or dates could trigger processes for periodic reviews of regulatory information and company documentation. These dates could be selected to augment other company activities.

# 3 safety oversight

## Safety Oversight

Safety oversight is fundamental to the safety management process. A principal tenet of safety management policies, principles and procedures requires an organization to critically review its existing operations, proposed operational changes and additions or replacements, for their safety significance. This is achieved through two principal means:

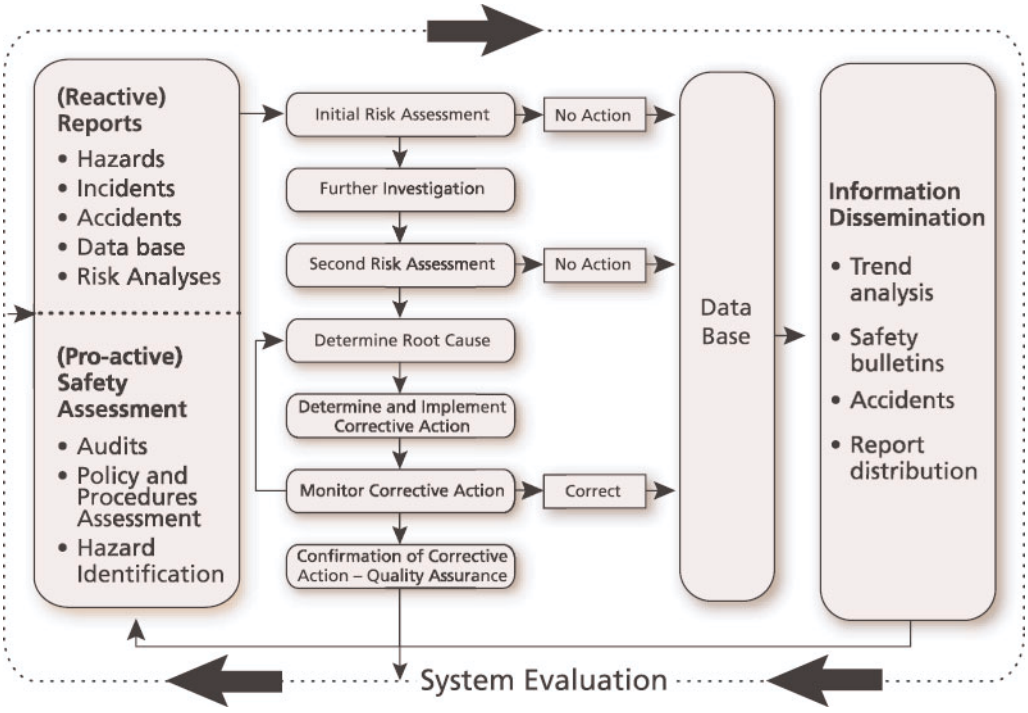
- *Reactive - Occurrence/hazard reporting, and*
- *Proactive - Safety assessments.*

For the most part these are two distinct elements in the safety management system: one is reactive, the other proactive. The basic difference is the method of discovery: the reactive process responds to events that have already occurred, whilst the proactive method actively seeks to identify potential hazards through an analysis of the everyday activities of the company. The exception to this rule occurs when a potential hazard has been reported through the company's safety reporting program.

Once an occurrence has been reported, or a hazard identified, the procedures for dealing with these issues follow the same process, as shown in figure 2. This section will review the specifics involved with the reactive and pro-active processes and will discuss the commonalities involved.

Figure 2 shows the process flow involved with the collection of data within a safety management system.

Figure 2: **Safety Management System Process Flow**




## Reactive Processes

### *Occurrence and Hazard Reporting*

Every event is an opportunity to learn valuable safety lessons. The lessons will only be understood, however, if the occurrence 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 organizational and human factors within the organization, that played a role in the event.

To achieve this, the company should maintain procedures for the internal reporting and recording of occurrences, hazards and other safety related issues. The collection of timely, appropriate and accurate data will allow the company to react to information received, and apply the necessary corrective action to prevent a recurrence of the event.

The key to accomplishing this is to have a reporting system that meets the needs of the people who will be using it - the employees. As such, employee input into the development of the system is vital. A safety reporting system is worthless if no one uses it; the importance of the employee in the whole process, therefore, should not be minimized. An attendant non-punitive discipline policy, and a real and demonstrated commitment by management to achieve the company's safety goals, will help to foster the development of a reporting culture within the company.

An operator's safety reporting system should encompass the following fundamental elements:

1. Systems for reporting hazards, events or safety concerns;
2. Systems for analyzing data, safety reports and any other safety related information;
3. Methods for the collection, storage and distribution of data;
4. Corrective action and risk reduction strategies;
5. On-going monitoring, and
6. Confirmation of the effectiveness of corrective action.

***Systems for Reporting Hazards, Events and Safety Concerns***

Employees must have a means of reporting all events and emerging hazards to an appropriate manager, as identified in the company manual. The manager will then forward it to the data bank for processing.

The reporting system should be simple, confidential and convenient to use and should be complemented with a non-punitive disciplinary policy. These attributes, accompanied by efficient follow-up mechanisms acknowledging to the reporter that a report has been received, investigated and acted upon, will encourage the development of a reporting culture. The results should be distributed to the individual involved and the population at large.

There are many reporting programs in place for all types of operations. It is important to establish a system that suits the size and technology level of the operational environment. In smaller operations, reporting might be achieved through a simple written form deposited in a conveniently situated, secure box. Larger organizations may employ a more sophisticated, on-line safety reporting system. Under certain conditions it may be more expedient to submit a verbal report; without exception, however, this should be augmented with a written report.

At a minimum, report forms should allow for a full description of the event and provide space for the reporter to offer suggestions as to possible solutions to the problem being reported. Reports should employ a common and clearly understood taxonomy for error classification. Simply put, this is the division of error types into ordered groups or categories. It is important that reporters and investigators share a familiar language to explain and understand the types of errors that are contributing to events. This will facilitate more accurate data inputs and trend analysis.

No matter what reporting system is utilized, its effectiveness will depend on four things:

- Employees clearly understand what they should report;
- All reports are confidential;
- Individuals are provided feedback on their reports in a timely fashion;
- The company as a non-punitive disciplinary policy in place.

***Why report?***

All events require appropriate investigation in order to:

- Establish their root cause, that is the underlying initial contributing factor(s) that caused the event, and identify actions to minimize the chance of recurrence;
- Satisfy any regulatory requirements for reporting and investigation as per the Canadian Aviation Regulations;
- Provide a factual record of the circumstances of the event or hazard to allow others to learn from the situation; and
- Categorize the underlying causes and establish the appropriate remedial and continuous improvement action.[ix]

***What should be reported?***

Knowing what to report plays a key role in an active reporting program. As a general rule, any event or hazard with the potential to cause damage or injury should be reported. Examples of these issues are:

- Excessive duty times
- Crews rushing through checks
- Inadequate tool or equipment control
- Unruly passengers
- Emergency exit paths blocked
- Incorrect or inadequate procedures, and a failure to adhere to standard procedures
- Poor communication between operational areas
- Lack of up to date technical manuals
- Poor shift changeovers
- Runway incursions
- Lack of adequate training and recurrent training.

***Report Investigation and analysis***

Every event should be investigated. The extent of the investigation will depend on the actual and potential consequences of the occurrence or hazard. This can be determined through a risk assessment (see figure 2). Reports that demonstrate a high potential should be investigated in greater depth than those with low potential.

The investigative process should be comprehensive and should attempt to address the factors that contributed to the event, rather than simply focusing on the event itself - the active failure. Active failures are the actions that took place immediately prior to the event and have a direct impact on the safety of the system because of the immediacy of their adverse effects. They are not, however, the root cause of the event; as such, applying corrective actions to these issues may not address the real cause of the problem. A more detailed analysis is required to establish the organizational factors that contributed to the error.

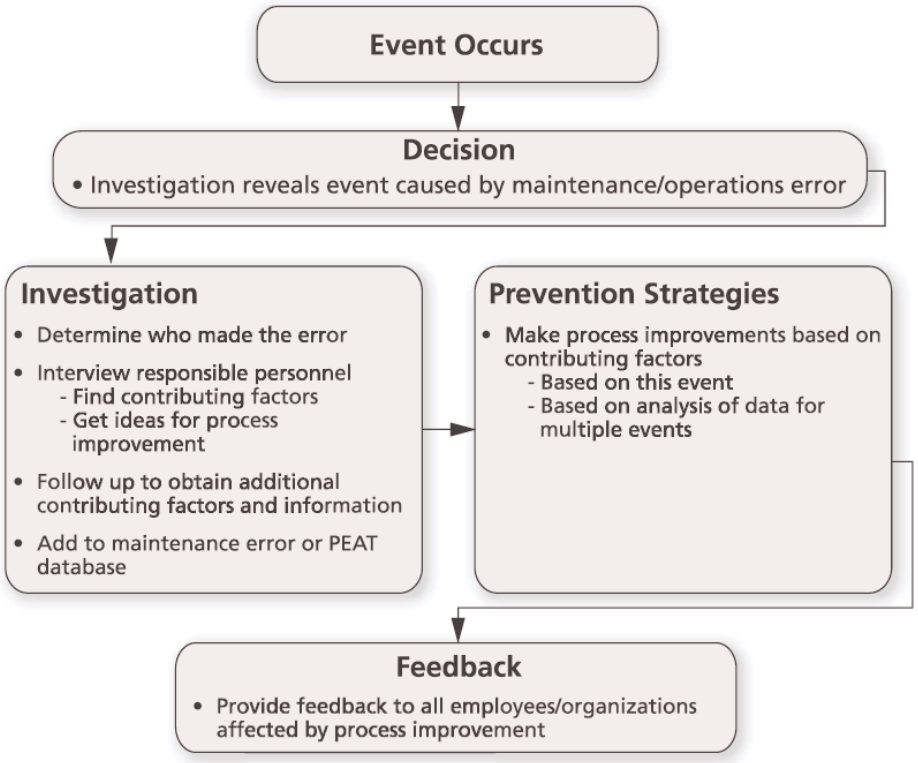
The investigator, or team of investigators must be technically competent and either possess or have access to background information, so the facts and events are interpreted accurately. The investigator should have the confidence of the staff and the investigation process should be a search to understand how the mishap happened, not a hunt for someone to blame.

***Event Investigation***

There are many tools that can be utilized to investigate events. An initial risk assessment may help determine the type of investigation that is conducted, or a company may employ a predetermined event investigation format regardless of the event. It is up to the individual company to determine which is the most appropriate method for their organization.

The Maintenance Error Decision Aid (MEDA) and the Procedural Event Analysis Tool (PEAT) developed by Boeing are examples of tools designed to investigate maintenance and operational events. Both MEDA and PEAT apply the following process flow:

Figure 3: **MEDA/PEAT Process Flow**



Boeing developed MEDA and PEAT to address the human performance factors that must be considered during an event investigation. There are slight differences with the investigative process employed in MEDA and PEAT. For example, PEAT focuses on the key event elements and identifies key underlying cognitive factors that contributed to the procedural deviation. The objective of the process is to help the investigator to arrive at valid, effective recommendations aimed at preventing the occurrence of similar types of procedural deviation. In contrast, MEDA looks at the organizational factors that can contribute to human error such as poor communication, inadequate information and poor lighting.

Both MEDA and PEAT are based on the philosophy that traditional efforts to investigate errors are often aimed at identifying the employee who made the error. The usual result is that the employee is defensive and is subjected to a combination of disciplinary action and recurrent training. Because retraining often adds little or no value to what the employee already knows, it may be ineffective in preventing future errors.

In addition, by the time the employee is identified, information about the factors that contributed to the event has been lost. Because the factors that contributed to the error remain unchanged, the error is likely to recur, setting what is called the "blame and train" cycle in motion again. To break this cycle, both MEDA and PEAT employ investigative techniques that look for the factors that contributed to the error, rather than looking for someone to blame.

***The MEDA Process***

Both MEDA and PEAT employ a basic five-step process for operators to follow (see figure 3 for the process flow). As previously stated, there are slight differences in the investigative focus between PEAT and MEDA, the process flow, however, is the same. In the MEDA process there are five steps:

- **Event** - An event occurs, such as a gate return or air turn back. It is the responsibility of the of the maintenance organ isation to select the error-caused events that will be investigated.
- **Decision** - After fixing the problem and returning the airplane to service, the operator makes a decision: Was the event maintenance-related? If yes, the operator performs a MEDA investigation.
- **Investigation** - Using the MEDA results form, the operator carries out an investigation. The trained investigator uses the form to record general information about the airplane, when the maintenance and the event occurred, the event that began the investigation, the error that caused the event, the factors that contributed to the error, and a list of possible prevention strategies.
- **Prevention Strategies** - The operator reviews, prioritizes, implements, and then tracks prevention strategies (process improvements) in order to avoid or reduce the likelihood of similar errors in the future.
- **Feedback** - The operator provides feedback to the maintenance workforce so

technicians know that changes have been made to the maintenance system as a result of the MEDA process. The operator is responsible for affirming the effectiveness of employees' participation and validating their contribution to the MEDA process by sharing investigation results with them.[x]

***The PEAT Process***

The primary focus of PEAT is to find out why a serious event occurred and if a procedural deviation is involved. As such, PEAT relies heavily on the investigative philosophy that professional flight crews very rarely fail to comply with a procedure intentionally, especially if doing so is a safety risk. The PEAT methodology comprises three elements:

- **A process** - PEAT provides an in-depth, structured analytic process consisting of a sequence of steps that guides the investigator through the identification of key contributing factors and the development of effective recommendations aimed at the elimination of similar errors in the future. This includes collecting information about the event, analyzing the event for errors, classify ing the error and identifying preliminary recommendations.

- **Data storage** - to facilitate data analysis PEAT provides a database for the storage of procedurally related event data. Although designed as a structured tool, PEAT also provides the flexibility to allow for the capture and analysis of narrative information as needed. This allows airlines to track their progress in addressing issues revealed by PEAT analyses and to identify emerging trends.

- **Analysis** - using the PEAT tool in a typical analysis of a procedurally related event, a trained investigator will consider the following areas and assess their significance in contributing to flight crew decision errors:
  - > Flight Phase where error occurred
  - > Equipment factors
    - o The role of automation
    - o Airplane deck indications
    - o Airplane configuration
  - > Other stimuli (beyond indications)
  - > Environmental factors
  - > The procedure from which the error resulted
    - o The status of the procedure
    - o Onboard source of the procedure
    - o Procedural factors (e.g. negative transfer, impractical, complexity, etc)
    - o Crew interpretation of the relevant procedure
    - o Current policies, guidelines/ policies aimed at prevention of event)
  - > Crew Factors
    - o Crew intention
    - o Crew understanding of situation at the time of procedure execution
    - o Situation awareness factors (e.g. Vigilance, attention, etc.)
    - o Factors affecting individual performance (e.g. fatigue, workload, etc.)

- Personal and corporate stressors, management or peer pressure, etc.)
- Crew coordination/ communication
- Technical knowledge/skills/ experience

> Other factors…

PEAT provides consistency in application and results. The PEAT form is designed to facilitate the investigation of specific types of events, i.e. those involving non-adherence to procedures. As such, it addresses all the pertinent elements.[xi]

## Pro-Active: Safety Assessment

For a safety management system to transition from a reactive to a proactive, it must actively seek out potential safety hazards and evaluate the associated risks. This can be achieved through a safety assessment. A safety assessment allows for the identification of potential hazards and then applies risk management techniques to effectively manage the hazard.

A certificate holder's safety assessment system should encompass the following basic elements:

1. *Systems for identifying potential hazards*
2. *Risk management techniques*
3. *On-going monitoring/quality assurance.*

***Hazard Identification***

Hazard identification is the act of identifying any condition with the potential of causing injury to personnel, damage to equipment or structures, loss of material, or reduction of the ability to perform a prescribed function. In particular, this includes any conditions that could contribute to the release of an un-airworthy aircraft, or to the operation of aircraft in an unsafe manner. This can be achieved through internal reporting mechanisms, such as flight data monitoring programs, or through an assessment of the processes used to perform a specific operation. This involves an on-going assessment of the functions and systems, and any changes to them, and the development of a safety case to proactively manage safety. Safety assessments are a core process in the safety management construct and provide a vital function in evaluating and maintaining the system's safety health.

Understanding the hazards and inherent risks associated with everyday activities allows the organization to minimize unsafe acts and respond proactively, by improving the processes, conditions and other systemic issues that lead to unsafe acts. These include - training, budgeting, procedures, planning, marketing and other organizational factors that are known to play a role in many systems-based accidents.[xii] In this way, safety management becomes a core-business function and is not just an adjunct management task. It is a vital step in the transition from a reactive culture - one in which the organization reacts to an event, to a proactive culture, in which the organization actively seeks to address systemic safety issues before they result in an active failure.

***Assessment frequency***

A safety assessment should be undertaken, at a minimum:

- During implementation of the safety management system and then at regular intervals;
- When major operational changes are planned;
- If the organization is undergoing rapid change, such as growth and expansion, offering new services, cutting back on existing service, or introducing new equipment or procedures; and
- When key personnel change.[xiii]

**Information Sources for Determining Potential Risks** > Assessing potential risk is often perceived as resource intensive and unduly onerous. It doesn't have to be. There are numerous sources of readily accessible information that can be utilized to better understand potential risk within an organization. The following list details some of the possible resources:

- **Company Experience** - Existing safety reports detailing events and near misses. Minutes of safety meetings and comittee meetings can also reveal potential areas of concern.
- **Line management Judgement** - All line managers will have perceptions of where the greatest risks are in their areas of accountability.
- **Workplace opinions** - Actively seek the input of the workforce. This can be achieved through focus groups, consulting employee representatives and conducting structured vulnerability analyses with subordinate managers and supervisors.
- **Audit Reports** - The company's internal audit system should contain a structured record of areas of concern in a prioritized format. A review of audit reports and remedial action plans (including an assessment of follow-up action completions) should conducted. Corporate memories are often much shorter than the current incumbents realize and research beyond 5 to 10 years could reveal important information.
- **Corporate hazard analysis** - Records of previously conducted formal hazard analyses may reveal risk exposures, which did not appear very significant at the time, but do now, in light of the changed circumstances.
- **Industry generic hazard register** - Hazards/risks identified by other organizations might trigger concerns that should be addressed by the company.
- **Safety data recording systems** - Mandatory occurrence reporting programs such as CADORs and industry safety data exchange programs like BASIS can be consulted.[xiv]

**Active Monitoring Techniques >**
There are several active monitoring methods that can be employed in safety assessment, these include:

- **Inspections** - Determines adherence to requirements, plans and procedures by inspection of premises, plant and equipment or activities. Usually achieved through detailed inspection of actual specific target area activities against planned methods of procedures. Tends to be focused at the task level.

- **Management safety inspections** - Determines the effectiveness of systems and demonstration of line commitment. Usually achieved through examination of managers or teams that focus on people's activities and the system they use.

- **Audits** - Verifies conformance with established guidelines and standards. Usually achieved through systematic independent review of an organization's systems personnel, facilities, etcetera using a predetermined targeted scope of coverage. Tends to be focused at the process level.

- **Process and practice monitoring** - Identifies whether the procedure in use is relevant and actively used and the practices employed are in line with the requirements of the procedures.

- **Review** - Provides an overview of the processes involved in a work area or system for their effectiveness and appropriateness. Resource allocation is often a target of a review.[xv]

**Checklist Usage >** In most quality assurance systems, audit checklists are used to collect data related to the system. The same type of checklist should be utilized to provide a safety assessment of the company. This will allow the company to develop a safety case, an analysis of safety issues within the organization that adequately portrays the safety level of the company.

**Safety Risk Profiling >** Once potential risks have been identified it is useful to fully understand the impact that they might have if they remain unchecked. In order to determine this, a full risk assessment should be conducted. This process is described in Common Elements below and should be applied to both the reactive investigations and pro-active safety assessments an organization conducts.

Safety risk profiling should look at the entire organization and identify levels of risk within the company. Examples of areas that should be considered are:

- Operational factors, such as weather information and approach aids

- Technical factors, such as parts interchangeability and aircraft type

- Human factors, such as availability of equipment, working environment and human resources.

## Common Elements

Occurrence and hazard reporting and safety assessment are two individual functions within the safety management system.

Once a report has been submitted, however, the process flow is the same. The following represent common element in both elements that should be considered when developing a safety management system.

***Reporting Procedures***

The process for reporting an event or a hazard should be as simple as possible. Report submission procedures should be well documented and should include details of where and to whom reports should be submitted. This will reduce confusion over where safety reports go and will ensure that all events are brought to the attention of the appropriate person.

When designing a safety report form it is important to consider that the form may be used to submit information regarding events and hazards. The form should be structured in such a manner that it can accommodate both the reactive and proactive type of reporting. Sufficient space should be allowed for reporters to identify suggested corrective actions related to the issue they are reporting.

There are many possible ways in which a report can be submitted. The size and complexity of the organization will determine how sophisticated the system is. In some cases this might involve having a locked postbox on the hangar floor, in other cases it might be more effective to submit reports directly to the safety office. It is up to the individual organization to determine the most suitable method.

***Data Collection***

When producing an occurrence or hazard report every effort should be made to ensure that the form is easy to understand and user friendly. The company should strive to make all reporting forms compatible for each area of the operation. This will facilitate data sharing, trend analysis and will also make the occurrence or hazard investigation process easier.

Depending on the size of the organization, the most expedient data collection method might be to utilize existing paperwork, such as flight and maintenance reports. The use of hand written reports or the information derived from verbal reports is equally acceptable. As previously stated, however, verbal accounts should always be followed-up with a written report.

Reporting can also be achieved through the use of a dedicated occurrence and hazard report. A general off-the-shelf software package can be used or a predefined report, generated from integrated systems such as the British Airways Safety Information System (BASIS), the Aviation Quality Database (AQD) report or the Aviation Events Reports Organiser (AERO). These types of system are all inclusive; they generate reports, collect and store data and can be used to provide trend analysis and safety reports.

***Data Collection Systems***

BASIS, AQD and AERO are examples of electronic data collection systems designed

for use in a variety of different sized organizations. The use of pre-existing electronic data collection and storage is not a safety management system requirement. A simple Microsoft ACCESS database or a manual filing system can be utilized.

***Risk Management***

Risk management is a proactive activity that looks at the risks associated with identified hazards and assists in selecting actions to maintain an appropriate level of safety when faced with these hazards.

Once hazards have been identified, either through occurrence/hazard reporting, or a safety assessment the risk management process begins. Risk management is an evaluation of the potential for injury or loss due to a hazard and the management of that probability. This concept includes both the likelihood of a loss and the magnitude. The basic elements of a risk management process are:

- Risk Analysis
- Risk Assessment
- Risk Control
- Monitoring

**Risk Analysis** is the first element in the risk management process. It encompasses risk identification and risk estimation. Once a hazard has been identified the risks associated with the hazard must be identified and the amount of risk estimated.

**Risk Assessment** takes the work completed during the risk analysis and goes one step further by conducting a risk evaluation. Here the probability and severity of the hazard are assessed to determine the level of risk. Figure 4 shows one example of a risk assessment matrix. In this diagram the matrix defines a method to determine the level of risk.

Figure 4: **Risk Analysis Matrix**

| SEVERITY | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 5 | 10 | 15 | 20 | 25 |
| | 4 | 4 | 8 | 12 | 16 | 20 |
| | 3 | 3 | 6 | 9 | 12 | 15 |
| | 2 | 2 | 4 | 6 | 8 | 10 |
| | 1 | 1 | 2 | 3 | 4 | 5 |
| | | 1 | 2 | 3 | 4 | 5 |
| | | PROBABILITY | | | | |

To use the risk assessment matrix effectively it is important that everyone has the same understanding of the terminology used for probability and severity. For this reason definitions for each level of these components should be provided.

It is up to individual company to define when intervention is required, in other words, the company must decide where its tolerable level of risk is. Figure 5 provides an example of what this risk classification index might look like. The description

should indicate the action required and if necessary a timeframe for completion.

Figure 5: **Risk Analysis Matrix**

| Values | Risk Levels | Action |
|---|---|---|
| 1 - 6 | Minimum Risk | Proceed after considering all elements of risk. |
| 6 - 14 | Moderate Risk level of risk. | Continue after taking action to manage overall |
| 15 - 25 | High Risk | **STOP**: Do not proceed until sufficient con trol measures have been implemented to reduce risk to an acceptable level. |

There are a number of examples of risk assessment and classification matrixes and their definitions available. Some of these utilize economic indicators such as dollar figures to define the level of acceptable risk.

**Risk Control** addresses any risks identified during the evaluation process that require an action to be taken to reduce the risks to an acceptable level. It is here that a corrective action plan is developed.

**Monitoring** is essential to ensure that once the corrective action plan is in place, it is effective in addressing the stated issues or hazards.

**Existing Risk Management Processes**. There are a number of existing processes that can assist a company in meeting the regulatory requirements for a risk assessment component to their safety management system. These processes vary considerably in their scope and complexity. It is important that the process selected meets the capabilities and requirements of the company in question. Following are only a few examples of processes that include the required components:

*Canadian Standards Association (CSA) Standard CAN/CSA-CEI/IEC 300-9-97, Dependability management - Part 3 Application Guide - Section 9: Risk Analysis of Technological Systems.* This document provides the guidelines for selecting and implementing risk analysis techniques, primarily for risk assessment of technological systems. It contains guidelines regarding:

- Risk analysis concepts
- Risk analysis processes
- Risk analysis methods

*CSA Standard CAN/CSA-Q850-97 Risk Management: Guideline for Decision Makers.* This guideline is intended to assist decision makers in effectively managing all types of

risk issues, including injury or damage to health, property, the environment, or something else of value. It describes a process for acquiring, analyzing, evaluating, and communicating information that is necessary for decision-making. The guideline provides a description of the major components of the risk management decision process using a step-by-step process as follows:

> Initiation
> Preliminary Analysis
> Risk Estimation
> Risk Evaluation
> Risk Control
> Action/Monitoring

*Tripod Delta.* > This program is a proactive error management tool that encompasses risk analysis within its overall scope. This program was originally designed for the oil and gas exploration and production operations of Shell Internationale Petroleum Mattschappij, however, it has been employed in a wide variety of operations. Tripod Delta looks at the whole system and identifies potential hazards. This program takes its name from the three areas or 'feet' on which it focuses. Each foot of the tripod has an effect on the other. The feet are related as follows:

- The first foot represents hazards and unsafe acts.
- The second foot follows and focuses on accidents, incidents and losses that result when the performance of unsafe acts penetrate the defenses and produce bad outcomes.
- The third foot is concerned with what has been termed General Failure Types (GFTs) and addresses system failures, in part, through the identification of latent conditions that are associated with past occurrences (the second foot).

In the past most remedial measures were aimed at the first two feet, however, these are programmatic fixes and do not necessarily address system failures. By including the third foot, and minimizing the impact of GFTs, exposure in the first area or foot of hazards and unsafe acts is reduced.[xvi]

*Commercially available Software Programs.* > There are a number of software programs, which advertise a risk analysis component, available to operators. Some are directly focused on the safety management aspect within aviation and others are more generic in nature, but may meet individual company requirements. Information on these programs is readily available on the internet.

***Corrective Action Plan***

Once a safety event report has been investigated and analysed, or a hazard identified, a safety report outlining the occurrence, and if available, the results of a hazard assessment, should be given to the appropriate director for determination of corrective or preventative action. The functional director should develop a corrective action plan (CAP), a plan submitted in response to findings, outlining how the company proposes to correct the deficiencies documented in the findings. Depending on the findings the CAP might include short-term and long-term corrective actions. As an example, Transport Canada's Inspection and Audit

Manual defines these in the following manner:

- **Short-Term Corrective Action** - This action corrects the specific issue specified in the audit finding and is preliminary to the long-term action that prevents recurrence of the problem. Short-term corrective action should be completed by the date/time specified in the corrective action plan.

- **Long-Term Corrective Action** - Long-term corrective action has two components. The first element involves identifying the root cause of the problem and indicating the measures the auditee will take to prevent a recurrence. These measures should focus on a system change. The second component is a timetable for implementation of the long-term corrective action. Long-term corrective action should include a proposed completion date.

  Some long-term corrective actions may require time periods in excess of the company's established acceptable timeframe, for example where major equipment purchases are involved. Where applicable, the company should include milestones or progress review points not exceeding the established timeframe leading up to the proposed completion date. Where the short-term corrective action taken meets the requirements for long-term corrective action, this should be stated in the long-term corrective action section on the corrective action form.[xvii]

***On-Going Monitoring***

In order to ensure the effectiveness of the remedial measures, the corrective actions should be monitored and evaluated on a regular basis. Follow-up activity should be conducted through the internal audit process. This should include comprehensive documentation of audit findings, corrective actions and follow-up procedures.

***Information Dissemination***

All safety related information should be disseminated throughout the organization. Keeping current on safety provides better background for understanding aspects of the organization's safety condition and developing novel solutions to difficult problems. This can be accomplished by subscribing to safety related programs, making relevant Transportation Safety Board (TSB) reports available, and encouraging staff to participate in safety related training, seminars and workshops. Manufacturers can also provide important safety information and reliability data related to the company's specific needs.

Another aspect of information dissemination is feedback on safety reports submissions. Employees should be notified when a safety report is received or when a potential safety threat is discovered. Further information should be provided pursuant to investigation, analysis and corrective action. Information dissemination can also be achieved through the publication of a company magazine or through the company website. The company should endeavor to inform all employees as to where safety related information can be found. In this way the entire company becomes aware of safety issues and understands that the company is actively seeking to address these issues.

# 4 training

## [ Training ]

In order for employees to comply with all safety requirements, they need the appropriate information, skills and training. To effectively accomplish this, the company should document the training requirements for each area of work within the company.

The type of training to be offered is already mandated via regulation for certain positions in the company. This includes initial, recurrent and update training requirements and, where required, training specific to the operation of the safety management system. These regulations will provide a good starting point to identify what training is required.

It is recommended that a training file be developed for each employee, including management, to assist in identifying and tracking employee training requirements.

# 5 quality assurance

## Quality Assurance

A quality assurance system (QAS) defines and establishes an organization's quality policy and objectives. It also allows an organization to document and implement the procedures needed to attain these goals. A properly implemented QAS ensures that procedures are carried out consistently, that problems can be identified and resolved, and that the organization can continuously review and improve its procedures, products and services. It is a mechanism for maintaining and improving the quality of products or services so that they consistently meet or exceed the organization's implied or stated needs and fulfill their quality objectives.[xviii]

In a safety management system, these elements are applied to an understanding of the human and organizational issues that can impact safety. In the same way that a QAS measures quality and monitors compliance, the same methods are used to measure safety within the organization. In the SMS context, this means quality assurance of the safety management system, which in effect includes the entire operation.

An effective quality assurance system should encompass the following elements:

1. Well designed and documented procedures for product and process control
2. Inspection and testing methods
3. Monitoring of equipment including calibration and measurement
4. Internal and external audits
5. Monitoring of corrective and preventive action(s), and
6. The use of appropriate statistical analysis, when required.[xix]

Quality assurance is based on the principle of the continuous improvement cycle. In much the same way that SMS facilitates continuous improvements in safety, quality assurance ensures process control and regulatory compliance through constant verification and upgrading of the system. These objectives are achieved through the application of similar tools: internal and independent audits, strict document controls and on-going monitoring of corrective actions.

**Audits >**
The use of audit functions, to verify compliance and standardization, is an integral part of the quality assurance system. An initial audit, covering all technical activities, should be conducted, followed by a recurring cycle of further internal audits. Detailed records of audit findings, including issues of compliance and non-compliance, corrective actions and follow-up inspections should be kept. The results of the audit should be communicated throughout the company.

Depending on the size of the organization, these functions may be performed by individuals within the company or assigned to external agents. Wherever practical, having regard to the size of the organization, these functions should be undertaken by persons who are not responsible for, and have not been involved in, the certification or performance of the tasks and functions being audited. In this way, the quality assurance function remains neutral and is independent from the operational aspects of the organization.

**Checklists >**
Audit checklists should be employed to identify all of the technical functions controlled by the MPM, the MCM or the COM. These should be sufficiently detailed to ensure that all of the technical functions performed by the organization are covered. Accordingly, the extent and complexity of these checklists will vary from company to company.

In the case of a quality audit on a company's safety management system, the checklist, should provide a detailed account of the following areas:

- Safety policy
- Safety standards
- Safety culture
- Contractor's safety organization
- Structure of safety accountabilities
- Hazard management arrangements
- Safety assessment, and
- Safety monitoring[xx]

(Examples of detailed audit checklists are provided in Transport Canada's Inspection and Audit Manual.)

**On-going monitoring >**
The on-going monitoring of all systems and the application of corrective actions are functions of the quality assurance system. Continuous improvement can only occur when the organization displays constant vigilance regarding the effectiveness of its technical operations and its corrective actions. Indeed, without on-going monitoring of corrective actions, there is no way of telling whether the problem has been corrected and the safety objective met. Similarly, there is no way of measuring if a system is fulfilling its purpose with maximum efficiency.

**Existing Systems >**
There are many existing quality assurance standards. The most appropriate system depends on the size and complexity of the organization and will be tailored to meet these requirements. ISO 9000, a series of international standards developed by quality

experts from around the world, is one example. ISO 9000 is for use by companies that either want to implement their own in-house quality systems or to ensure that suppliers have appropriate quality systems in place. The standards were developed under the auspices of the International Organization for Standardization (ISO).

The current series, ISO 9000:2000, was developed to assist all types and size of organization, to implement and operate effective quality management systems. ISO standards are intended to be generic and not specific to any product or industry. They are intended to document the elements required for an effective quality system, however, they do not specify the technology requirements to be utilized.[xxi] ISO 9000:2000 works on the principal that, to successfully operate an organization, it is necessary to direct and control it in a systematic and transparent manner. The objective is to continually improve performance whilst addressing the needs of all interested parties.[xxii]

The ISO 9000:2000 standards are composed of a set of eight quality management principles that contribute to improved performance:

- **Customer Focus** - Understanding what the customer wants and needs. In aviation some of these requirements are a safe, reasonably priced flight, that departs on time.
- **Leadership** - Leaders set the goals and purpose of the organization. They should establish and maintain the internal environment in which the individual becomes fully involved in attaining the organization's objectives.
- **Involvement of people** - Safety is every one's responsibility. It is incumbent on all employees therefore to involve them selves and utilize their abilities for the organization's benefit.
- **Process Approach** - A managed approach is applied to activities and related resources.
- **System Approach to Management** - Identifying, understanding and managing interconnected processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.
- **Continual Improvement** - Continual improvement of the organization's overall performance should be a fixed objective of the organization.
- **Factual Approach to Decision Making** - Decisions are made utilizing available information and current data.
- **Mutually Beneficial Supplier Relations** - Given that an organization and its suppliers are interdependent, a mutually beneficial relationship enhances the ability of both to create value.[xxiii]

There are several steps and organization must take to ensure a successful implementation of ISO standards. The organization must clearly understand what it hopes to achieve and what the expectations of the stakeholders are. Furthermore, it must identify the gap between where it is now and where it hopes to be in the future. A plan must be developed to close these gaps and it must be monitored to ensure effectiveness. This consists of both internal and external audits.[xxiv]

# 6 emergency response plan

## Emergency Response Plan

An Air operator emergency response plan is an integral part of the SMS. It must contain the following items:

- Air Operator Policy
- Air Operator Mobilization And Agencies Notification
- Passenger and Crew Welfare
- Casualty and Next Of Kin Coordination
- Accident Investigation On Behalf Of The Air Operator
- Air Operator Team's Response To The Accident Site
- Preservation Of Evidence
- Media Relations
- Claims And Insurance Procedures
- Aeroplane Wreckage Removal
- Emergency Response Training

# Conclusion

The implementation of safety management systems represents a fundamental shift in the way we all do business. Safety management systems require organizations' to adopt the elements detailed in this document and to incorporate them into their everyday business practices. In effect, safety becomes an integral part of the everyday operations of the organization and is no longer considered an adjunct function belonging to the safety office.

If SMS is to be a success, however, Transport Canada, like the industry we regulate, must establish a disciplinary/enforcement policy that promotes and rewards the behaviors we are striving to achieve. SMS involves a transferal of some of the responsibility for aviation safety issues, from the regulator to the individual organization. A role shift, in which the regulator oversees the effectiveness of the safety management system and withdraws from a day-to-day involvement in the companies' it regulates. The day-to-day issues are discovered, analysed and corrected internally, with minimal intervention from Transport Canada. From the company perspective the success of the system will hinge on the development of a safety culture that promotes open reporting, through non-punitive disciplinary policies and continual improvement through, proactive safety assessments and quality assurance.

The safety management system philosophy requires that responsibility and accountability for safety be retained within the management structure of the organization. The directors and senior management are ultimately responsible for safety, as they are for other aspects of the enterprise. The responsibility for safety, however, resides with every member of the organization; in safety management everyone has a role to play.

# References


[i] In Approved Maintenance Organizations the requirement for safety management programs is limited to AMOs holding ratings in respect of aircraft types eligible for commuter or airline operations. In Air Operator Certificate holders, safety management programs are required in the following types of operations:

(a) Subpart 702 – date and applicability to be determined;
(b) Subpart 703 – date and applicability to be determined;
(c) Subpart 704 – date and applicability to be determined;
(d) Subpart 705 – by 28 March 2004.

[ii] **Alan Waring,** *Safety Management Systems*, (UK: Chapman & Hall, 1996)

[iii] See **James Reason**, *Managing the Risks of Organizational Accidents*, (UK: Ashgate, 1987) and **Alan Waring**, *Safety Management Systems*, (UK: Chapman & Hall, 1996) for a more detailed discussion of this subject.

[iv] **Alan Waring**, *Safety Management Systems*, (UK: Chapman & Hall, 1996)

[v] For additional examples of performance measurement see **Alan Waring**, *Safety Management Systems*, (UK: Chapman & Hall, 1996).

[vi] **Reproduced by permission of Air Canada**.

[vii] *Shell Aircraft Aviation Safety Management Guidelines, Part 2, p.8*.

[viii] **Peter M. Senge**, *The Fifth Discipline*, (New York: Doubleday, 1990).

[ix] *Shell Aircraft Aviation Safety Management Guidelines, Part 2: Safety Management System Guidelines*, January 2000.

[x] **Reproduced By permission of the Boeing Company**, AERO no.3, 1998.

[xi] **R. Curtis Graeber** and **Mike Moodi**, *Understanding Flight Crew Adherence to Procedures: The Procedural Event Analysis Tool (PEAT)*. Flight Safety Foundation, IFA/IASS, South Africa 1998.

# References


[xii] **James Reason**, *Managing the Risks of Organizational Accident*, (UK: Ashgate, 1997)

[xiii] **Transport Canada**, *Introduction to Safety Management Systems*. TP 13739 E (04/2001)

[xiv] *Shell Aircraft Aviation Safety Management Guidelines, part 4, page 21*.

[xv] *Shell Aircraft Aviation Safety Management Guidelines, part 2, appendix 1, page 2*.

[xvi] **James Reason**, *Managing the Risks of Organizational Accident*, (UK: Ashgate, 1997)

[xvii] *Inspection and Audit Manual*, Transport Canada website: www.tc.gc.ca/civilaviation/maintenance/aarpf/menu.htm

[xviii] **The Standards Council of Canada**

[xix] **James R. Evans** and **William M. Lindsay**, *The Management and Control of Quality*, (USA: South-Western College Publishing, 1999)

[xx] *Shell Aircraft Aviation Safety Management Guidelines, part 2, appendix 1, page 3*.

[xxi] *Quality Assurance Planning, Course Manual, P.213*, University of Manitoba.

[xxii] **National Standard of Canada CAN/CSA-ISO 9000-00, Quality Management Systems-Fundamentals and Vocabulary**.

[xxiii] **Ibid**.

[xxiv] **International Organization for Standardization**.